Federal Reserve Bank of New York

December 2014
Volume 20 Number 2

# Economic Policy Review

## Special Issue: Large and Complex Banks

Economic Policy Review



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This volume is dedicated to Michael De Mott,
whose skillful editing over two decades helped make the *Economic Policy Review*
a singularly clear and well-crafted journal.

1961-2014

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## Special Issue: Large and Complex Banks

# Contents

## 41 Do "Too-Big-to-Fail" Banks Take On More Risk?

Gara Afonso, João A. C. Santos, and James Traina

The notion that some banks are "too big to fail" builds on the premise that governments will offer support to avoid the adverse consequences of disorderly bank failures. However, this promise of support comes at a cost: Large, complex, or interconnected banks might take on more risk if they expect future rescues. This article studies the effect of potential government support on banks' appetite for risk. Using balance-sheet data for 224 banks in forty-five countries starting in March 2007, the authors find higher levels of impaired loans after an increase in government support. To measure support, they rely on Fitch Ratings' support rating floors (SRFs), a new rating that isolates potential sovereign support from other sources of external support. A one-notch rise in the SRF is found to increase the impaired loan ratio by roughly 0.2—an 8 percent increase for the average bank. The authors obtain similar results when they assess the effect of increased support on net charge-offs and when they narrow their sample to U.S. banks only.

## 59 Components of U.S. Financial-Sector Growth, 1950-2013

Samuel Antill, David Hou, and Asani Sarkar

The U.S. financial sector grew steadily as a share of the total business sector from 1959 until the recent financial crisis, when the trend reversed. In this article, the authors develop measures based on firm-level data to estimate the size of the financial sector and its subsectors relative to the total business (financial and nonfinancial) sector over time. The analysis further sheds light on how these size measures are affected by a firm's choice of financing (whether public or private), firm size, industry type, use of leverage, and regulation. The authors find that the relative size of finance is smaller when only publicly listed firms are included. Financial firms are more prevalent among large firms than among small firms, with the relative size of finance being two to three times bigger in the large firm sample than in the small firm sample within any period and for any measure. While large financial firms on average grew only at moderately higher rates than smaller financial firms, large traditional banks grew substantially faster than their smaller counterparts. Shadow banks increased rapidly in size at the expense of traditional banks, becoming a significant portion of the financial sector in the mid-1990s and peaking just before the crisis. Overall, the results show that both the pre-crisis growth and the crisis-era decline mainly occurred in opaque, complex, and less-regulated subsectors of finance.

a descriptive and analytical perspective on dealer banks and their sources of financing, both internal and external. The authors conclude that internal sources of financing may prove more efficient than external sources of financing in normal times, but may be subject to significant and abrupt reductions in stressful times. The analysis suggests that accounting rules that allow dealer banks to net certain collateralized transactions may obscure the banks' actual economic exposure to their customers, and that a prudent risk management framework should acknowledge the risks inherent in collateralized finance.

Anna Kovner, James Vickery, and Lily Zhou

# Do Big Banks Have Lower Operating Costs?

- Concern that some banks remain "too big to fail" has prompted many calls for limits on bank holding company (BHC) size.
- But such limits could have adverse effects if they were to undercut the economies of scale associated with large banking firms.
- Reasoning that scale economies may be achieved in part through lower operating costs, the authors of this study examine the relationship between BHC size and noninterest expense.
- Their analysis, which considers these costs at a finer level of detail than in past studies, reveals a robust negative relationship between BHC size and scaled noninterest expenses, including employee compensation, information technology, and corporate overhead costs.
- The results suggest that limits on BHC size may, in fact, increase the cost of providing banking services—a drawback that must be weighed against the potential financial stability benefits of limiting firm size.

## 1. Introduction

The largest U.S. banking firms have grown significantly over time, their expansion driven by a combination of merger activity and organic growth. In 1991, the four largest U.S. bank holding companies (BHCs) held combined assets equivalent to 9 percent of gross domestic product (GDP). Today, the four largest firms' assets represent 50 percent of GDP, and six BHCs control assets exceeding 4 percent of GDP. Despite recent financial reforms, there is still widespread concern that large banking firms remain "too big to fail"—that is, policymakers would be reluctant to permit the failure of one or more of the largest firms because of fears about contagion or damage to the broader economy (see, for example, Bernanke [2013]).

A growing number of market observers advocate shrinking the size of the largest banking firms in order to limit the problem of too-big-to-fail. The most direct approach would be to simply impose a firm cap on the size of assets or liabilities; for example, Johnson and Kwak (2010) propose a size limit of 4 percent of nominal GDP. An alternative would be to impose levies or progressively higher capital requirements on large banking firms to encourage them to shed assets.

Would such policies impose any real costs on the economy? A number of recent academic papers suggest that the answer may be "yes" because of the presence of economies of scale in banking. Scale economies imply that the cost of producing an additional unit of output (for example, a loan) falls as the

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The authors thank Peter Olson for outstanding research assistance and Gara Afonso, Jan Groen, Joseph Hughes, Donald Morgan, an anonymous referee, and workshop participants at the Federal Reserve Bank of New York for helpful comments and suggestions. The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

quantity of production increases. A number of papers find evidence of scale economies even among the largest banking firms (Hughes and Mester 2013; Wheelock and Wilson 2012; Feng and Serletis 2010). Taken at face value, this research implies that the introduction of limits on bank size would impose deadweight economic costs by increasing the cost of providing banking services.

We contribute to this line of research by studying the relationship between size and components of noninterest expense (NIE), with the goal of shedding light on the *sources* of scale economies in banking. NIE includes a wide variety of operating costs incurred by banking firms: examples include employee compensation and benefits, information technology, legal fees, consulting, postage and stationery, directors' fees, and expenses associated with buildings and other fixed assets. Our hypothesis is that lower operating costs may be a source of scale economies for large BHCs, because large firms can spread overhead such as information technology, accounting, advertising, and management over a larger asset or revenue base. Our analysis therefore tests for an inverse relationship between BHC size and scaled measures of different components of NIE.

One novel contribution of this paper is to make use of detailed noninterest expense information provided by U.S. banking firms in the memoranda of their quarterly regulatory FR Y-9C filings. The Y-9C reports contain detailed consolidated financial statements and other data for U.S. BHCs (see Section 3 for details). Since 2001, about 35 percent of total noninterest expense is classified in the Y-9C as part of a broad "other noninterest expense" category. For the period 2008 to 2012, we disaggregate this line item into nine author-defined categories, using memoranda information from Schedule HI of the Y-9C. In part, this involved manually classifying about 5,500 individual "write-in" text fields reported by individual BHCs. To our knowledge, ours is the first paper to make use of these data.

We start by estimating the relationship between bank holding company size (measured by the natural logarithm of total assets) and total noninterest expense scaled by net operating revenue, assets, or risk-weighted assets. We find a statistically and economically significant negative relationship between BHC size and these NIE ratios, robust to the expense measure or set of controls used. Quantitatively, a 10 percent increase in assets is associated with a 0.3 to 0.6 percent decline in noninterest expense scaled by income or assets, depending on the specification. In dollar terms, our estimates imply that for a BHC of mean size, an additional $1 billion in assets reduces noninterest expense by $1 million to $2 million per year, relative to a base case in which operating cost ratios are unrelated to size.[1]

[1] For details of this calculation, see Appendix B, available as a separate file at http://www.newyorkfed.org/research/epr/2014/1412kovn_appendixB.pdf. The appendix was omitted from the main document because of space constraints.

These results hold across the size distribution of banking firms, and over different parts of our sample period. We find no evidence that these lower operating costs flatten out above some particular size threshold. The point estimate of the slope of the relationship steepens, if anything, although the statistical uncertainty associated with the estimate becomes larger owing to the small sample.

The relationship between size and the NIE ratio is negative for each of the three main components of noninterest expense reported in BHC regulatory filings: employee compensation, premises and fixed asset expenses, and other noninterest expense. Using our novel by-hand classification of other NIE into nine subcomponents, however, we find significant variation in the size-expense relationship among the subcomponents. The inverse relationship between size and expense is particularly pronounced for corporate overhead (for example, accounting, printing, and postage); information technology (IT) and data processing; legal fees; other financial services; and directors' fees and other compensation. In contrast, large BHCs spend proportionately *more* on consulting and advisory services than do smaller firms, relative to revenue or assets. Large BHCs also incur proportionately higher expenses relating to amortization and impairment of goodwill and other intangible assets.

Overall, our results are consistent with the presence of scale economies in banking, as found in recent academic literature (for example, Wheelock and Wilson [2012]; Hughes and Mester [2013]; Feng and Serletis [2010]) and industry research (Clearing House Association 2011). In particular, our findings suggest that these scale economies stem in part from an operating cost advantage of large BHCs in areas such as employee compensation, information technology, and corporate overhead expenses.

We emphasize that a number of caveats apply to our results. First, our estimates represent reduced-form statistical correlations; caution should be exercised in drawing a causal interpretation from them. Although our regressions control for a wide range of BHC characteristics, firm size may still be correlated with omitted variables that are also associated with lower expenses, such as the quality of management. This caveat also seems to apply more generally to the existing literature on scale economies in banking.

Second, our results may also reflect factors other than scale economies. One possibility, closely related to scale economies but conceptually distinct, is that large firms operate closer to their production frontier on average; that is, they have greater *X-efficiency* (see Section 2 for a discussion).[2]

[2] Our analysis does not attempt to separate the effects of X-efficiency from those of scale economies. We note, however, that Hughes et al. (2001) and Hughes and Mester (2013) find that estimated scale economies are larger for more efficient banks than for less efficient ones, controlling for size.

Another possibility is that large banking firms have greater bargaining power vis-à-vis their suppliers and employees. If cost differences are due only to bargaining power effects, then limiting the size of the largest BHCs would not necessarily generate deadweight economic costs, although it might instead reallocate rents to employees or suppliers. An additional possibility is that our results are influenced by too-big-to-fail subsidies for large BHCs. Our prior is that such subsidies would be more likely to be manifested as a lower cost of funds for large firms, or a more leveraged capital structure, than as lower operating costs. However, it is still possible that a too-big-to-fail banking firm could respond by reducing expenditures on functions such as information technology or risk management; these would show up as part of noninterest expense.

These caveats aside, our results and those of related research suggest that imposing size limits on banking firms is unlikely to be a free lunch. For example, taking our estimates at face value, a back-of-the-envelope calculation implies that limiting BHC size to no more than 4 percent of GDP would increase total industry noninterest expense by $2 billion to $4 billion per quarter.[3] Limiting the size of banking firms could still be an appropriate policy goal, but only if the benefits of doing so exceeded the attendant reductions in scale efficiencies.

A second contribution of this article is to present new evidence on other determinants of BHC operating costs. In particular, we find that proxies for organizational complexity (for example, the number of distinct legal entities controlled by the BHC), as well as measures of the diversity of business activities, are robustly correlated with higher expense ratios. This result appears consistent with prior research on the diversification discount in banking (for example, Goetz, Laeven, and Levine [2013]). A third contribution is to present new stylized facts about the composition of noninterest expense, based on our data collection efforts. For example, we document the large share of NIE that is composed of corporate overhead, investment technology and data processing, consulting and advisory services, and legal expenses.

The remainder of the article proceeds as follows: Section 2 presents background and reviews the literature on economies of scale in banking. Section 3 describes the data, discusses our method for classifying other noninterest expense, and presents descriptive statistics. Section 4 presents multivariate analysis of the relationship between size and noninterest expense ratios. Section 5 studies components of noninterest expense. Section 6 summarizes our findings.

[3] Details of this calculation are presented in Appendix B, http://www.newyorkfed.org/research/epr/2014/1412kovn_appendixB.pdf.

## 2. Background and Literature

Our analysis is closely related to academic literature on scale economies and organizational efficiency in banking. In a microeconomic production model, the cost function traces out the relationship between output and the minimum total cost required to produce that output, for a given set of input prices. A firm exhibits economies of scale if minimum cost increases less than proportionately with output—for example, if the firm could double its output by less than doubling its costs, holding input prices fixed.

A large literature empirically estimates the cost function for banks and/or BHCs, and tests for the presence of scale economies by measuring whether the elasticity of total costs with respect to output is greater than, equal to, or less than unity (indicating diseconomies of scale, constant returns to scale, or economies of scale, respectively).

The earliest studies of scale economies in banking (for example, Benston [1972]), estimated during an era when U.S. banking organizations were on average much smaller than today, found evidence of modest economies of scale. Subsequent research, using more flexible cost functions, found that these scale economies were limited to small banks (for example, Benston, Hanweck, and Humphrey [1982] and Peristiani [1997]; see also Berger and Humphrey [1994] for a survey).

More recent research, however, has found evidence of scale economies even among the class of large banks and bank holding companies. Examples include Wheelock and Wilson (2012), Hughes and Mester (2013), Feng and Serletis (2010), and Hughes et al. (2001). This departure from earlier findings reflects greater statistical power, attributable to the use of larger datasets with many more observations for large banking firms, as well as the evolution of empirical techniques. For example, Wheelock and Wilson (2012) estimate a nonparametric cost function rather than the typical parametric translog function estimated in earlier literature, while Hughes and Mester (2013) and Hughes et al. (2001) endogenize bank risk and capital structure decisions. The difference in time periods may also play a role (for example, the greater use of information technology may have changed the extent to which scale economies are present).

The theoretical derivation of the cost function assumes that the bank maximizes profits, or equivalently, minimizes costs for any given level of output. A related body of literature on bank efficiency, however, finds evidence of surprisingly large cost differences between otherwise similar banks. These differences are viewed as evidence of *X-inefficiencies*, that is, firms operating inside their production possibilities frontier because of agency conflicts, management problems, or other inefficiencies (DeYoung 1998; Berger, Hunter, and Timme 1993; Berger and Humphrey 1991).

Rather than analyzing total scale economies or X-efficiency, this paper instead presents disaggregated evidence on the relationship between firm size and detailed components of noninterest expense. We have in mind the idea that operational and technological efficiencies related to size are likely to show up in the data in the form of lower operating costs in areas such as information technology and corporate overhead (for example, accounting and human resources) because large BHCs are able to spread the fixed component of these costs over a broader revenue or asset base. Our goal is to shed additional light on the mechanisms driving differences in efficiency between small and large firms. We note that our empirical finding that large BHCs have lower average operating costs could be driven by the presence of scale economies in the production of banking services, higher average X-efficiency for large firms, or both. For some categories of NIE, it could also be possible that lower costs for larger banking firms not only reflect technological efficiencies, but also greater bargaining power relative to suppliers, customers, or employees.

Our analysis is related to recent research by the Clearing House (2011) that uses proprietary management information systems data from a number of large banks to estimate product-specific scale curves in seven areas: online bill payment, debit cards, credit cards, wire transfers, automated clearing house, check processing, and trade processing. The Clearing House finds that in each of these areas, unit costs are decreasing in production volume, a conclusion that suggests the presence of fixed costs or other technological benefits of size. The economies of scale associated with these seven services are estimated to total $10 billion to $25 billion per year.

Although our approach is similar in some respects to the analysis by the Clearing House, we make use of data from audited regulatory filings, rather than internal management information system data, and study components that together sum up to total noninterest expense, rather than just a subset of NIE (the seven items studied by the Clearing House together cover only 7 to 10 percent of NIE). We also study the entire cross-section of BHCs, while the Clearing House sample consists of only six firms.

Our approach is related to the literature on banking mergers that uses accounting variables to estimate the effects of mergers on operating performance. Kwan and Wilcox (2002) find evidence that bank mergers reduced operating costs, although more so for the early 1990s than the late 1980s. Cornett, McNutt, and Tehranian (2006) examine different measures of efficiency improvements for large mergers, and find evidence for cost-efficiency improvements in addition to other revenue improvements. Hannan and Pilloff (2006) show that cost-efficient banks tend to acquire relatively inefficient targets. Using German banking data, Niepmann (2013) finds a negative correlation between size and scaled operating costs—a result consistent with our findings for U.S. firms.

Davies and Tracey (2014) argue that standard estimates of scale economies for large banks are influenced by too-big-to-fail (TBTF) subsidies, and that scale economies are no longer present after controlling for TBTF factors. Hughes and Mester (2013) dispute this conclusion, arguing that the cost function used by Davies and Tracey is misspecified. One potential advantage of our focus on noninterest expense is that operating costs (for example, information technology, printing, postage, and advertising) may be relatively more likely to reflect technological features of the firm's production process than any distortions due to TBTF. Instead, TBTF seems most likely to affect the firm's funding costs and capital structure. It seems difficult, however, to rule out the possibility that TBTF subsidies may affect our results or those of previous literature.

## 3. Data and Descriptive Statistics

Our analysis is based on quarterly FR Y-9C regulatory data filed by U.S. bank holding companies. The Y-9C filings include detailed balance sheet and income data, as well as information about loan performance, derivatives, off-balance-sheet activities, and other aspects of BHC operations. Data are reported on a consolidated basis, incorporating both bank and nonbank subsidiaries controlled by the BHC (see Avraham, Selvaggi, and Vickery [2012] for more details). Our analysis considers only "top-tier" BHCs—that is, the ultimate parent U.S. entity. Our sample includes top-tier U.S. BHCs with a foreign parent, although it excludes "stand-alone" commercial banks that are not owned by a BHC, and BHCs that are too small to file the Y-9C (the Y-9C reporting threshold varies over time, but is currently $500 million). Our sample excludes investment banks, thrifts, and other types of financial institutions, unless those firms are owned by a commercial BHC.

Noninterest expense is reported in the consolidated Y-9C income statement (Schedule HI), broken down into five categories. Note that noninterest expense does not include loan losses due to defaults, trading losses, gains and losses on owned securities, or taxes; these are recorded in other parts of the income statement.[4] Our analysis focuses on noninterest

[4] BHC net income in Schedule HI is calculated as follows: net income = net interest income + noninterest income − noninterest expense − provision for loan and lease losses + realized securities gains (losses) − taxes + extraordinary items and other adjustments − net income attributable to noncontrolling interests. See Copeland (2012) for descriptive information on how the main components of BHC income have evolved over time.

expense because it is the most likely area in which firms would realize operating cost advantages from size.

We compute several normalized measures of noninterest expense. The first measure, widely used by practitioners and industry analysts, is the "efficiency ratio," defined as the ratio of noninterest expense to "net operating revenue," the sum of net interest income and noninterest income:

$$Efficiency\ ratio = \frac{noninterest\ expense}{net\ interest\ income + noninterest\ income}$$

A higher efficiency ratio indicates higher expenses, or equivalently, lower efficiency. Effectively, this ratio measures the operating cost incurred to earn each dollar of revenue. Efficiency ratios vary widely across BHCs, as we document below, but typical values range from 50 to 80 percent. Efficiency ratios are sometimes computed excluding certain noncash items from noninterest expense, such as amortization of intangible assets. We refer to such measures as "cash" efficiency ratios.

One limitation of the efficiency ratio is that it is sensitive to quarter-to-quarter movements in net operating revenue. For example, ratios spiked for many BHCs during the financial crisis, because of trading losses and other noninterest losses. (In rare cases, the efficiency ratio even flips sign, because the sum of net interest and noninterest income is negative.) To provide an alternative normalization that is less sensitive to these concerns, we also present results based on scaling noninterest expense by total assets or risk-weighted assets (RWA), rather than net operating revenue:

$$Expense\ asset\ ratio = \frac{noninterest\ expense}{total\ assets\ (or\ risk\text{-}weighted\ assets)}$$

These normalizations can be computed for total noninterest expense, or for NIE subcomponents such as compensation.

## 3.1 Descriptive Statistics

Table 1 presents descriptive statistics for noninterest expense over the period from first-quarter 2001 to fourth-quarter 2012. We selected this period to take advantage of additional detail on noninterest income expense that was added to the Y-9C in 2001, thereby allowing us to separate noninterest income (which we use as a control) into components such as investment banking fees, income from insurance fees, deposit fees, and servicing fees. Note that the sample period for our regression analysis in Section 4 begins in first-quarter 2002 because we incorporate lagged income variables from the previous four quarters. A total of 2,810 BHCs are present in the sample for at least one quarter.

Panel A of the table reports summary statistics for four normalized measures of noninterest expense: the efficiency ratio, the cash efficiency ratio (which excludes goodwill impairment and amortization from noninterest expense), noninterest expense scaled by total assets, and noninterest expense scaled by RWA. The industry efficiency ratio averages 66.3 percent over 2001-12, although it is somewhat higher (71.7 percent) in 2012. The standard efficiency ratio and the cash efficiency ratio differ little on average, reflecting the fact that goodwill impairment and amortization expense generally represent a small total of total noninterest expense.

The distribution of the expense ratios is skewed to the right. For example, the difference between the 5th percentile of the efficiency ratio and its median is 19.5 percent, significantly smaller than the difference of 28.0 percent between the median and the 95th percentile value. Furthermore, the right tail includes some extremely high values (for example, the 99.5th percentile is 198.4 percent), likely driven by one-time spikes in revenue. To reduce the influence of outliers, our regression analysis winsorizes the top and bottom 0.5 percent of observations for each noninterest expense ratio (all data below and above the bottom and top 0.5th percentiles, respectively, are set equal to the 0.5th and 99.5th percentiles).

We examine the components of noninterest expense in Panel B of the table, based on the five noninterest expense categories reported on Schedule HI.[5]

- *Compensation* (49.4 percent of industry total over the sample time period, reported on FR Y-9C as "salaries and employee benefits"). This category includes wages and salaries, bonus compensation, contributions to social security, retirement plans, health insurance, employee dining rooms, and other components of employee compensation.
- *Premises and fixed assets* (11.6 percent of total, reported on Y-9C as "expenses of premises and fixed assets net of rental income") includes depreciation, lease payments, repairs, insurance and taxes on premises, equipment, furniture, and fixtures. It excludes mortgage interest on corporate real estate.
- *Goodwill impairment* (1.8 percent of total, reported on Y-9C as "goodwill impairment losses") represents losses incurred when goodwill exceeds implied fair value and is revalued downwards. This item is reported separately from "other noninterest expense" from 2002 onwards.
- *Amortization expense* (1.9 percent of total, reported on Y-9C as "amortization expense and impairment losses for other intangible assets") includes amortization of goodwill

[5] A detailed definition of these five variables can be found in the Federal Reserve Microdata Reference Manual data dictionary, available at http://www.federalreserve.gov/apps/mdrm/data-dictionary.

Table 1

## Noninterest Expense Summary Statistics

| | Industry | | Individual Observations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Full Sample | 2012 | p0.5 | p5 | p25 | p50 | p75 | p95 | p99.5 | Mean | Standard Deviation |
| Panel A: Efficiency Measures, in Percent: 2001-12 | | | | | | | | | | | |
| Efficiency ratio | 66.32 | 71.68 | 29.07 | 46.31 | 58.26 | 65.77 | 74.44 | 93.71 | 198.40 | 68.10 | 18.69 |
| Cash efficiency ratio | 63.29 | 70.39 | 28.69 | 45.81 | 57.72 | 65.17 | 73.72 | 92.07 | 168.11 | 67.05 | 16.64 |
| Expense-to-asset ratio | 0.82 | 0.82 | 0.25 | 0.45 | 0.63 | 0.75 | 0.88 | 1.25 | 3.95 | 0.80 | 0.37 |
| Expense-to-RWA ratio | 1.22 | 1.35 | 0.35 | 0.61 | 0.87 | 1.05 | 1.28 | 1.89 | 6.02 | 1.15 | 0.58 |
| Panel B: Components of Noninterest Expense, as a Percentage of Total: 2001-12 | | | | | | | | | | | |
| Compensation | 49.36 | 48.68 | 18.08 | 40.45 | 50.31 | 54.67 | 58.58 | 64.59 | 74.30 | 53.96 | 13.54 |
| Premises and fixed assets | 11.63 | 9.64 | 2.79 | 7.78 | 11.47 | 13.67 | 16.01 | 20.16 | 26.53 | 13.84 | 5.45 |
| Goodwill impairment | 1.75 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 16.28 | 0.29 | 5.03 |
| Amortization expense | 1.93 | 1.78 | -0.03 | 0.00 | 0.00 | 0.00 | 0.97 | 3.57 | 9.03 | 0.76 | 1.72 |
| Other | 34.95 | 39.88 | 10.02 | 20.93 | 26.22 | 30.04 | 34.71 | 45.82 | 69.29 | 31.11 | 16.15 |

Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data).

Notes: The table reports summary statistics for 2,810 unique bank holding companies from 2001:Q1 to 2012:Q4, a total of 58,217 firm-quarter observations. The column labeled "industry" reports the average industry efficiency ratio, calculated by summing across all bank holding companies each quarter, taking the ratio, and then taking the time-series mean, either over the 2001:Q1 – 2012:Q4 sample period or over calendar year 2012. The denotation "p" refers to percentiles of individual observations (for example, "p50" is the median). Variables are defined in Appendix A. RWA is risk-weighted assets.

and other intangible assets owned by the BHC, as well as impairment losses for intangible assets other than goodwill. This item is also available from 2002 onwards.

- *Other* (35.0 percent of total) includes a broad range of other operating costs, such as telecommunication and information technology costs, legal fees, deposit insurance, advertising, printing, postage, and so on. Additional information on these expenses is provided in the memoranda to Schedule HI, as we explain in detail below.

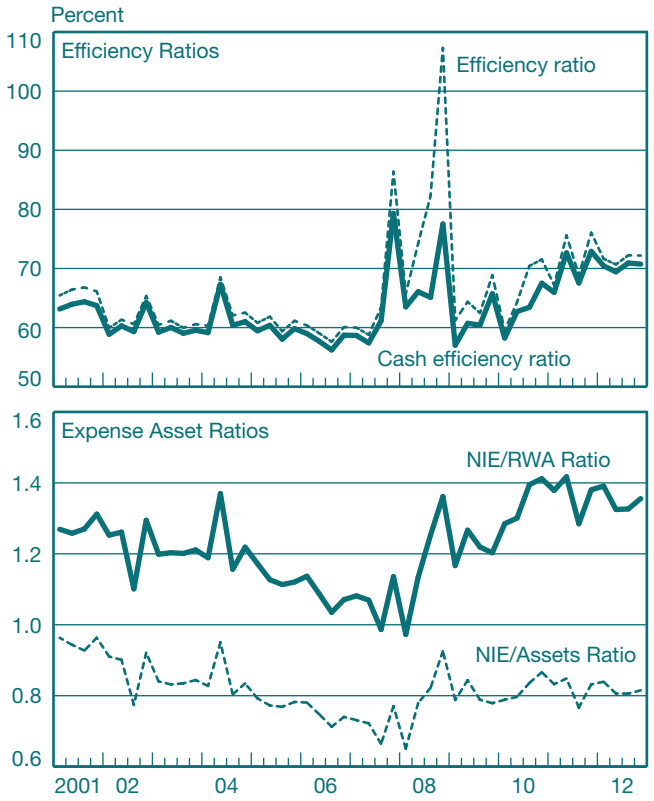
Chart 1 plots the time series evolution of the four normalized measures of total industry NIE. Each expense measure declined between 2001 and mid-2007, a period when the revenues and assets of the banking system grew rapidly. For example, the industry efficiency ratio fell from 65.4 percent in quarter-one 2001 to 58.8 percent in quarter-two 2007, while the expense asset ratio declined from 0.96 percent to 0.72 percent over the same period. This downward trend was reversed during the 2007-09 financial crisis. Since the efficiency ratio is mechanically inversely related to net operating revenue, the reversal for that NIE measure is perhaps unsurprising. However, the expense asset ratio also increased, whether normalized by total assets or risk-weighted assets. In recent years noninterest expense ratios have stabilized at levels higher than those prevailing prior to the onset of the crisis. The rise in the efficiency ratio in part simply reflects the decline in net operating revenue and measures of profitability for the banking industry, owing to compression of net interest margins and lower noninterest income.

Appendix B also plots the evolution of the relative shares of the five noninterest expense subcategories.[6] Goodwill impairment expenses are almost entirely concentrated in 2008, with negligible levels for this expense category before and after 2008. Other noninterest expense makes up a progressively larger fraction of total NIE over the past five years. (In 2012, this category represented 39.9 percent of total NIE, a share similar to that held by compensation expenses).

As a first look at the relationship between firm size and normalized noninterest expense, the main focus of this paper, we present scatter plots of BHC size and the efficiency ratio (Chart 2). The plots are based on year-to-date 2012 expense data and assets as of the end of 2012. A striking feature of the chart

[6] Appendix B is available at http://www.newyorkfed.org/research/epr/2014/1412kovn_appendixB.pdf.

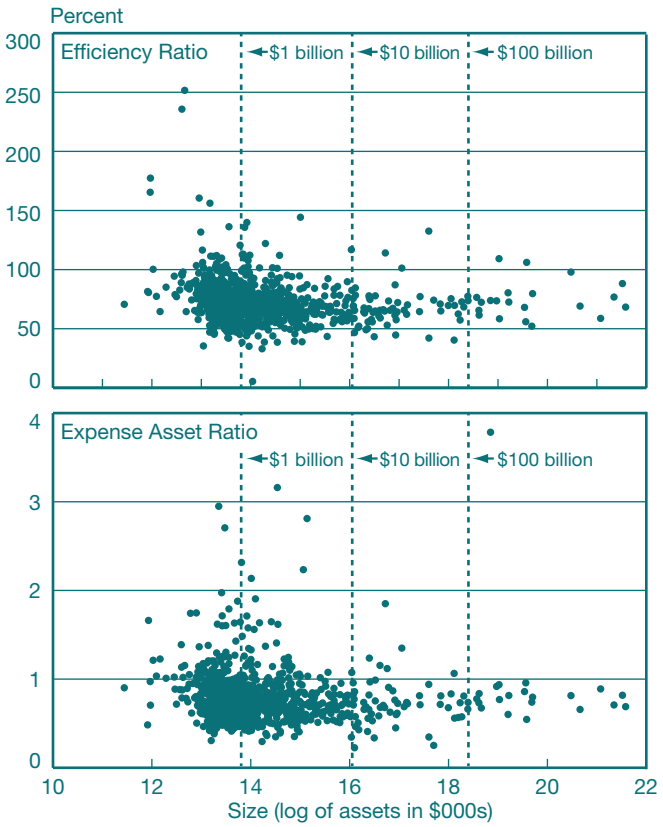
Chart 1
Noninterest Expense Ratios over Time




Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data).

Notes: Income data are quarterly and are not annualized. Ratios are reported in percentages. NIE is noninterest expense; RWA is risk-weighted assets.

Chart 2
Scatter Plots of Operating Cost Ratios and BHC Size




Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data).

Notes: Scatter plots are based on average quarterly noninterest expenses over 2012 and total BHC assets as of the end of 2012. BHC is bank holding company.

is the variability in noninterest expense across firms, particularly among smaller BHCs. This finding is also borne out in our multivariate analysis in Section 4. The variability points to the importance of adding controls for those observable differences in BHCs' activities that are associated with different types of expenses. These controls are described in Section 3.3.

## 3.2 Classifying Other Noninterest Expense

The category "other NIE" represents more than one-third of industry noninterest expenses since 2001. To shed light on these costs, we examine data from the memoranda to Schedule HI. Since 2008, Schedule HI has allowed BHCs to classify other NIE into eleven standardized subcategories;[7] in addition, space is provided for BHCs to report additional "write-in" expense items that were not captured by the standardized fields. For the eleven standardized subcategories, BHCs are instructed to record items for amounts greater than $25,000 that also exceed 3 percent of total other noninterest expense. Write-in items bear the additional requirement that the expense item exceed 10 percent of total other noninterest

[7] The eleven standardized memoranda categories are (a) data processing expenses, (b) advertising and marketing expenses, (c) directors' fees, (d) printing, stationery, and supplies, (e) postage, (f) legal fees and expenses, (g) FDIC insurance assessments, (h) accounting and auditing expenses, (i) consulting and advisory expenses, (j) automated teller machine (ATM) and interchange expenses and (k) telecommunications expenses. See FR Y-9C Schedule HI Memorandum Item 7.

expense. Since 2008, amounts in the eleven standardized categories have made up 38 percent of total other noninterest expense, while the write-in fields have constituted another 28 percent of other NIE. The remaining 34 percent of other noninterest expense is not reported in the Schedule HI memoranda, presumably because it does not meet the reporting thresholds described above.

It is particularly challenging to classify and analyze items recorded in the write-in expense fields, because these amounts are reported using nonstandardized language by each BHC. For example, noninterest expenses related to foreclosures and to properties that are "other real estate owned"[8] are variously written in as "reo," "ore," "R.E.O," "oreo," "foreclose," and so on, as well as various misspelled text strings such as "oero" and "forclosuer" (sic). Overall, more than 30,000 text strings are written in by the BHCs in our sample between 2008 and 2012. Approximately 5,500 of these strings are unique. Individual BHCs often tend to use the same text field from one quarter to the next when referring to a given data item, a practice that reduces the total number of fields to be classified.

We classify each unique text string into broad categories, proceeding in two steps. First, we classify each string into one of ninety subcategories, such as "card rewards," "custodian fees," "affordable/low-income housing," "servicing," "dues/memberships/subscriptions," and "lockbox fee." We chose these subcategories by grouping together apparently similar items, employing our institutional knowledge where possible, as well as internet searches and our best judgment. A list of these subcategories, along with the percentage of nonmissing values, is presented in Appendix B to this paper. This classification was in part done by hand, and in part via Stata code that conducted Boolean searches for keywords within each text string. The subcategories include four separate "miscellaneous/other" categories, one for text strings that are well-defined but do not fit into any obvious category (for example, "cattle feed," "livestock," and "image processing"), one for items that we did not understand (for example, "tops expense"), one for items that are vague or otherwise unclassifiable (for example, "sundry loss"), and one for text strings that combine multiple items with values listed.

Since most of the subcategories are fairly sparsely populated, as documented in Appendix B, we then aggregate them into nine categories that are better suited to statistical analysis. We also assign each of the eleven standardized memoranda items to one of the same nine author-defined categories. By doing this, we are able to classify 66.2 percent of other noninterest expense into the nine high-level categories, which are listed below:

- *Corporate overhead* (18.6 percent of other NIE). This category, which is intended to measure general corporate expenses, includes four standardized Y-9C items: "accounting and auditing," "printing, stationery, and supplies," "postage," and "advertising and marketing." It also includes write-in expenses related to corporate overhead costs, such as travel, business development, recruitment, professional memberships and subscriptions, and charitable contributions.
- *Information technology and data processing* (12.6 percent of other NIE). This category covers the standardized Y-9C item "data processing expenses," as well as write-in expenses related to information technology, software, and internet banking.
- *Consulting and advisory* (11.1 percent of other NIE). This category is the standardized Y-9C item "consulting and advisory expenses." It does not include any write-in expenses.
- *Legal* (6.7 percent of other NIE). This category includes the standardized Y-9C item "legal fees and expenses," as well as write-in line items related to "litigation," "settlement," "records retention," "legal reserve," and similar items.[9]
- *Retail banking* (6.4 percent of other NIE). This category is intended to reflect operating costs related to lending and deposit-taking. It includes the standardized NIE category "ATM and interchange expenses," as well as write-in items related to loans, retail banking, or credit cards (for example, costs related to real estate owned properties, credit reports, credit card rewards, branch closing costs, lockbox fees, check fraud, and so on).
- *Federal Deposit Insurance Corporation (FDIC) assessments and other government-related expenses* (5.8 percent of other NIE). This category includes the standardized Y-9C item "FDIC deposit insurance assessments" and write-in expenses related to the Community Reinvestment Act, compliance with regulation, and other items. In practice, deposit insurance fees make up the bulk of these expenses.
- *Other financial services* (3.0 percent of other NIE). This category embraces written-in expense items for financial activities other than traditional lending and depository services—in particular, asset management, insurance, and miscellaneous derivatives- and trading-related expenses.
- *Directors' fees and other compensation* (0.3 percent of other NIE). This category includes the standardized Y-9C category "directors' fees," as well as write-in fields related to director compensation or other compensation costs.

[8] "Other real estate owned" refers to real estate owned by a bank as a result of the foreclosure of a mortgage loan.

[9] The standardized "legal fees and expenses" other NIE category includes fees and retainers paid for legal services obtained, but excludes legal settlements and legal expenses associated with owned real estate. Legal settlements and legal reserves established against expected future settlements are recorded in the write-in text fields, if separately reported.

Table 2

## Components of Other Noninterest Expense

Panel A: FR Y-9C Classification of Other Noninterest Expense: 2008-12

| Category | Percentage of Total Other Noninterest Expense, Industry |
|---|---|
| In Y-9C | 37.99 |
| Text classified | 28.21 |
| Unclassified | 33.80 |
| Total | 100.00 |

Panel B: Components of Other Noninterest Expense, as a Percentage of Total Other Noninterest Expense: 2008-12

| | | Individual Observations | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Component (Author-Defined) | Industry | p0.5 | p5 | p25 | p50 | p75 | p95 | p99.5 | Mean | Standard Deviation |
| Corporate overhead | 18.63 | 0.00 | 2.43 | 10.29 | 16.26 | 22.70 | 34.58 | 50.95 | 17.07 | 10.07 |
| Information technology and data processing | 12.63 | 0.00 | 0.64 | 8.21 | 13.84 | 19.81 | 29.91 | 45.01 | 14.54 | 8.69 |
| Consulting and advisory | 11.07 | 0.00 | 0.00 | 0.00 | 2.31 | 5.78 | 12.73 | 29.97 | 3.74 | 5.23 |
| Legal | 6.68 | 0.00 | 0.00 | 0.00 | 3.53 | 6.19 | 12.43 | 24.71 | 4.16 | 4.71 |
| Retail banking | 6.35 | 0.00 | 0.00 | 0.00 | 6.41 | 13.48 | 29.64 | 55.24 | 9.24 | 10.55 |
| FDIC assessments and other government | 5.81 | 0.00 | 0.00 | 6.80 | 11.53 | 16.95 | 25.54 | 37.34 | 12.26 | 7.58 |
| Other financial services | 3.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 4.00 | 15.85 | 0.56 | 2.72 |
| Directors' fees and other compensation | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 3.45 | 6.99 | 14.60 | 1.91 | 2.85 |
| Miscellaneous | 1.76 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.75 | 24.91 | 0.84 | 3.98 |
| Total classified | 66.20 | 4.02 | 35.11 | 55.83 | 66.87 | 75.05 | 85.72 | 95.35 | 64.32 | 15.73 |
| Unclassified | 33.80 | | | | | | | | | |

Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data).

Notes: The table reports summary statistics for 2,810 unique bank holding companies from 2008 to 2012. Annual data are as of year-end, for a total of 4,999 firm-year observations. Panel A summarizes information on the following types of noninterest expense: (i) FR Y-9C line items: eleven standardized other noninterest expense items reported in FR Y-9C Schedule HI: Memoranda, (ii) text classified: other noninterest expense items reported in Schedule HI: Memoranda as text fields, and (iii) unclassified: other noninterest expense items not classified in Schedule HI (for example, because the amounts do not exceed the reporting threshold). Panel B includes summary statistics for the nine author-defined other noninterest expense categories, which are constructed from the FR Y-9C line items and the text fields. These data are described in Section 3.2. FDIC is Federal Deposit Insurance Corporation.

- *Miscellaneous* (1.8 percent of other NIE). The final category reflects the four types of miscellaneous categories described above—that is, items that cannot be easily classified or are not understood by us based on the content of the write-in field.

In a small minority of cases, the write-in field content suggests an expense item that may have been classified as other NIE by mistake (for example, costs related to employee compensation). We did not attempt to reclassify these expenses, given the limited context and detail in the write-in fields.

Descriptive statistics for these nine author-defined categories of other NIE are presented in Panel B of Table 2. Note that the individual percentiles and standard deviations reported in the table are based on annual expenses, rather than quarterly values. We adopt this approach because of the significant number of zero values reported for even these nine aggregated categories. Our analysis of the other NIE subcategories is based on these year-end cumulative expenses.

The variation across BHCs in the relative size of different components of other NIE is striking. For example, the category "other financial services," which includes noninterest expense related to insurance and other nonbanking financial services, has a median value of zero, but at the 99.5th percentile, it is 15.9 percent of total other noninterest expense. This varied distribution of expenses is consistent with the dispersion in products and services offered by BHCs.

## 3.3 Controls

Operating costs are likely to vary significantly across BHCs engaged in different business activities. While the decision to enter different businesses is endogenous, and may be related to size, we are primarily interested in understanding how size is related to operating expenses on an apples-to-apples basis. For this reason, our regression analysis controls for a variety of BHC characteristics reported in the FR Y-9C. Summary statistics for these controls are presented in Table 3. In order to show how these controls are related to bank size, we also present industry averages for the following size cohorts: largest 1 percent, 95 to 99 percent, 75 to 95 percent, 50 to 75 percent, and smallest 50 percent.[10] Differences in BHC characteristics by size are clear from differences in sample means within the cohorts. However, there is substantial variation in business models apparent within size cohorts as well.

The controls in Table 3 are grouped into six categories, as follows:

- *Asset shares*. Our asset composition control variables measure the fraction of balance sheet assets held in various types of loans and other assets (for example, trading assets, securities, cash, and fixed assets). As shown in Table 3, small firms hold a higher fraction of total assets in the form of loans, while trading assets are a significantly higher share of total assets for the largest BHCs than for any other group.
- *Risk*. We control for two additional measures of asset risk: risk-weighted assets as a percentage of total assets, and nonperforming loans (NPLs) as a percentage of total loans. The relationship between firm size and risk is non-monotonic for both risk measures, although we note that the largest firms have significantly higher nonperforming loan ratios than other BHCs.
- *Revenue composition*. Revenue composition refers to the percentage of net operating revenue (the sum of interest and noninterest income) that is earned from different sources: (i) interest income, (ii) trading income, and (iii) five different components of noninterest nontrading income. Since these components can be volatile, in the regressions we include these variables in the form of a four-quarter rolling average lagged value. (The standard deviation reported in the table is based on this four-quarter rolling average.) It is notable that large BHCs earn a significantly higher percentage of revenue from noninterest income.
- *Funding structure*. In some specifications, we include two controls for funding structure, the ratio of deposits to assets, and a dummy for whether the BHC is a publicly traded company (firms with foreign parents are coded as private, regardless of whether their ultimate parent is public). Large firms fund less of their assets with deposits, on average.
- *Business concentration*. Research in organizational economics has found that diversified firms tend to be less efficient and less profitable than focused firms. In studies that are most relevant to our analysis, Goetz, Laeven, and Levine (2013) find that geographically diversified commercial banks have lower valuations, while Laeven and Levine (2007) find a diversification discount (based on the firm's activity mix) in an international cross-section of banks. In the spirit of these studies, we include Herfindahl-Hirschman Index (HHI)–style measures of asset and income concentration, computed as the sum of squared asset weights and income weights, respectively, based on the categories presented in Table 3. Higher values of these measures indicate greater concentration. As the table shows, large firms have more diversified assets and activities (lower HHI), reflecting their greater reliance on financial activities outside of traditional lending and deposit taking.
- *Organizational complexity*. Organizationally complex firms may also have higher operating costs, because of various internal inefficiencies (for example, duplication of efforts across different subsidiaries or divisions within the same firm). It is important to attempt to disentangle the effects of size and structure, given that large firms are likely to be organizationally complex. Our analysis includes three measures of organizational structure, the log number of subsidiaries (following Avraham, Selvaggi, and Vickery [2012]), the percentage of subsidiaries domiciled overseas, and a dummy for whether the BHC has a foreign parent. As shown by the sample means across size cohorts, large firms have more complex organizational structures than small firms on each of these dimensions. The differences are striking: the largest BHCs (those in the top 1 percent of the size distribution) have 962 subsidiaries on average, 22.7 percent of which are domiciled overseas. BHCs below the sample median in size, however, have only 4 subsidiaries on average, and only 4.8 percent of these subsidiaries are domiciled outside the United States.

[10] To compute the industry average for the asset and income ratios, we sum the numerator and denominator of the ratio across all firms in the size cohort, and then take the ratio of the two sums. In contrast, the mean and standard deviation reported in the first two columns represent the unweighted mean and standard deviation of the individual observations in the sample. Of course, the mean of the individual observations may differ substantially from the industry mean if the ratio in question is correlated with firm size.

Table 3

## Summary Statistics for Control Variables

| | Industry, by Size Cohort | | | | | | Individual Observations | |
|---|---|---|---|---|---|---|---|---|
| | Top 1% | 95-99% | 75-95% | 50-75% | Bottom 50% | Industry | Mean | Standard Deviation |
| **Asset shares (percentage of total assets)** | | | | | | | | |
| Total loans | 42.08 | 59.58 | 64.65 | 67.84 | 67.57 | 48.39 | 66.44 | 13.36 |
| Residential real estate loans | 14.94 | 16.63 | 16.55 | 17.32 | 18.08 | 15.53 | 17.78 | 10.62 |
| Commercial real estate loans | 4.26 | 15.65 | 28.12 | 31.47 | 29.77 | 9.48 | 28.27 | 15.02 |
| Commercial and industrial loans | 8.64 | 12.54 | 11.20 | 10.25 | 9.94 | 9.65 | 10.42 | 6.84 |
| Credit card loans | 3.53 | 2.33 | 0.59 | 0.26 | 0.17 | 2.93 | 0.32 | 2.93 |
| Other consumer loans | 4.68 | 6.11 | 4.19 | 3.72 | 3.87 | 4.89 | 4.25 | 5.14 |
| All other loans | 6.03 | 6.32 | 4.00 | 4.83 | 5.73 | 5.91 | 5.40 | 7.83 |
| Trading assets | 15.52 | 1.45 | 0.24 | 0.04 | 0.04 | 10.89 | 0.20 | 1.75 |
| Federal funds and repurchase agreements | 13.67 | 2.20 | 1.24 | 1.61 | 2.07 | 9.95 | 2.14 | 3.93 |
| Cash | 5.49 | 5.76 | 4.41 | 4.65 | 4.91 | 5.43 | 4.64 | 4.01 |
| Investment securities | 12.65 | 20.60 | 22.94 | 20.56 | 20.46 | 15.34 | 21.35 | 12.38 |
| Other real estate owned | 0.11 | 0.12 | 0.31 | 0.42 | 0.49 | 0.14 | 0.36 | 0.89 |
| Fixed assets | 0.70 | 1.24 | 1.62 | 1.92 | 2.02 | 0.93 | 1.90 | 1.05 |
| Investments in unconsolidated subsidiaries | 0.33 | 0.18 | 0.09 | 0.12 | 0.07 | 0.27 | 0.09 | 1.38 |
| Investments in real estate ventures | 0.08 | 0.05 | 0.02 | 0.03 | 0.02 | 0.07 | 0.02 | 0.94 |
| Intangible and other assets | 8.02 | 6.77 | 3.89 | 3.19 | 2.97 | 7.24 | 3.19 | 2.11 |
| **Risk** | | | | | | | | |
| Risk-weighted assets (percentage of total assets) | 63.85 | 75.08 | 71.72 | 72.95 | 71.82 | 67.04 | 71.68 | 11.89 |
| Nonperforming loans (percentage of total loans) | 2.94 | 1.85 | 2.05 | 1.83 | 1.95 | 2.51 | 1.65 | 2.65 |
| **Revenue composition (percentage of net operating revenue)** | | | | | | | | |
| Interest income | 50.61 | 51.56 | 65.08 | 73.25 | 77.26 | 53.01 | 77.62 | 12.54 |
| Trading income | 7.38 | 1.58 | 0.28 | 0.08 | 0.09 | 5.44 | 0.19 | 1.14 |
| Noninterest nontrading income | 45.38 | 46.85 | 34.65 | 26.68 | 22.66 | 43.90 | 22.26 | 12.30 |
| Fiduciary income | 7.86 | 9.63 | 4.54 | 3.96 | 2.64 | 7.83 | 2.84 | 4.97 |
| Investment banking fees | 12.96 | 7.32 | 8.60 | 1.38 | 0.83 | 10.73 | 0.99 | 2.83 |
| Service charges on deposits | 5.43 | 6.53 | 7.40 | 7.84 | 7.79 | 5.93 | 7.87 | 4.56 |
| Net servicing fees | 3.48 | 1.52 | 0.65 | 0.47 | 0.52 | 2.69 | 0.60 | 1.58 |
| Other income | 15.55 | 21.85 | 13.45 | 13.03 | 10.88 | 16.66 | 9.77 | 9.32 |
| **Funding structure** | | | | | | | | |
| Deposits/assets (percent) | 43.67 | 62.76 | 74.85 | 79.58 | 81.17 | 51.49 | 79.21 | 10.42 |
| Publicly traded (percentage of sample) | 76.85 | 79.16 | 60.18 | 30.81 | 12.69 | 30.02 | 27.75 | 44.78 |
| **Business Concentration** | | | | | | | | |
| HHI assets | 0.25 | 0.41 | 0.48 | 0.51 | 0.51 | 0.29 | 0.52 | 0.13 |
| HHI income | 0.53 | 0.56 | 0.59 | 0.64 | 0.67 | 0.53 | 0.69 | 0.17 |
| **Organizational complexity** | | | | | | | | |
| Number of subsidiaries | 962.25 | 68.78 | 10.76 | 6.22 | 4.07 | 18.29 | 15.75 | 139.99 |
| Percentage of subsidiaries foreign | 22.71 | 14.46 | 3.88 | 4.54 | 4.83 | 16.15 | 0.75 | 5.18 |
| BHC is foreign-owned (percentage of sample) | 23.15 | 18.06 | 3.28 | 0.39 | 0.62 | 2.02 | 1.78 | 13.24 |

Table 3 (continued)
Summary Statistics for Control Variables

| | Industry, by Size Cohort | | | | | |
|---|---|---|---|---|---|---|
| | Top 1% | 95-99% | 75-95% | 50-75% | Bottom 50% | Industry |
| **Sample statistics: Regression sample (2002-12)** | | | | | | |
| N | 604 | 2,405 | 12,197 | 15,181 | 27,830 | 58,217 |
| Average number of firms | 14 | 56 | 282 | 352 | 705 | 1,410 |
| Average asset size (millions of dollars) | 599,180 | 42,761 | 3,153 | 838 | 424 | 9,065 |

Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data).

Notes: The table reports summary statistics for 2,810 unique bank holding companies from 2001:Q1 to 2012:Q4, a total of 58,217 firm-quarter observations. The first six columns are industry ratios (computed by first summing numerator and denominator across all firms in the relevant size class), or are statistics weighted by firm size, except for the two indicator variables "publicly traded" and "BHC is foreign-owned." Size cohorts are recalculated in each quarter. The last two columns are unweighted statistics across all firms. Note that the sample period for the regression analysis begins in 2002:Q1, not 2001:Q1, because specifications include lagged income variables from the previous four quarters. See Appendix A for variable definitions. HHI is Herfindahl-Hirschman Index; BHC is bank holding company.

## 4. Analysis

In this section, we study the relationship between BHC size and measures of total noninterest expense scaled by revenue or assets, examining how this relationship is affected by controlling for differences in firms' business models and by the normalization of noninterest expense used. Our analysis progressively adds controls for a wide range of measures of the composition of BHC assets and sources of income, on the presumption that some types of assets or activities are likely to be more complex and time-consuming to manage than others. For example, a BHC with a large portfolio of other real estate owned assets will likely incur significant property maintenance and management expenses associated with these assets, compared with an otherwise similar banking firm that has liquidated such properties in return for cash, government securities, or other simple assets. Similarly, a portfolio of consumer loans is likely to have different screening and monitoring costs than a portfolio of commercial loans. Including these controls seems particularly important given that asset composition varies significantly by firm size, as documented in Section 3.

### 4.1 Total Noninterest Expense

Table 4 presents ordinary least squares estimates of the relationship between the efficiency ratio and BHC size measured by the log of total assets. We find a statistically and economically significant inverse relationship between size and the efficiency ratio in each regression specification. That is, noninterest expenses per dollar of net operating revenue are lower for large BHCs.

The first column of results controls only for time-series variation in the efficiency ratio, through the inclusion of quarter fixed effects. Each subsequent regression specification successively adds more explanatory variables associated with differences in BHCs' business activities. We begin with simple controls for the composition of BHC assets and add more detailed measures of the risk of those assets, the composition of revenue, funding structure, business concentration, organizational complexity, and geography.

Looking across the models, we see that the inclusion of additional controls tends to *steepen* the inverse relationship between BHC size and the efficiency ratio. Including controls for BHC asset composition (for example, the percentage of assets in fixed assets, residential real estate loans, trading assets, and so on) increases the magnitude of the coefficient on bank size by 54 percent (from -1.32 in specification 1 to -1.96 in specification 3), and increases the explanatory power of the model by 13 percentage points. Controlling for the percentage of income generated by different activities (for example, trading, investment banking, and deposit service charges) shifts the coefficient to -2.63 (specification 6). The inclusion of controls for organizational complexity further steepens the association between BHC size and the efficiency ratio; the coefficient increases in magnitude from -2.98 (specification 8) to -4.13 (specification 9).

Table 4

## BHC Size and the Efficiency Ratio

| | Specification | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Log assets | -1.320*** | -1.892*** | -1.962*** | -2.044*** | -2.509*** | -2.631*** | -2.886*** | -2.983*** | -4.131*** | -4.151*** | -2.471* |
| | (0.235) | (0.228) | (0.226) | (0.246) | (0.239) | (0.240) | (0.271) | (0.273) | (0.334) | (0.326) | (1.156) |
| **Asset shares (percentage of total assets)** | | | | | | | | | | | |
| Total loans | | -50.105*** | | | | | | | | | |
| | | (7.446) | | | | | | | | | |
| Residential real estate loans | | | -41.250*** | -42.777*** | -28.889** | -30.446*** | -31.136*** | -23.170* | -21.549* | -22.379* | -31.408** |
| | | | (7.850) | (8.211) | (8.877) | (8.367) | (8.579) | (9.415) | (8.859) | (8.910) | (10.472) |
| Commercial real estate loans | | | -55.329*** | -63.050*** | -46.223*** | -46.866*** | -47.723*** | -38.003*** | -36.868*** | -31.123** | -45.328*** |
| | | | (7.452) | (9.352) | (10.172) | (9.729) | (9.922) | (10.596) | (9.990) | (9.894) | (10.340) |
| Commercial and industrial loans | | | -41.365*** | -43.923*** | -30.428** | -32.324** | -32.581** | -24.657* | -25.291* | -15.721 | -43.188*** |
| | | | (8.235) | (10.014) | (10.676) | (10.189) | (10.276) | (10.748) | (10.249) | (10.201) | (10.512) |
| Credit card loans | | | -70.539*** | -84.648*** | -79.998*** | -81.301*** | -80.567*** | -69.742*** | -66.710*** | -59.817*** | -36.635 |
| | | | (11.455) | (10.068) | (11.430) | (10.945) | (10.950) | (12.164) | (11.620) | (10.812) | (19.167) |
| Other consumer loans | | | -63.106*** | -67.709*** | -54.509*** | -53.905*** | -54.258*** | -45.243*** | -45.078*** | -34.291** | -37.861*** |
| | | | (8.749) | (9.973) | (10.805) | (10.353) | (10.466) | (11.060) | (10.654) | (10.619) | (11.343) |
| All other loans | | | -69.382*** | -74.193*** | -59.828*** | -61.058*** | -60.776*** | -52.092*** | -51.257*** | -41.791*** | -60.073*** |
| | | | (8.442) | (9.793) | (10.711) | (10.216) | (10.442) | (10.901) | (10.321) | (10.233) | (13.084) |
| Trading assets | | -2.154 | -2.418 | -1.657 | -3.909 | -12.428 | -10.508 | -5.105 | -3.128 | -1.641 | -9.133 |
| | | (18.177) | (18.105) | (17.966) | (17.525) | (16.434) | (16.871) | (18.359) | (17.552) | (18.084) | (33.833) |
| Federal funds and repurchase agreements | | -20.466* | -18.125 | -22.468* | -17.305 | -19.636* | -18.727* | -18.063 | -16.537 | -15.062 | -16.323* |
| | | (9.526) | (9.598) | (9.278) | (9.253) | (9.194) | (9.378) | (9.220) | (8.875) | (8.654) | (7.514) |
| Investment securities | | -44.233*** | -46.246*** | -47.976*** | -35.704*** | -36.532*** | -36.918*** | -35.623*** | -32.975*** | -29.990*** | -28.246*** |
| | | (7.538) | (7.420) | (7.135) | (7.792) | (7.487) | (7.660) | (7.625) | (7.248) | (7.193) | (6.448) |
| Other real estate owned | | 511.223*** | 516.118*** | 218.441*** | 224.027*** | 227.645*** | 228.260*** | 224.115*** | 223.890*** | 248.885*** | 264.291*** |
| | | (59.960) | (58.233) | (50.156) | (52.325) | (51.683) | (51.743) | (52.201) | (51.959) | (51.125) | (54.925) |
| Fixed assets | | 195.591*** | 195.896*** | 213.179*** | 182.093*** | 190.166*** | 197.031*** | 187.538*** | 189.759*** | 223.443*** | 289.553*** |
| | | (31.754) | (31.448) | (30.379) | (29.035) | (29.664) | (29.974) | (29.496) | (28.939) | (29.775) | (36.789) |
| Investments in unconsolidated subsidiaries | | -74.519*** | -64.972*** | -56.758*** | -69.983*** | -75.613*** | -74.270*** | -75.580*** | -86.452*** | -81.657*** | 7.582 |
| | | (13.295) | (16.201) | (13.768) | (12.469) | (11.868) | (12.733) | (13.733) | (13.632) | (13.386) | (42.429) |
| Investments in real estate ventures | | -72.295*** | -64.503*** | -54.043*** | -66.178*** | -71.900*** | -70.348*** | -29.115 | -42.377* | -36.690* | 58.462 |
| | | (15.963) | (16.499) | (15.216) | (14.355) | (13.837) | (14.470) | (19.204) | (19.251) | (17.849) | (50.434) |
| Intangible and other assets | | 92.308*** | 90.825*** | 55.478** | 34.231 | 31.273 | 26.103 | 23.238 | 19.702 | 16.813 | 0.999 |
| | | (18.720) | (17.868) | (21.111) | (20.543) | (19.928) | (20.804) | (20.893) | (20.411) | (20.255) | (21.117) |

For the model including all controls but excluding firm fixed effects (specification 10), the coefficient on size of -4.151 implies that a 10 percent increase in size is associated with a 42 basis point decrease in the efficiency ratio, equivalent to 0.6 percent of the sample average efficiency ratio. In dollar terms, the coefficient implies that for a BHC at the mean of the data ($9.1 billion in assets), an increase in size of $1 billion is associated with a reduction in operating expenses of $437,000 per quarter, relative to a counterfactual in which the efficiency ratio is not associated with size. The corresponding

Table 4 (continued)

## BHC Size and the Efficiency Ratio

| | Specification | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| **Revenue composition (percentage of net operating revenue)** | | | | | | | | | | | |
| Trading income | | | | | 49.008 | 45.614 | 47.794 | 44.346 | 30.746 | 46.602 | 35.616 |
| | | | | | (26.304) | (25.079) | (25.203) | (26.351) | (25.803) | (25.765) | (43.903) |
| Noninterest nontrading income | | | | | 19.746*** | | | | | | |
| | | | | | (3.151) | | | | | | |
| Fiduciary income | | | | | | 30.172*** | 29.695*** | 25.165*** | 27.327*** | 24.057*** | 34.635*** |
| | | | | | | (4.570) | (4.580) | (4.793) | (4.822) | (4.718) | (8.471) |
| Investment banking fees | | | | | | 37.832** | 37.510** | 33.487** | 29.794** | 35.915*** | 46.586** |
| | | | | | | (12.036) | (12.140) | (11.527) | (11.075) | (9.925) | (14.453) |
| Service charges on deposits | | | | | | 13.020* | 13.072* | 3.950 | 5.965 | 14.567* | 49.324*** |
| | | | | | | (6.356) | (6.284) | (6.448) | (6.294) | (7.094) | (10.446) |
| Net servicing fees | | | | | | -1.060 | 1.707 | -5.177 | -1.426 | 14.615 | -9.113 |
| | | | | | | (16.367) | (16.477) | (16.582) | (16.699) | (14.275) | (15.153) |
| Other noninterest income | | | | | | 21.814*** | 21.688*** | 20.629*** | 20.181*** | 21.462*** | 0.801 |
| | | | | | | (3.837) | (3.919) | (3.751) | (3.716) | (3.730) | (3.656) |
| **Funding structure** | | | | | | | | | | | |
| Deposits/assets (percent) | | | | | | | -0.497 | -2.194 | -0.643 | -1.061 | 4.577 |
| | | | | | | | (3.119) | (3.075) | (2.980) | (2.903) | (3.770) |
| Public [1=yes] | | | | | | | 1.474* | 1.314* | 1.787** | 1.418* | -0.704 |
| | | | | | | | (0.606) | (0.608) | (0.621) | (0.626) | (1.705) |
| **Business concentration** | | | | | | | | | | | |
| HHI assets | | | | | | | | -10.565* | -9.828* | -10.531** | -10.581* |
| | | | | | | | | (4.220) | (4.093) | (3.907) | (5.091) |
| HHI income | | | | | | | | -8.101** | -7.205* | -8.681** | -8.903** |
| | | | | | | | | (3.023) | (2.934) | (2.902) | (3.447) |
| **Organizational complexity** | | | | | | | | | | | |
| Log number of subsidiaries | | | | | | | | | 1.883*** | 1.771*** | 1.404** |
| | | | | | | | | | (0.395) | (0.396) | (0.534) |
| Percentage of subsidiaries that are foreign | | | | | | | | | -3.813 | -5.668 | 2.694 |
| | | | | | | | | | (5.341) | (5.139) | (8.515) |
| Foreign-owned [1=yes] | | | | | | | | | 14.895*** | 13.512*** | 15.046** |
| | | | | | | | | | (2.481) | (2.436) | (5.529) |
| Constant | 101.061*** | 143.904*** | 146.053*** | 144.782*** | 136.250*** | 138.941*** | 142.911*** | 152.872*** | 161.137*** | 157.186*** | 122.139*** |
| | (3.377) | (8.397) | (8.432) | (8.075) | (8.276) | (8.036) | (9.438) | (9.380) | (9.324) | (9.372) | (19.637) |

calculation for the smaller coefficient from column 2 implies a reduction in operating expenses of $199,000 per quarter.

The final specification in Table 4 includes BHC fixed effects, and thus examines only changes in size within bank holding companies. This within-firm analysis includes both

Table 4 (continued)
## BHC Size and the Efficiency Ratio

| | Specification | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| State fixed effects | | | | | | | | | | Yes | |
| Firm fixed effects | | | | | | | | | | | Yes |
| $R^2$ | 0.080 | 0.195 | 0.207 | 0.247 | 0.258 | 0.261 | 0.262 | 0.264 | 0.271 | 0.296 | 0.549 |
| N | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 |

Source: Authors' calculations.

Notes: The table presents an analysis of the relationship between size, measured by log of total assets, and efficiency ratio, defined as total noninterest expense normalized by net operating revenue. All explanatory variables are lagged by one quarter. Revenue composition variables are the rolling average for the absolute value of the income share over net operating revenue. HHI (Herfindahl-Hirschman Index) assets is the sum of squared asset shares, by asset type, and HHI income is the sum of squared four-quarter rolling average income shares, by income type. See Appendix A for further detail on controls included in the models. Models are estimated with robust standard errors and two-way clustering by firm and quarter. Standard errors are in parentheses.

*** p<0.01
** p<0.05
* p<0.1

size changes from organic growth and size changes from mergers. While still statistically significant, this coefficient is somewhat smaller in magnitude than that of specification 10 (-2.47 compared with -4.15). There is some evidence that noninterest expenses after mergers are inflated by one-time merger related costs (Kwan and Wilcox 2002), which may account for this difference. The standard error of the size coefficient estimate from specification 11 is much larger than in the other specifications; in other words, the coefficients are estimated with lower power, owing to the smaller residual variation in the efficiency ratio not absorbed or accounted for by the fixed effects and other controls.

As expected, observable differences among BHCs explain a significant fraction of the variation in noninterest expenses. Simple asset controls alone more than double the adjusted $R^2$ of the initial specification. However, even the fixed effects specification in column 11 has an $R^2$ of only 54.9 percent, implying a large amount of residual variation in operating costs. Furthermore, the inclusion of BHC fixed effects nearly doubles the $R^2$ relative to specification 10, a result suggestive of large persistent differences in operating costs across observably similar firms. This finding seems consistent with prior literature on X-inefficiency, which shows that many banking firms operate significantly inside the efficient production frontier (see, for example, Berger, Hunter, and Timme [1993]). It is worth noting that BHC size alone explains only a very small fraction (less than 1 percent) of the total variation in noninterest expense in the data, as illustrated graphically in Chart 2.

In sum, Table 4 provides consistent evidence that large BHCs have lower operating costs as measured by the efficiency ratio, although the strength of the relationship is sensitive to the set of controls used. Instead of taking a strong stance on the "appropriate" set of controls, throughout the paper we present results for specifications using controls from columns 1, 2, and 10 from Table 4. A comparison of the results across these specifications enables the reader to observe how the relationship between noninterest expenses and size is influenced by the inclusion or exclusion of controls for the mix of BHC assets and business activities.

Although our main focus is on the relationship between operating costs and firm size, estimates for several of the controls included in Table 4 are also of independent interest. In particular, BHC organizational complexity, measured by the log number of subsidiaries, is associated with higher noninterest expense ratios. BHCs with a foreign parent also have higher expenses. Proxies for greater organizational focus are associated with lower noninterest expense: BHCs that have more concentrated asset portfolios and more concentrated sources of noninterest income have lower expenses, all else equal, although the marginal explanatory power of additional concentration is relatively low. Each of these relationships is robust to the inclusion of BHC fixed effects (column 11). Although not shown in Table 4, these relationships are also robust to specification changes that allow for a more flexible linkage between size and the efficiency ratio. This finding suggests that our results are not likely to be driven only by the largest BHCs.

Caution should be exercised in applying a causal interpretation to these associations, given that we do not have a convincing econometric instrument for organizational complexity or focus. But taken at face value, each of these estimates implies that complex, diversified firms have higher operating expenses than focused or organizationally simple firms, consistent with the conclusions of prior literature on the diversification discount in banking (Goetz, Laeven, and Levine 2013; Laeven and Levine 2007).

## 4.2 Other Functional Forms

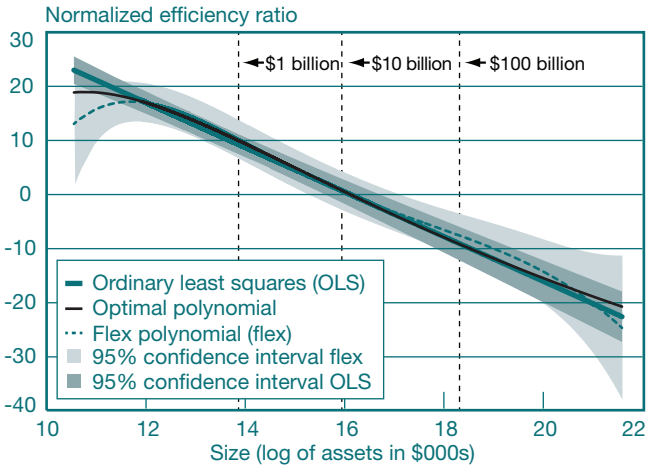
The specifications so far assume a log-linear relationship between BHC size and the efficiency ratio. Next we allow for a more flexible functional form by estimating fractional polynomial specifications that permit the data to determine the shape of the relationship between size and the NIE ratio. An alternative to regular polynomials, fractional polynomials provide flexible parameterization for continuous variables. We use the Stata function *fracpoly* to determine an optimal polynomial specification (optimal polynomial) and also estimate a specification with exponents ranging from -2 to 2—that is, log assets raised to the -2, -1, 0, 1, and 2 power (flex polynomial). These best-fit polynomials are shown in Chart 3 along with the ordinary least squares line of best fit.

Overall, the log-linear functional form assumed in Table 4 appears to be a good approximation, although we note that, based on point estimates, the point-estimated relationship between log assets and the efficiency ratio is somewhat concave at the tails. Specifically, the relationship between BHC size and the NIE ratio is relatively flat among small BHCs (those with assets below $150 million), while the relationship is steeper among the largest BHCs (those with assets above $750 billion). For the vast range of asset sizes, the relationship between log size and efficiency ratio is close to linear, and the 95 percent confidence interval of the alternative forms is very similar. Thus, we use a log-linear specification for the remainder of the analysis.

In addition to investigating flexible polynomial specifications, we separate the sample into different size cohorts, re-sorted in each quarter, and estimate separate specifications for each cohort. This approach allows the relationship between NIE and control variables, as well as size, to vary by BHC size class. (In the fractional polynomial approach, the coefficients on explanatory variables other than size are unrelated to size.) Each column of Table 5 represents specifications 1, 2, and 10 of Table 4 estimated on a subset of the BHCs sorted by size in each year. The first column replicates the results on the entire sample, for comparison. Without including controls for BHC asset mix, it appears that much of the coefficient on size is driven by BHCs below the median asset size (column 6). As additional controls are included, economies of scale become apparent in many of the size cohorts. In the specification including all controls, the estimated coefficient on size is negative in all cohorts and statistically significant. As suggested by the flexible polynomial specifications, the point estimate coefficient on size is largest in the top 1 percent of the sample.

What do these findings imply for the policy debate around size limits for the largest BHCs? We find no evidence that the inverse relationship between size and operating costs disappears above any particular size threshold; indeed, our point estimates suggest that, if anything, the relationship is steeper among the largest firms. This result is consistent with scale economies from sources other than bargaining power to the extent that we believe that differences in bargaining power may be small within the top 1 percent of BHCs. The statistical precision of our estimates is limited, however, given the small number of observations for the largest BHCs.

Chart 3
### Efficiency Ratio and BHC Size, Flexible Functional Forms




Source: Authors' calculations, based on statistical analysis of FR Y-9C data.

Note: Functional forms are partial predictions based on varying log of assets ($000s), holding other covariates fixed at their sample means. The efficiency ratio is normalized to be equal to zero for a bank holding company with $10 billion in assets.

Table 5
Coefficient on Log Assets, by Size Cohort

| | (1) | (2) | (3) | (4) | (5) | (6) | |
|---|---|---|---|---|---|---|---|
| | All | Top 1% | 95-99% | 75-95% | 50-75% | Bottom 50% | Controls |
| Table 4, Specification (1) | -1.320*** | 1.860 | 1.273 | -1.790** | -0.768 | -6.140*** | Time fixed effects |
| | (0.235) | (1.647) | (1.164) | (0.687) | (1.509) | (1.633) | |
| Table 4, Specification (2) | -1.892*** | -2.864 | -0.379 | -1.888** | -1.914 | -3.195* | Asset shares |
| | (0.228) | (2.020) | (1.278) | (0.674) | (1.352) | (1.334) | |
| Table 4, Specification (10) | -4.151*** | -8.018* | -5.138*** | -4.132*** | -4.238*** | -5.055*** | All controls |
| | (0.326) | (3.931) | (1.442) | (0.696) | (1.204) | (1.311) | |
| N | 58,217 | 604 | 2,405 | 12,197 | 15,181 | 27,830 | |

Source: Authors' calculations.

Notes: The table presents an analysis of the relationship between size, measured by the log of total assets (lagged by one quarter), and efficiency ratio, defined as total noninterest expense as a percentage of net operating revenue. Each row represents the coefficient on size for specifications (1), (2), and (10) of Table 4, estimated on a subset of bank holding companies sorted by size in each quarter. Specification (1) includes time fixed effects. Specification (2) includes time fixed effects as well as controls for the percentage of assets in each broad category (asset shares). Specification (10) includes the controls from specification (2) as well as controls for types of loans, revenue composition, funding structure, business concentration, organizational complexity, and headquarters state fixed effects. Robust standard errors reported in parentheses are clustered by bank holding company and quarter.

*** p<0.01
** p<0.05
* p<0.1

## 4.3 Alternative Measures of Operating Costs

The efficiency ratio may be distorted in periods when net operating income is temporarily low.[11] Next, we test the sensitivity of our results to other normalizations of noninterest expense: the expense asset ratio discussed in Section 3 (NIE / total assets), NIE / risk-weighted assets, and a "cash" efficiency ratio, which excludes noncash expenses such as goodwill amortization in the numerator. We do this because noncash expenses are often associated with one-time costs relating to mergers and acquisitions that are not likely to persist, and may be associated with size. We also estimate a specification using the log of noninterest expense as an alternative measure of operating costs.

As before, for each normalization of NIE, we re-estimate specifications with the set of right-hand-side variables from columns 1, 2, and 10 of Table 4 and present the coefficient on asset size. Results are presented in Table 6. Regardless of the normalization used, the coefficient on size is negative and statistically significant once BHC controls are included. In the specification including all controls, the estimated coefficient on size is approximately 7 to 10 percent of the average expense ratio.

For the specifications using the log of noninterest expense as the dependent variable, the coefficient on log assets can be directly interpreted as the *elasticity* of operating costs with respect to size. In line with our other results, this elasticity is less than unity—in other words, a 10 percent change in BHC size is associated with a less than 10 percent change in NIE operating costs, a finding consistent with the presence of scale economies in operating costs. For the specification including all controls, the operating cost elasticity is 0.899, much smaller than one, although it is significantly closer to one for the specification just including asset controls (0.979). Both these estimates are statistically significantly smaller than unity.

## 5. Decomposition of Noninterest Expense

This section examines the relationship between BHC size and components of noninterest expense. First, we consider the five major components of noninterest expense reported in the Y-9C income statement. Probing more deeply, we then analyze

[11] During the 2007-08 financial crisis, trading losses and other losses brought net operating income close to zero for several large BHCs.

Table 6

## Alternative Measures of Operating Costs

| | Noninterest Expense/ Risk-Weighted Assets | | | Noninterest Expense/ Assets | | | Cash Noninterest Expense/ Net Revenue (Cash Efficiency Ratio) | | | Log Noninterest Expense | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Table 4, Specification: | (1) | (2) | (10) | (1) | (2) | (10) | (1) | (2) | (10) | (1) | (2) | (10) |
| Log assets | 0.007 | -0.044*** | -0.115*** | 0.003 | -0.018** | -0.083*** | -1.686*** | -2.239*** | -4.339*** | 0.993*** | 0.979*** | 0.899*** |
| | (0.010) | (0.011) | (0.013) | (0.006) | (0.007) | (0.009) | (0.231) | (0.217) | (0.303) | (0.007) | (0.007) | (0.008) |
| Asset share controls | | Yes | Yes | | Yes | Yes | | Yes | Yes | | Yes | Yes |
| All controls | | | Yes | | | Yes | | | Yes | | | Yes |
| $R^2$ | 0.016 | 0.231 | 0.487 | 0.007 | 0.171 | 0.430 | 0.078 | 0.208 | 0.325 | 0.935 | 0.949 | 0.968 |
| N | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,217 | 58,192 | 58,192 | 58,192 |

Source: Authors' calculations.

Note: The table presents an analysis of the relationship between size, measured by the log of total assets (lagged by one quarter), and different measures of efficiency. The dependent variables in the first three specifications are cash efficiency ratio, defined as total noninterest expense less goodwill impairment and amortization expense over net operating revenue; in the next three specifications, NIE/assets ratio, defined as total noninterest expense (NIE) over total assets; and in the final three specifications, NIE/RWA ratio, defined as total noninterest expense over total risk-weighted assets (RWA). For each alternative measure of efficiency ratio, specifications (1), (2) and (10) of Table 4 are presented. Specification (1) includes controls for quarter fixed effects. Specification (2) includes the controls from specification (1) as well as controls for the percentage of assets in each broad category. Specification (10) includes the controls from specification (2) as well as controls for types of loans, revenue composition, funding structure, business concentration, organizational complexity, and headquarters state fixed effects. Models are estimated with robust standard errors and two-way clustering by firm and quarter.

*** p<0.01
** p<0.05
* p<0.1

the nine subcomponents of "other noninterest expense," using our manual classification of these expenses as described in Section 3.

One goal of this disaggregated analysis is to shed additional light on the sources of the lower operating costs enjoyed by large BHCs. Although these lower costs could be due to scale economies or other efficiency benefits of size, they could also reflect implicit government guarantees for large BHCs, or the greater bargaining power of these firms. For example, large banks may endogenously select riskier activities, but invest less in risk management because of implicit insurance associated with being "too big to fail." Alternatively, large banks may simply take advantage of greater bargaining power to reduce expenses. These different explanations have very different normative welfare implications. Efficiency benefits of size imply that limiting size would impose deadweight economic costs, while explanations relating to bargaining power and TBTF primarily relate to the allocation of economic rents. Although the breakdown of expenses in the Y-9C does not allow us to fully disentangle these different explanations, we are able to draw some suggestive conclusions.

### 5.1 Major Components of Noninterest Expense

We begin by studying the five expense categories reported on Schedule HI: compensation (49.4 percent of noninterest expense), premises and fixed assets expense (11.6 percent), goodwill impairment (1.8 percent), amortization (1.9 percent), and other (35.0 percent). Results are presented in Table 7. As before, we normalize each expense by net operating revenue, and for parsimony, focus on the coefficient on log assets for specifications 1, 2, and 10 from Table 4.

Each of the three largest categories of noninterest expense declines as a percentage of net revenue as size increases, all else equal, with or without the inclusion of controls for BHC characteristics. The final column of the table presents the estimated coefficient scaled by the mean of the dependent variable in question (that is, an elasticity of the component efficiency ratio with respect to firm size). Focusing on the specifications including these controls (either for asset composition alone, or for all controls), we find that the inverse relationship between BHC size and scaled noninterest expense is steepest for compensation, followed by other noninterest expense, based on this calculated elasticity. For the specifications including

Table 7

## Bank Holding Company Size and the Efficiency Ratio, by Component of Noninterest Expense

| | Table 4 Specification | Log Assets | Standard Error | Significance Level | Adjusted $R^2$ | Mean (Percent) | Controls | Coefficient/ Mean (Percent) |
|---|---|---|---|---|---|---|---|---|
| Total noninterest expense | 1 | -1.320 | (0.235) | *** | 0.080 | | Time FE | -1.99 |
| | 2 | -1.892 | (0.228) | *** | 0.195 | 66.32 | Asset shares | -2.85 |
| | 10 | -4.151 | (0.326) | *** | 0.296 | | All | -6.26 |
| **Components of noninterest expense** | | | | | | | | |
| Compensation | 1 | -1.135 | (0.126) | *** | 0.048 | | Time FE | -3.50 |
| | 2 | -1.472 | (0.133) | *** | 0.103 | 32.44 | Asset shares | -4.54 |
| | 10 | -2.385 | (0.175) | *** | 0.242 | | All | -7.35 |
| Premises and fixed assets | 1 | -0.265 | (0.045) | *** | 0.025 | | Time FE | -3.47 |
| | 2 | -0.103 | (0.048) | * | 0.135 | 7.64 | Asset shares | -1.35 |
| | 10 | -0.365 | (0.073) | *** | 0.257 | | All | -4.78 |
| Other | 1 | -0.283 | (0.127) | * | 0.111 | | Time FE | -1.22 |
| | 2 | -0.658 | (0.125) | *** | 0.256 | 23.20 | Asset shares | -2.84 |
| | 10 | -1.585 | (0.167) | *** | 0.354 | | All | -6.83 |
| Amortization expense | 1 | 0.181 | (0.016) | *** | 0.077 | | Time FE | 14.00 |
| | 2 | 0.164 | (0.018) | *** | 0.106 | 1.29 | Asset shares | 12.68 |
| | 10 | 0.159 | (0.024) | *** | 0.163 | | All | 12.29 |
| Goodwill impairment | 1 | 0.044 | (0.015) | ** | 0.031 | | Time FE | 3.01 |
| | 2 | 0.042 | (0.014) | ** | 0.032 | 1.46 | Asset shares | 2.88 |
| | 10 | 0.017 | (0.011) | | 0.039 | | All | 1.16 |
| **Components of other noninterest expense** | | | | | | | | |
| Corporate overhead | 1 | -0.002 | (0.073) | | 0.018 | | Time FE | -0.04 |
| | 2 | -0.212 | (0.063) | *** | 0.074 | 4.77 | Asset shares | -4.45 |
| | 10 | -0.334 | (0.074) | *** | 0.212 | | All | -7.00 |
| Information technology and data processing | 1 | -0.106 | (0.044) | * | 0.006 | | Time FE | -3.28 |
| | 2 | -0.150 | (0.054) | ** | 0.023 | 3.23 | Asset shares | -4.64 |
| | 10 | -0.213 | (0.068) | ** | 0.139 | | All | -6.59 |
| Consulting and advisory | 1 | 0.285 | (0.047) | *** | 0.069 | | Time FE | 9.92 |
| | 2 | 0.208 | (0.053) | *** | 0.097 | 2.87 | Asset shares | 7.24 |
| | 10 | 0.053 | (0.054) | | 0.210 | | All | 1.84 |
| Legal | 1 | 0.006 | (0.035) | | 0.008 | | Time FE | 0.33 |
| | 2 | -0.022 | (0.034) | | 0.141 | 1.79 | Asset shares | -1.23 |
| | 10 | -0.118 | (0.045) | ** | 0.263 | | All | -6.57 |
| Retail banking | 1 | -0.225 | (0.058) | *** | 0.017 | | Time FE | -13.59 |
| | 2 | -0.068 | (0.087) | | 0.108 | 1.66 | Asset shares | -4.11 |
| | 10 | -0.205 | (0.118) | | 0.208 | | All | -12.38 |
| FDIC assessments and other government | 1 | -0.249 | (0.048) | *** | 0.242 | | Time FE | -16.51 |
| | 2 | -0.103 | (0.042) | * | 0.393 | 1.51 | Asset shares | -6.83 |
| | 10 | -0.036 | (0.068) | | 0.536 | | All | -2.39 |
| Other financial services | 1 | 0.038 | (0.019) | * | 0.009 | | Time FE | 4.86 |
| | 2 | -0.022 | (0.011) | | 0.146 | 0.78 | Asset shares | -2.81 |
| | 10 | -0.058 | (0.017) | *** | 0.211 | | All | -7.42 |

Table 7 (continued)

## Bank Holding Company Size and the Efficiency Ratio, by Component of Noninterest Expense

| | Table 4 Specification | Log Assets | Standard Error | Significance Level | Adjusted $R^2$ | Mean (Percent) | Controls | Coefficient/ Mean (Percent) |
|---|---|---|---|---|---|---|---|---|
| Directors' fees and other compensation | 1 | -0.142 | (0.012) | *** | 0.095 | | Time FE | -221.31 |
| | 2 | -0.182 | (0.015) | *** | 0.139 | 0.06 | Asset shares | -283.65 |
| | 10 | -0.190 | (0.019) | *** | 0.259 | | All | -296.12 |
| Miscellaneous | 1 | 0.026 | (0.014) | | 0.002 | | Time FE | 5.62 |
| | 2 | 0.017 | (0.017) | | 0.010 | 0.46 | Asset shares | 3.68 |
| | 10 | -0.004 | (0.022) | | 0.042 | | All | -0.87 |
| Unclassified other noninterest expenses | 1 | -0.129 | (0.115) | | 0.004 | | Time FE | -1.48 |
| | 2 | -0.063 | (0.102) | | 0.147 | 8.72 | Asset shares | -0.72 |
| | 10 | -0.289 | (0.134) | * | 0.229 | | All | -3.32 |

Source: Authors' calculations.

Notes: The table presents an analysis of the relationship between size, measured by the log of total assets (lagged by one quarter), and the components of noninterest expense normalized by net operating revenue. The first nineteen rows present the specifications for NIE and its large components: compensation, premises and fixed assets, other, amortization expense, and goodwill impairment. The remaining rows present three specifications each for the nine subcomponents of other, as well as for unclassified expense, the total other noninterest expense less the nine constructed components of other noninterest expense. All noninterest expense components are normalized by net operating revenue. Each row presents specifications (1), (2), and (10) of Table 4 for each main component of noninterest expense. Specification (1) includes time fixed effects. Specification (2) includes time fixed effects as well as controls for the percentage of assets in each broad category (asset shares). Specification (10) includes the controls from specification (2) as well as controls for types of loans, revenue composition, funding structure, business concentration, organizational complexity, and headquarters state fixed effects. See Appendix A for further detail. The sample mean for each component is presented, and the final column is the estimated coefficient on size normalized by the sample mean for the NIE component. Robust standard errors reported in parentheses are clustered by BHC and quarter. FE is fixed effects; FDIC is Federal Deposit Insurance Corporation.

*** p<0.01
** p<0.05
* p<0.1

all controls, a 10 percent increase in size is associated with a 0.735 percent decline in compensation scaled by net operating revenue and a 0.683 percent decline in the corresponding ratio for other noninterest expense. The result for employee compensation is perhaps surprising, given that large BHCs have more employees in highly compensated roles such as investment banking and trading. However, the higher productivity and additional revenue earned by these employees (the denominator of the efficiency ratio) appears to offset this higher compensation.

Expenses related to premises and fixed assets may represent a category of operating costs for which scale efficiencies are lower (for example, building lease costs are roughly proportionate to the size of the leased space, at least within a specific geographic area). Given this, it is perhaps unsurprising that estimated economies of scale are smaller for premises and fixed assets expense: for this category, our point estimate implies that a 10 percent increase in size is associated with a 0.478 percent decline in expenses scaled by operating revenue.

Significantly, expenses related to the impairment and amortization of goodwill and other intangible assets are actually proportionately *higher* for large firms—a fact that distinguishes these expenses from the other categories. We estimate a positive, statistically significant (in most specifications) coefficient on these expenses. The likely key reason for this finding is that large BHCs often have grown by way of acquisitions, which will sometimes result in goodwill when the acquisition purchase price exceeds the tangible book value of assets purchased. Consequently, these firms report higher expenses related to the amortization or impairment of these assets. Although the positive slope for these two expense categories is economically significant, the two categories together make up only a relatively small proportion (3.7 percent) of total industry NIE.

## 5.2 Subcomponents of Other Noninterest Expense

In this section, we examine the nine subcomponents of "other NIE" identified in section 3.2. (Recall that these categories reflect both standardized memoranda items reported on the Y-9C since 2008 and "write-in" text strings classified by us.) Previous work estimating scale curves for these disaggregated categories has been based on case studies or has had limited sample size (for example, Clearing House Association [2012]).

Overall, we find evidence that scaled expense falls with size for most, but not all, components of other noninterest expense, especially after including controls for BHC asset and income composition. When controls for the composition of assets and income sources are included in the specification, large BHCs exhibit lower expenses in categories in which a fixed cost can be spread across an expanded scale of operations, such as corporate overhead, information technology, and data processing.

The lower part of Table 7 presents results for the other NIE components, listed in descending order of size. Corporate overhead is the largest component of other noninterest expense, and a component for which we estimate significant scale efficiencies (a high estimated coefficient on size relative to mean level of expense). Corporate overhead includes expenses such as accounting and auditing, advertising and marketing, treasury expenses, travel and business development, charitable donations, insurance, and utilities. These expenses appear to have significant operational leverage; the estimated coefficient on size is -0.33, approximately 7 percent of the mean level of corporate overhead expenses.

Similar scale economies are observed for expenses associated with information technology and data processing, with an estimated coefficient on size that is -6.6 percent of mean IT expense. This finding is consistent with the view that spreading overhead expenses associated with technology may be one source of cost advantage for large banking firms.

In contrast to these two categories, we find that expenses associated with consulting and advisory services are proportionately *higher* for large BHCs. Prior to adding controls for BHC characteristics, our estimates show that the coefficient on size and consulting expenses is positive and statistically significant. This coefficient remains significant when asset composition controls are included, although once all controls are included, the coefficient is positive but no longer statistically significant. This suggests that consulting and advisory services may be related to noninterest income, rather than to the composition of BHC assets. Despite recent publicity surrounding large BHCs' legal issues and large-dollar-value settlements, over the 2008-12 period, legal expenses also increase less than proportionately with BHC size, particularly in the specification including the full set of controls (specification 10 from Table 4). This expense category includes both legal fees and retainers paid for legal services performed, as well as expenses associated with legal settlements and reserves, to the extent we can identify these expenses from the write-in text fields. Some part of this finding may reflect the fact that small banks may lack internal legal departments, for which expenses would be recorded as part of compensation, and thus have higher external legal fees.

The assignment of write-in fields to retail banking requires perhaps the most judgment on our part. This category includes collection expenses, credit reports, mortgage-related expenses such as appraisal and title fees, branch expenses, checks, lockboxes, and robbery, among many others. After including asset composition controls, the estimated coefficient remains negative although not statistically significant. This result may reflect the wide variation in the types of retail banking businesses that are not well captured by our BHC characteristics. Alternatively, economies of scale may be limited or not present for branch banking (at least among the set of expenses classified into this category), since many costs only scale until the next branch is opened.

Similarly, we find a negative but statistically insignificant relationship between size and normalized FDIC assessments and other government-related expenses after including the full complement of BHC characteristics. The majority of the expenses in this line item are due to deposit insurance, and thus it would be surprising to uncover economies of scale once we control for the amount of deposit financing. This coefficient would likely shrink further if our regression specification included a control for the fraction of insured deposits, rather than total deposits.

The category "other financial services" represents the sum of expenses associated with BHCs' non-banking businesses, such as asset management, trust and custody services, and insurance. Given likely differences in the noninterest expenses of these businesses, it is not surprising that the estimated coefficient changes sign from positive to negative once we control for the composition of BHCs' assets and noninterest income. Banking firms that earn a high percentage of income from fee income should naturally have higher expenses. But holding all else equal and controlling for income composition, we find that larger BHCs have *lower* scaled expenses in this category: we estimate a coefficient of 7.4 percent of the mean value. This result is consistent with cost economies of scale in noncompensation expenses associated with businesses such as insurance and asset management.

The component of other noninterest expense for which scale economies are largest in percentage terms is directors' fees and other compensation. For this category, the coefficient on size is almost three times as large as the sample mean. This makes intuitive sense; even though directors of large BHCs have higher compensation, board size does not increase dramatically with firm size. This coefficient is negative and significant regardless of the set of controls used.

Miscellaneous expenses include items as varied as expenditures for cattle feed and reducing gold to market. It also includes nonspecific write-in text fields such as "miscellaneous expense," "miscellaneous fee," and "other expense." Regardless of the controls for bank businesses used, we do not see economies of scale in these varied expenses, although some economies may exist in the residual category "other expenses," which includes all noninterest expenses not otherwise classified.

## 6. Conclusion

We find a robust inverse relationship between the size of bank holding companies and scaled measures of operating costs. Quantitatively, a 10 percent increase in assets is associated with a 0.3 to 0.6 percent decline in noninterest expense scaled by income or assets, depending on the specification. In dollar terms, our estimates imply that for a BHC of mean size in our sample, an additional $1 billion in assets reduces noninterest expense by $1 million to $2 million per year, relative to a base case where operating cost ratios are unrelated to size. This inverse relationship is robust to various changes in model specification, although the magnitude of the relationship is sensitive to the set of controls used.

Unpacking our results, we find that while size is associated with lower scaled operating costs for most components of noninterest expense, the largest contributions in dollar terms come from employee compensation, premises and fixed assets, corporate overhead, and information technology and data processing. While not a large component of total noninterest expense, directors' fees and other compensation account for the largest proportionate savings, presumably a reflection of the fact that corporate boards do not expand with firm size, even if their members are better paid on average.

Our results likely reflect a combination of three factors: First, large BHCs benefit from "operational leverage" or economies of scale, whereby they effectively spread costs over a higher revenue or asset base. Second, "X-efficiency"—a factor closely related to operational leverage—may be higher for large BHCs; that is, these firms may operate closer to the production frontier on average. Third, large BHCs may have greater bargaining power than smaller firms with suppliers or employees. We are not able to pin down with confidence the relative contribution of these three factors. We emphasize, however, that the inverse relationship between BHC size and scaled measures of NIE is not limited to particular components of expense or particular segments of the BHC size distribution.

Consistent with recent research that identifies the presence of scale economies in banking, our results suggest that imposing size limits on banking firms would be likely to involve real economic costs. Although the limitations of our econometric methodology must be borne in mind, a back-of-the-envelope calculation applied to our estimates implies that limiting BHC size to be no larger than 4 percent of GDP would increase total noninterest expense by $2 billion to $4 billion per quarter. These costs should be weighed against the potential benefits of size limits as policymakers address the "too-big-to-fail" problem.

# Appendix A: Variable Definitions

## Income Statement Variables

| Variable | Definition | Y-9C Mnemonic Construction/Variable Source |
|---|---|---|
| Net interest income | | bhck4074 [1981:Q2 - present] |
| Noninterest income | | bhck4079 [1981:Q2 - present] |
| Trading revenue | Includes the net gain or loss from trading cash instruments and off-balance-sheet derivative contracts (including commodity contracts) that has been recognized during the calendar year-to-date | bhcka220 [1996:Q1 - present] |
| Fiduciary income | Includes income from fiduciary activities, fees and commissions from annuity sales, underwriting income from insurance and reinsurance activities, and income from other insurance activities | bhck4070 + bhckb494 [2001:Q1 - 2002:Q4], bhck4070 + bhckc386 + bhckc387 [2003:Q1 - 2006:Q4], bhck4070 + bhckc887 + bhckc385 + bhckc387 [2007:Q1 - present] |
| Investment banking income | Includes venture capital revenue, fees and commissions from securities brokerage, and investment banking, advisory, and underwriting fees and commissions | bhck b491 + bhckb490 [2001:Q1 - 2006:Q4], bhckb491 + bhckc886 + bhckc888 [2007:Q1 - present] |
| Service charges on deposits | Service charges on deposit accounts in domestic offices | bhck4884 [1981:Q2 - present] |
| Net servicing fees | Includes income from servicing real estate mortgages, credit cards, and other financial assets held by others | bhckb492 [2001:Q1 - present] |
| Other income | Total noninterest income not accounted for in the five categories listed above | Derived |
| Net operating revenue | Net interest income plus noninterest income | bhck4074 + bhck4079 [1981:Q2 - present] |
| Noninterest expense | | bhck4093 [1981:Q2 - present] |
| Compensation | Salaries and employee benefits | bhck4135 [1981:Q2 - present] |
| Premises and fixed assets | | bhck4217 [1981:Q2 - present] |
| Amortization expense | Amortization expense and impairment losses for other intangible assets | bhckc232 [2002:Q1 - present] |
| Goodwill impairment | Goodwill impairment losses | bhckc216 [2002:Q1 - present] |
| Other | Total noninterest expense not accounted for in the four categories listed above | Derived |
| Data processing expenses | Eleven standardized other noninterest expense items reported in Schedule HI: Memoranda of the FR Y-9C beginning either in 2002 or in 2008. BHC filers only report amounts greater than $25,000 that exceed 3 percent of total other noninterest expense | bhckc017 [2002:Q1 - present] |
| Advertising and marketing expenses | | bhck0497 [2002:Q1 - present] |
| Directors' fees | | bhck4136 [2002:Q1 - present] |
| Printing, stationery, and supplies | | bhckc018 [2002:Q1 - present] |
| Postage | | bhck8403 [2002:Q1 - present] |
| Legal fees and expenses | | bhck4141 [2002:Q1 - present] |
| FDIC deposit insurance assessment | | bhck4146 [2002:Q1 - present] |
| Accounting and auditing expenses | | bhckf556 [2008:Q1 - present] |
| Consulting and advisory expenses | | bhckf557 [2008:Q1 - present] |
| ATM and interchange expenses | | bhckf558 [2008:Q1 - present] |
| Telecommunications expenses | | bhckf559 [2008:Q1 - present] |
| TEXT8565 | Description of the "write-in" components of other noninterest expense. BHCs only report amounts that exceed 10 percent of total other noninterest expense | bhck8565 [1994:Q1 - present] |
| TEXT8566 | | bhck8566 [1994:Q1 - present] |
| TEXT8567 | | bhck8567 [1994:Q1 - present] |

## Consolidated Balance Sheet Variables

| Variable | Definition | Y-9C Mnemonic Construction/Variable Source |
|---|---|---|
| Total assets | | bhck2170 [1991:Q1 - present] |
| Total loans | | bhck2122 [1991:Q1 - present] |
| Residential real estate loans | The sum of 1) all other loans secured by one-to-four-family residential properties: secured by first liens; 2) all other loans secured by one-to-four-family residential properties: secured by junior liens; 3) revolving, open-end loans secured by one-to-four-family residential properties and extended under lines of credit | bhdm1797 + bhdm5367 + bhdm5368 [1991:Q1 - present] |
| Commercial real estate loans | The sum of 1) one-to-four-family residential construction loans; 2) other construction loans and all land development and other land loans; 3) real estate loans secured by multifamily (five or more) residential properties; 4) loans secured by owner-occupied nonfarm nonresidential properties; 5) loans secured by other nonfarm nonresidential properties | bhdm1415 + bhdm1460 + bhdm1480 [1990:Q3 - 2006:Q4], bhckf158 + bhckf159 + bhdm1460 + bhckf160 + bhckf161 [2007:Q1 - present] |
| Credit card loans | Loans to individuals for household, family, and other personal expenditures (that is, consumer loans). Includes purchased paper: credit cards | bhck2008 [1991:Q1-2000:Q4], bhckb538 [2001:Q1 - present] |
| Other consumer loans | The sum of 1) loans to individuals for household, family, and other personal expenditures—that is, consumer loans (includes purchased paper): other revolving credit plans; 2) automobile loans to individuals for household, family, and other personal expenditures—that is, consumer loans (includes purchased paper); 3) other consumer loans to individuals, for household, family, and other personal expenditures (includes single payment, installment, and all student loans) | bhck2011 [1991:Q1 - 2000:Q4], bhck2011 + bhckb539 [2001:Q1 - 2010:Q4], bhckb539 + bhckk137 + bhckk207 [2011:Q1 - present] |
| All other loans | Total loans minus the sum of residential real estate loans, commercial real estate loans, credit card loans, and other consumer loans | derived |
| Cash and balances due from depository institutions | The sum of 1) non-interest-bearing balances and currency and coin; 2) interest-bearing balances in U.S. offices; 3) interest-bearing balances in foreign offices, edge and agreement subsidiaries, and international banking facilities | bhck0081 + bhck0395 + bhck0397 [1991:Q1 - present] |
| Trading assets | Assets held in trading accounts include but are not limited to U.S. Treasury securities; U.S. government agency and corporation obligations; securities issued by states and political subdivisions in the United States; other bonds, notes, and debentures; certificates of deposit; commercial paper; and bankers acceptances. Assets held in trading accounts also include the amount of revaluation gains from the "marking to market" of interest rate, foreign exchange rate, and other off-balance-sheet commodity and equity contracts held for trading purposes | bhck2146 [1981:Q2 - 1994:Q4], bhck3545 [1995:Q1 - present] |
| Federal funds and repurchase agreements | The sum of 1) outstanding amount of federal funds sold—that is, immediately available funds lent (in domestic offices) under agreements or contracts that have an original maturity of one business day or roll over under a continuing contract, excluding such funds lent in the form of securities purchased under agreements to resell and overnight lending for commercial and industrial purposes; 2) securities resale agreements, regardless of maturity, if the agreement requires the bank to resell the identical security purchased or a security that meets the definition of substantially the same in the case of a dollar roll, and purchases of participations in pools of securities, regardless of maturity | bhck1350 [1981:Q2 - 1988:Q1][1997:Q1 - 2001:Q4], bhck0276 + bhck0277 [1988:Q2 - 1996:Q4], bhdmb987 + bhckb989 [2002:Q1 - present] |
| Investment securities | Held-to-maturity securities (at amortized cost) plus available for sale securities (at fair value) | bhck0390 [1981:Q2 - 1993:Q4], bhck1754 + bhck1773 [1994:Q1 - present] |
| Other real estate owned | The book value (not to exceed fair value), less accumulated depreciation, if any, of all real estate other than bank premises actually owned by the bank and its consolidated subsidiaries. | bhck2150[1981:Q2-1990:Q2][2001:Q1 - present], bhck2744 + bhck2745 [1990:Q3 - 2000:Q4] |
| Premises and fixed assets | | bhck2145 |

## Consolidated Balance Sheet Variables

| Variable | Definition | Y-9C Mnemonic Construction/Variable Source |
|---|---|---|
| Investments in unconsolidated subsidiaries and associated companies | Includes the amount of the bank holding company's investments in subsidiaries that have not been consolidated; associated companies; and corporate joint ventures, unincorporated joint ventures, general partnerships, and limited partnerships over which the bank exercises significant influence (collectively referred to as "investees"). Also includes loans and advances to investees and holdings of their bonds, notes, and debentures | bhck2130 - bhck3656 [1981:Q2 - 2009:Q1], bhck2130 [2009:Q2 - present] |
| Investments in real estate ventures | The book value of direct and indirect investments in real estate ventures | bhck3656 [1981:Q2 - present] |
| Intangible and other assets | Other identifiable intangible assets plus other assets | bhck3165 + bhck2160 + bhck2155 [1985:Q2 - 1991:Q4], bhck3164 + bhck5506 + bhck5507 + bhck2160 + bhck2155 [1992:Q1 - 1998:Q4], bhck0426 + bhck2160 + bhck2155 [2001:Q1 - 2005:Q4], bhck0426 + bhck2160 [2006:Q1 - present] |
| Nonperforming loans | The sum of 1) total loans and leasing financing receivables that are ninety days or more past due and still accruing; 2) total loans and leasing financing receivables in nonaccrual status. | bhck5525 - bhck3506 + bhck5526 - bhck3507 [1990:Q3 - present] |
| Risk-weighted assets | BHC risk-weighted assets net of all deductions | bhcka223 [1996:Q1 - present] |
| Total deposits | 1) Non-interest-bearing deposits 2) total interest-bearing deposits in foreign and domestic offices | bhdm6631 + bhdm6636 + bhfn6631 + bhfn6636 [1981:Q2 - present] |

## Other Characteristics and Organizational Structure Variables

| Variable | Definition | Y-9C Mnemonic Construction/Variable Source |
|---|---|---|
| Public | Dummy=1 if firm has PERMCO, Dummy=0 otherwise | Federal Reserve Bank of New York. 2013. CRSP-FRB Link |
| Number of subsidiaries | Total number of offspring entities whose relationship to the bank holding company is regulated, that is, governed by applicable banking statutes, which are either federal or state banking laws | NIC Top Holder Table: top holder variable rssd9003 |
| Foreign subsidiaries | Total number of offspring entities that are not domiciled in the United States | NIC Country Name Directory: domestic indicator rssd9101 |
| Foreign parent | Dummy=1 if the highest entity in the organization is not domiciled in the United States, Dummy=0 otherwise | NIC Board Derived Items Table: foreign family ID rssd9360 |

Source: Board of Governors of the Federal Reserve System, Microdata Reference Manual.

Note: BHC is bank holding company; FDIC is Federal Deposit Insurance Corporation; CRSP is Center for Research in Securities Prices; NIC is National Information Center.

*Note to Readers:*
*Appendix B, "Additional Materials," is available as a separate file at http://www.newyorkfed.org/research/epr/2014/1412kovn_appendixB.pdf.*

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João A. C. Santos

# Evidence from the Bond Market on Banks' "Too-Big-to-Fail" Subsidy

- Expectations that the government will step in to save the largest banks from failure could create a "subsidy" for these banks by encouraging investors to discount risk when they provide funding.
- A look at bond data over the 1985-2009 period suggests that investors accept lower credit spreads on bonds issued by the largest banks than on bonds issued by small banks.
- The funding advantage enjoyed by the largest banks appears to be significantly larger than that of the largest nonbanks and nonfinancial corporations.
- This evidence is consistent with the idea that "too-big-to-fail" status gives the largest banks a competitive edge.

## 1. Introduction

The idea that some firms may be too big to fail appears to go back as far as 1975 in connection with Lockheed Corporation and the financial difficulties experienced by that firm at the time.[1] It was, however, the demise of Continental Illinois Bank in 1984 that provided solid supporting evidence for this idea.

Continental Illinois, which was the seventh-largest U.S. bank by deposits, experienced runs by large depositors following news it had incurred significant losses in its loan portfolio. Concerns that a failure of Continental Illinois would have significant adverse effects on the banks that had deposits with it led regulators to take the unprecedented action of assuring all of Continental's depositors—large and small—that their

[1] In 2008, in his *New York Times* column on language, William Safire explored the origins of the phrase, citing a 1975 *Business Week* article about Lockheed Corporation that carried the headline "When Companies Get Too Big to Fail" ("Too Big to Fail or to Bail Out?" *New York Times*, April 6, 2008).

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The author thanks Mark Flannery and seminar participants at the Federal Reserve Bank of New York for valuable comments on an earlier draft of this article, and Vitaly Bord for outstanding research assistance. The views expressed in the article are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

money was fully protected.[2] Subsequently, during Congressional hearings on Continental Illinois, the Comptroller of the Currency indicated that the eleven largest banks in the United States were too big to fail and would not be allowed to fail.[3]

The perception that some banks will be rescued because they are too big to fail is important because it can have far-reaching implications. If investors, creditors in particular, believe that certain banks are too big to fail, they will discount risk when providing those banks with funding. This insensitivity of financing costs to risk will encourage too-big-to-fail banks to take on greater risk. The largest banks' risk taking, in turn, will drive the smaller banks that compete with them to take on additional risk as well.[4]

That perception has triggered a large body of research attempting to determine whether bank investors, including depositors, believe that the largest banks are too big to fail, and whether those banks behave differently because they expect to be rescued if they get into financial difficulties. A number of studies have tried to test the too-big-to-fail hypothesis by investigating spreads on bank bonds. Flannery and Sorescu (1996), for example, find that yield spreads on bank bonds were not risk sensitive after the Continental Illinois bailout, suggesting that bond investors believed large banks were too big to fail. However, the authors find that bond spreads came to reflect the specific risks of individual issuing banks starting around 1988 when conjectural guarantees no longer covered (many) bank debentures. Balasubramnian and Cyree (2011) document that the relationship between spread and risk for the largest banks flattened after the rescue of Long-Term Capital Management in 1998. Anginer and Warburton (2014) find a positive relationship between risk and bond spreads in the secondary market but only for mid-size and small institutions. Acharya, Anginer, and Warburton (2013) document that bond credit spreads continued to be less sensitive to risk for the largest financial institutions even after the passage of the Dodd-Frank act.[5] Penas and Unal (2004), in turn, focus on bank mergers. They find that bondholders of medium-sized banks that may push the merging bank into the too-big-to-fail category realize the highest returns around the merger and only these banks benefit from some savings when they issue in the bond market after they merge.

Some studies have considered instead credit default swap (CDS) spreads. Demirguc-Kunt and Huizinga (2010) report that, in countries with weak finances, too-big-to-fail banks could increase their value by downsizing (they are too big to save) while, in stronger regimes, CDS spreads tend to decrease with bank size.[6]

Other studies have focused on support ratings, which attempt to capture the likelihood that the bank will receive government support if it runs into financial difficulties. Rime (2005) shows that proxies for the too-big-to-fail status of a bank, such as size and market share, have a positive effect on a large bank's support rating relative to its stand-alone rating. Haldane (2010) documents that the stand-alone versus support ratings differential was between 1.5 and 4 notches for a sample of U.K. banks, building societies, and global banks between 2007 and 2009. Ueda and Weder di Mauro (2011) in turn report that, for the top forty-five U.S. banks, the mean support rating differential increased from 3.2 in 2007 to 4.1 in 2009, suggesting an increase in the importance of the too-big-to-fail status over that period.

Still other studies have considered the cost of deposits and bank merger premiums. Baker and McArthur (2009), for example, report that the average cost of deposits is lower for large banks. They also report that the difference in the cost of deposits for banks with more than $100 billion in assets and those with less increased in the period from the fourth quarter of 2008 to the fourth quarter of 2009. Jacewitz and Pogach (2013) report that the risk premium on uninsured deposits paid by the largest banks was 15 to 40 basis points lower than at other banks, based on deposit rates offered at the branch level over the 2005-08 time period.

Brewer and Jagtiani (2007), meanwhile, study the purchase premium that acquirers are willing to pay for becoming too big to fail and gaining the presumed benefits of that status. The authors estimate that, over the 1991-2004 period, acquirers in nine mergers were willing to pay about $14 billion in additional premiums in order to become too big to fail.[7]

Lastly, a set of studies has unveiled evidence that banks believed to be too big to fail take on additional risk. Gropp,

[2] Simultaneously, the Federal Reserve Board, the Federal Deposit Insurance Corporation (FDIC), and the Comptroller of the Currency, together with twenty-four U.S. banks, announced a $7.3 billion bailout for Continental Illinois. The rescue package comprised a $2 billion capital injection by the FDIC and the group of twenty-four banks and an unsecured line of credit by the banks of $5.3 billion.

[3] See O'Hara and Shaw (2000) for further details on the Comptroller of the Currency's announcement.

[4] As Hakenes and Schnabel (2010) show, lower financing costs induce large banks to behave more aggressively, increasing competition and decreasing margins and hence charter values for competing banks—developments that push these banks toward higher risk taking. See Gropp, Hakenes, and Schnabel (2011) for evidence of this effect on smaller competing banks.

[5] See Sironi (2003) and Morgan and Stiroh (2005) for further studies of bank bond spreads in Europe and the United States, respectively.

[6] Li, Qu, and Zhang (2011) also consider CDS spreads to investigate whether investors believe the largest U.S. banks are too big to fail.

[7] Molyneux, Schaeck, and Zhou (2010) also investigate the merger premiums, but their analysis is based on a sample of bank mergers and acquisitions in nine European Union economies.

Hakenes, and Schnabel (2011), for example, find support for this conclusion by looking at bank balance sheet data, and Gadanecz, Tsatsaronis, and Altunbas (2012), by looking at bank lending in the syndicated loan market. Brandao Marques et al. (2013) and Afonso, Santos, and Traina (2014), in turn, uncover evidence of bank risk taking by studying various measures of bank risk. These studies are important because they show that too-big-to-fail status does have an effect on banks' policies.

Although this article, like other studies reviewed here, focuses on the primary bond market, our approach differs from that of other researchers who look for evidence of a too-big-to-fail subsidy in bond spreads. Specifically, we ascertain whether investors perceive the largest banks to be too big to fail by investigating whether these banks benefit from a cost advantage when they raise funding in the bond market. We start by examining how the bonds issued by the largest banks over the 1985-2009 period compare with those issued by smaller banks in terms of their credit spreads over Treasury securities of the same maturity, controlling for bond risk and other factors that may affect bond spreads.

The results of this part of our investigation show that the top-five banks by asset size pay significantly lower spreads than their smaller peers. In particular, the spreads of bonds issued by the largest banks are, on average, 41 basis points below the smaller banks' bond spreads, after controlling for bond characteristics, including the credit rating, maturity, and amount of the issue, as well as conditions in the bond market at the time of issue. However, this cost difference does not necessarily imply that investors believe that the largest banks are too big to fail. For example, if the largest banks are better positioned to diversify risk because they offer more products and operate across more businesses (something not fully captured in their credit rating), this advantage could explain part of that difference in the cost of bond financing.

To address this concern, we extend the analysis and compare the largest banks' cost advantage over smaller banks in the bond market with the cost advantages that the large nonbank financial institutions (nonbanks) and the largest nonfinancial corporations enjoy relative to their smaller peers. If what drives the difference in the cost of bond issuance for the largest and smaller banks is a size-specific factor or a perception by investors that the largest firms in general are all too big to fail, then the cost advantage of the largest banks should be similar to the cost advantages possessed by the largest nonbanks and the largest nonfinancial corporations in the bond market. If, however, investors believe that the largest banks are more likely to be considered too big to fail, then the cost advantage of these banks will exceed that of the largest nonbanks and nonfinancial corporations.

The results of this part of our investigation show that the largest nonbanks and the largest nonfinancial corporations pay less than their smaller peers to raise funding in the bond market. However, in contrast to our findings on banks, that discount is generally not statistically different from zero. Given these findings, it is not surprising that our results show that the largest banks enjoy a significantly larger discount than both the largest nonbanks and the largest nonfinancial corporations. The largest banks that issue bonds rated double A and single A—the two main rating categories for these banks' bonds—benefit from a discount (relative to their smaller peers) that is larger by 92 and 16 basis points, respectively, than the discount enjoyed by the largest nonbanks that issue bonds with those same ratings (relative to their smaller peers), though the difference is statistically significant only in the former case. When compared with the largest nonfinancial corporations, the largest banks that issue bonds rated double A and single A benefit from an additional discount of 53 and 50 basis points, respectively, although only the latter difference is statistically significant.

Our finding that the largest banks, the largest nonbanks, and the largest nonfinancial corporations all benefit from a discount relative to their smaller peers in the bond market can be interpreted as some support for the view that the too-big-to-fail status does not apply solely to banks. However, our evidence that the largest banks benefit from a bigger discount than the largest nonbanks and the largest nonfinancial corporations suggests that investors believe that the largest banks are more likely to be rescued if they get into financial difficulties.

The rest of the paper is organized as follows. Section 2 describes the methodology and data sources used and characterizes the sample. Section 3 compares the spreads that the largest banks pay to raise funding in the bond market with those paid by smaller banks. Section 4 conducts a similar exercise for nonbanks and nonfinancial corporations, respectively. Section 5 compares the discount that the largest banks enjoy (relative to their smaller peers) with the discount available to the largest nonbanks and the largest nonfinancial corporations in the bond market. Section 6 summarizes our findings.

## 2. Methodology, Data, and Sample Characterization

### 2.1 Methodology

To ascertain whether too-big-to-fail banks benefit from a discount in the bond market, we begin by estimating the following model of bond spreads on the sample of bonds issued by U.S. banks:

$$SPREAD_i = c + \alpha TOP5_i + \beta BOND_i + \gamma TIME_i + \varepsilon_i,$$

where SPREAD is the bond yield over the Treasury security (with the same maturity as the bond) at the time of the bond origination. TOP5, the key variable of interest, is a dummy variable equal to 1 for bonds issued by the top-five banks (by asset size) in the year. If large banks benefit from a discount in the bond market relative to their smaller peers, then we should find that TOP5 is negative and statistically significant.

We attempt to identify that effect while controlling for a set of bond characteristics, BOND, which includes a dummy variable for the rating of the bond (AAA, AA, A . . .), the log of the size of the bond issue (LAMOUNT), and the maturity of the bond (MATURITY). Everything else equal, we should expect bonds with higher ratings to carry lower spreads. With regard to the size of the bond issue, banks that are more creditworthy usually find it easier to make larger issues, but they may have to offer higher yields to create a sufficiently large demand for their bond issues. So the effect of the size of the bond issue on the spread is ambiguous. Similarly, banks that are more creditworthy may find it easier to issue longer-term bonds, but these bonds tend to carry a higher risk. Finally, we include a set of year-quarter dummy variables to control for any effects that economic conditions at the time of the issue may have on the bond spread.

The large-bank discount identified by the model of bond spreads we presented above may not be solely attributable to a too-big-to-fail subsidy. For example, if bonds of the largest banks are safer in a way that is not captured in their credit ratings, this will lower the coefficient on TOP5; yet it is not the result of investors "offering" a discount to the largest banks because they believe these banks will be protected in the event of financial difficulties. In an attempt to disentangle these effects, we expand the sample to include bonds issued by nonbanks and nonfinancial firms. We then investigate whether the largest banks benefit from a discount relative to their smaller peers and consider how that discount compares with that of the largest nonbank issuers relative to their smaller peers. To that end, we estimate the following model of bond spreads:

$$SPREAD_i = c + \theta TOP5_i + \vartheta BK_i + \alpha BK \times TOP5_i + \delta BOND_i + \beta BK_i \times BOND_i + \gamma TIME_i + \varepsilon_i.$$

This is an extension of the previous model. TOP5 is a dummy variable equal to 1 if the bond issuer is a top-five firm by assets in its group (banks, nonbanks, and nonfinancial corporations). BK is a dummy variable equal to 1 if the bond was issued by a bank. As in the previous model, the key variable of interest is the dummy variable BK × TOP5. This variable will indicate whether the largest banks benefit from a bigger discount in the bond market than the largest nonbank issuers.

We attempt to identify that difference in the cost paid by the largest firms while using the same set of controls we use in our base model of bond spreads. To allow for the possibility that bank bonds are priced differently from the bonds of the remaining firms, we include not only the set of bond controls, BOND, but also its interactions with our bank dummy variable, BK. As in the base model, we include year-quarter dummy variables to control for the potential effects of economic conditions at the time of the bond issue.

Since there are important differences between the two control groups considered, we estimate that model separately on the sample of bonds issued by banks and by nonbanks, and on the sample of bonds issued by banks and by nonfinancial corporations. Finally, since the pool of bonds issued by the largest firms may carry a different level of risk than the set of bonds issued by the remaining firms, we estimate our bond spread model separately for bonds with the same credit rating. In this case, we restrict the sample to bonds most commonly issued by the largest banks, that is, bonds rated single A and those rated double A.

### 2.2 Data

The data for this analysis come from the Securities Data Corporation's Domestic New Bond Issuances (SDC) database and from Compustat. We use the SDC database to obtain information on all bonds issued in the United States, including their maturity and yield at origination, and whether they are callable or convertible or have a floating rate. We also use the SDC database to get information about the identity of the bond issuer.

We complement these data with information on issuers' assets from Compustat and from banks' *Consolidated Reports of Condition and Income* (call reports), which are used to

identify the largest firms among banks, nonbanks, and nonfinancial corporations.

### 2.3 Sample Characterization

To select our sample of bonds, we start out with all the bonds issued in the U.S. bond market by banks, nonbanks, and nonfinancial corporations between 1985 and 2009. We begin in 1985 since the claim that some banks were too big to fail was first made in connection with the demise of Continental Illinois in 1984. Next, we drop the bonds that do not have the information we need to estimate the bond spread model (ex ante yield to maturity, issue date, maturity date, and Standard & Poor's rating). Finally, we drop bonds with "unique" features that affect their pricing (such as floating-rate bonds, as well as callable bonds and convertible bonds). These criteria leave us with a sample of 8,399 bonds, of which 436 were issued by banks, 1,696 were issued by nonbanks, and 6,267 were issued by nonfinancial corporations.

We identify the top-five firms by asset size in each group and isolate their bonds. Of the 436 bonds issued by banks, 243 were issued by the top-five banks. Of the 1,696 bonds issued by nonbanks, 241 were issued by the top-five firms. Lastly, of the 6,267 bonds issued by nonfinancial corporations, 139 were issued by the top-five firms. Table 1 reports the rating distribution of the bonds issued by each of these groups.

Significant differences emerge in the risk profile of the sample of bonds issued by each of the three groups in the sample. For example, only about 16 percent of the bonds issued by banks are rated below investment grade. In the case of bonds issued by nonbanks, that percentage goes up to 20 percent, and it rises further to 33 percent in the case of nonfinancial corporations. These differences are even more striking when we consider the bonds issued by the top-five firms within each group. For example, none of the bonds in the sample issued by the top-five banks are rated below investment grade. It is for this reason that, when comparing the difference in credit spreads at origination across the three groups of firms, we focus on single-A- and double-A-rated bonds, which are the two most populated rating categories among bonds issued by the largest banks.

Table 1
**Ratings Distribution of Bonds in the Sample**

| | Financials | | | | | |
|---|---|---|---|---|---|---|
| | Banks | | Nonbanks | | Nonfinancials | |
| | TOP5 | All Others | TOP5 | All Others | TOP5 | All Others |
| | 243 | 193 | 241 | 1,455 | 139 | 6,128 |
| | Percentage of Bonds by Bond Rating | | | | | |
| AAA | 0.058 | 0.010 | 0.095 | 0.014 | 0.007 | 0.006 |
| AA | 0.152 | 0.150 | 0.320 | 0.086 | 0.266 | 0.035 |
| A | 0.790 | 0.446 | 0.581 | 0.333 | 0.410 | 0.253 |
| BBB | | 0.238 | 0.004 | 0.353 | 0.108 | 0.382 |
| BB | | 0.119 | | 0.058 | 0.007 | 0.130 |
| B | | 0.031 | | 0.054 | 0.007 | 0.116 |
| CCC | | 0.006 | | 0.037 | 0.122 | 0.053 |
| CC | | | | 0.003 | | 0.004 |
| C | | | | 0.002 | | 0.001 |
| D | | | | 0.060 | 0.073 | 0.020 |

Source: Author's calculations.

Notes: Our sample includes 8,399 bonds issued by banks (436), nonbank financial institutions (1,696), and nonfinancial corporations (6,267) over the 1985-2009 time period. TOP5 is a dummy variable for the top-five issuers by asset size. AAA, AA . . . are dummy variables for the S&P rating of the bond.

## 3. Do the Largest Banks Issue Bonds at a Discount?

To ascertain whether the largest banks benefit from a discount in the bond market, we use our model of bond spreads to compare the credit spreads (over Treasuries with the same maturity) on their bonds in the primary market with the spreads on the bonds of the remaining banks. Table 2 reports the results. Model 1 distinguishes the bonds issued by the top-five banks (as measured by asset size) from those issued by the remaining banks, controlling only for the year-quarter when the bond was issued in order to account for the overall macroeconomic effects on the cost to issue in the bond market. According to our results, the largest banks benefit from a discount of 44 basis points relative to the spread paid by the remaining banks to issue in the bond market.

Model 2 shows that when we control for the risk of the bond as determined by its Standard & Poor's rating and for the maturity and size of the bond issue, the discount enjoyed by the largest banks drops to 41 basis points, although it continues to be statistically different from zero. As one would expect, safer bonds carry lower credit spreads, and bonds with longer maturity carry higher credit spreads, probably to compensate investors for the higher risk associated with these bonds. Lastly, our controls show that larger bond issues carry larger

Table 2

## Spreads on Bonds of Banks

| | Model 1: All Bonds | Model 2: All Bonds | Model 3: AA Bonds | Model 4: A Bonds |
|---|---|---|---|---|
| TOP5 | -0.440*** | -0.406*** | -1.208** | -0.308* |
| | (3.48) | (3.01) | (2.13) | (1.84) |
| AAA | | -4.151*** | | |
| | | (7.55) | | |
| AA | | -1.433*** | | |
| | | (5.25) | | |
| A | | -1.064*** | | |
| | | (3.92) | | |
| BBB | | -0.45 | | |
| | | (1.51) | | |
| BB | | -0.39 | | |
| | | (1.40) | | |
| B | | -0.773*** | | |
| | | (3.60) | | |
| MATURITY | | 0.036*** | 0.081** | 0.031*** |
| | | (3.44) | (2.65) | (2.66) |
| LAMOUNT | | 0.250*** | 0.319 | 0.329*** |
| | | (4.24) | (1.13) | (4.03) |
| Constant | 1.620*** | 0.255 | -3.275* | -1.169* |
| | (9.43) | (0.58) | (1.79) | (1.93) |
| Observations | 436 | 436 | 66 | 278 |
| $R^2$ | 0.375 | 0.539 | 0.799 | 0.579 |

Source: Author's calculations.

Notes: The dependent variable in these models is the bond spread in the primary market (computed over the Treasury security with the same maturity as the bond). TOP5 is a dummy variable for the top-five issuers by assets size. AAA, AA . . . are dummy variables for the S&P rating of the bond. Maturity is the maturity of the bond. LAMOUNT is the log of the amount of the issue. Included in all of the models are also year-quarter dummy variables. Models estimated with robust standard errors clustered at the bond issuer. The *t*-statistics are reported in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

yields, suggesting that economies of scale are not prevalent in the bond underwriting business.

As we saw in Table 1, the largest banks issue, on average, safer bonds than their smaller peers—an observation that helps explain part of the discount that these banks enjoy in the bond market, as captured in model 2. To account for this risk difference in the pool of bonds issued by the two groups, we reestimate the bond spread model on bonds with the same credit rating. We limit this exercise to bonds rated double A and single A because they are the ones most commonly issued by the largest banks. Models 3 and 4 of Table 2 report the results of this exercise. The negative coefficient on the dummy variable that isolates the bonds issued by the largest banks, TOP5, in the new models indicates that the largest banks enjoy a discount in the bond market relative to their smaller peers that issue bonds with the same credit rating.

These last findings suggest that the status of too big to fail may give the largest banks a competitive edge by virtue of their ability to raise funding in the bond market at a discount relative to their smaller peers. However, it is possible that the discount enjoyed by the largest banks reflects only their unique ability to diversify risk because of their presence in a larger number of markets—a distinction that is not fully captured in their credit rating. We investigate this possibility next by comparing banks with nonbank financial institutions and with nonfinancial corporations, respectively.

## 4. Do Large Firms Enjoy a Discount in the Bond Market?

To investigate whether the largest firms outside the banking sector also benefit from a discount when they raise funding in the bond market, we repeat the same exercise we conducted for banks, but now for the bonds issued by nonbanks and nonfinancial corporations. The results of this investigation are reported in Tables 3 and 4, respectively.

We find that the largest nonbanks also appear to benefit from a discount relative to their smaller peers when they issue bonds (Table 3). The top-five nonbanks are able to issue bonds with spreads about 79 basis points lower than those issued by their smaller peers (model 1). When we control for the rating of the bond, its maturity, and the size of the issue, that discount comes down to 22 basis points (model 2). These results suggest that the largest nonbanks, like the largest banks, benefit from a discount in the bond market. As we will show, this similarity disappears when we investigate how that discount varies with the credit rating of the issuer.

For bonds rated triple A, double A, and single A (models 3-5), TOP5 is negative in all of the models, but not statistically significant.[8] Thus it appears that the largest nonbanks also benefit from a discount when they issue in the bond market; however, in contrast to banks, that discount is generally not statistically different from zero within risk categories.

[8] We omit from this exercise bonds rated triple B because the sample contains only one such bond that is issued by the largest nonbanks.

Table 3

## Spreads on Bonds of Nonbank Financial Institutions

| | Model 1: All Bonds | Model 2: All Bonds | Model 3: AAA Bonds | Model 4: AA Bonds | Model 5: A Bonds |
|---|---|---|---|---|---|
| TOP5 | -0.788*** | -0.220** | -0.156 | -0.007 | -0.177 |
| | (7.92) | (2.29) | (0.90) | (0.04) | (1.53) |
| AAA | | -1.761*** | | | |
| | | (4.83) | | | |
| AA | | -0.448** | | | |
| | | (2.42) | | | |
| A | | -0.229 | | | |
| | | (1.39) | | | |
| BBB | | 0.451*** | | | |
| | | (2.71) | | | |
| BB | | 0.553*** | | | |
| | | (2.60) | | | |
| B | | 1.756*** | | | |
| | | (6.34) | | | |
| CCC | | 1.190*** | | | |
| | | (4.23) | | | |
| CC | | -0.071 | | | |
| | | (0.14) | | | |
| C | | 4.771*** | | | |
| | | (4.12) | | | |
| MATURITY | | 0.051*** | 0.152*** | 0.077*** | 0.053*** |
| | | (12.71) | (7.87) | (6.40) | (6.93) |
| LAMOUNT | | 0.043** | 0.025 | 0.025 | 0.064** |
| | | (2.24) | (0.41) | (0.57) | (2.13) |
| Constant | 1.092*** | -0.275 | -0.291 | -2.613*** | -0.940*** |
| | (6.07) | (1.06) | (1.19) | (4.21) | (10.48) |
| Observations | 1,696 | 1,696 | 44 | 202 | 625 |
| $R^2$ | 0.249 | 0.472 | 0.978 | 0.633 | 0.574 |

Source: Author's calculations.

Notes: The dependent variable in these models is the bond spread in the primary market (computed over the Treasury security with the same maturity as the bond). TOP5 is a dummy variable for the top-five issuers by asset size. AAA, AA . . . are dummy variables for the S&P rating of the bond. Maturity is the maturity of the bond. LAMOUNT is the log of the amount of the issue. Included in all of the models are also year-quarter dummy variables. Models estimated with robust standard errors clustered at the bond issuer. The *t*-statistics are reported in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Turning to nonfinancial corporations (Table 4), we see that the results are very similar to those for nonbanks. The largest nonfinancial corporations enjoy a discount of about 76 basis points relative to their smaller peers when we do not account for any bond characteristics (model 1). This discount drops to 47 basis points when we account for the characteristics of the bonds (model 2). Once again, we see that this discount does not continue to hold when we estimate our model separately for the ratings of the bonds issued by the largest nonfinancial corporations (models 3-6).[9]

Overall, these results suggest that the cost advantage that the largest banks enjoy in the bond market relative to their smaller peers is unique to banks. When we do not restrict the comparison to bonds with the same credit rating, it appears as if both the largest nonbanks and the largest nonfinancial corporations benefit from a discount relative to their smaller peers, as happens with banks. This similarity is not present, however, when we restrict the comparison to bonds with the same rating. Looking at bonds rated double A or single A, we continue to find that the largest banks benefit from a statistically significant discount relative to their smaller peers. The largest nonbanks benefit from a discount, but it is not statistically different from zero, and the results show mixed effects for the largest nonfinancial corporations. The largest nonfinancials rated double A benefit from a discount, while those rated single A pay a premium, but in either case the difference relative to their smaller peers is not statistically significant.

It is unclear from these findings, however, whether the discount that the largest banks enjoy relative to their smaller peers is statistically different from the discount for the largest nonbanks or even that for the largest double-A-rated nonfinancial corporations. We investigate this issue next.

## 5. Do the Largest Banks Benefit from a Unique Discount?

To determine whether the discount that the largest banks enjoy in the bond market (relative to their smaller peers) is unique to banks, we estimate our expanded model of bond spreads separately on the set of bonds issued by banks and nonbanks, and on the set of bonds issued by banks and nonfinancial corporations. The results of these investigations, reported in Tables 5 and 6, reveal whether the discount for the largest banks is significantly larger than the discounts for the largest nonbanks and nonfinancial corporations.

[9] We omit from this exercise bonds rated triple A, single B, and D because of their reduced number in the sample.

Table 4

## Spreads on Bonds of Nonfinancial Corporations

| | Model 1: All Bonds | Model 2: All Bonds | Model 3: AA Bonds | Model 4: A Bonds | Model 5: BBB Bonds | Model 6: CCC Bonds |
|---|---|---|---|---|---|---|
| TOP5 | -0.76*** | -0.47*** | -0.17 | 0.14 | -0.17 | 0.52 |
| | (6.52) | (4.30) | (1.18) | (1.34) | (0.82) | (1.21) |
| AAA | | -3.85*** | | | | |
| | | (15.36) | | | | |
| AA | | -3.64*** | | | | |
| | | (21.08) | | | | |
| A | | -3.28*** | | | | |
| | | (20.02) | | | | |
| BBB | | -2.73*** | | | | |
| | | (16.03) | | | | |
| BB | | -1.44*** | | | | |
| | | (8.61) | | | | |
| B | | -0.36** | | | | |
| | | (2.06) | | | | |
| CCC | | -0.3 | | | | |
| | | (1.57) | | | | |
| CC | | 0.54 | | | | |
| | | (1.18) | | | | |
| C | | -0.73 | | | | |
| | | (1.06) | | | | |
| MATURITY | | 0.02*** | 0.05*** | 0.03*** | 0.02*** | -0.02 |
| | | (9.7) | (7.94) | (10.89) | (7.05) | (1.38) |
| LAMOUNT | | -0.07*** | 0.01 | -0.02 | 0.03 | -0.59*** |
| | | (4.24) | (0.09) | (1.30) | (1.35) | (4.36) |
| Constant | 1.04*** | 4.33*** | -0.45 | 0.46*** | 0.06 | 5.71*** |
| | (10.17) | (15.11) | (1.15) | (3.21) | (0.4) | (4.74) |
| Observations | 6,267 | 6,267 | 250 | 1,609 | 2,355 | 339 |
| $R^2$ | 0.175 | 0.423 | 0.717 | 0.478 | 0.227 | 0.636 |

Source: Author's calculations.

Notes: The dependent variable in these models is the bond spread in the primary market (computed over the Treasury security with the same maturity as the bond). TOP5 is a dummy variable for the top-five issuers by asset size. AAA, AA . . . are dummy variables for the S&P rating of the bond. MATURITY is the maturity of the bond. LAMOUNT is the log of the amount of the issue. Included in all of the models are also year-quarter dummy variables. Models estimated with robust standard errors clustered at the bond issuer. The *t*-statistics are reported in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Looking at Table 5 and the variable BK × TOP5, which tells us whether the discount for the largest banks is different from the discount for the largest nonbanks (relative to their smaller peers), we see that there is no statistically significant difference between these discounts when we consider all of the bonds of these issuers together (models 1 and 2). However,

Table 5
## Spreads on Bonds of Banks and Nonbanks

| | Model 1: All Bonds | Model 2: All Bonds | Model 3: AA Bonds | Model 4: A Bonds |
|---|---|---|---|---|
| TOP5 | -0.74*** | -0.22** | 0.1 | -0.20* |
| | (7.68) | (2.36) | (0.59) | (1.82) |
| BK | -0.45*** | -2.53*** | -1.24 | -1.32** |
| | (5.00) | (5.48) | (0.85) | (2.52) |
| BK × TOP5 | 0.24 | -0.18 | -0.92** | -0.16 |
| | (1.61) | (1.18) | (2.15) | (0.92) |
| Constant | 2.13*** | 0.19 | -0.54*** | 0.09 |
| | (15.07) | (0.58) | (4.33) | (0.29) |
| Observations | 2,132 | 2,132 | 268 | 903 |
| $R^2$ | 0.252 | 0.476 | 0.614 | 0.543 |

Source: Author's calculations.

Notes: The dependent variable in these models is the bond spread in the primary market (computed over the Treasury security with the same maturity as the bond). TOP5 is a dummy variable for the top-five issuers by asset size. BK is a dummy variable for bonds issued by banks. All of the models include year-quarter dummy variables. Additionally, models 2 through 4 include dummy variables for the S&P rating of the bond, MATURITY, LAMOUNT, and the interaction of these variables with BK. Models estimated with robust standard errors clustered at the bond issuer. The *t*-statistics are reported in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 6
## Spreads on Bonds of Banks and Nonfinancial Corporations

| | Model 1: All Bonds | Model 2: All Bonds | Model 3: AA Bonds | Model 4: A Bonds |
|---|---|---|---|---|
| TOP5 | -0.77*** | -0.49*** | -0.21 | 0.12 |
| | (6.71) | (4.43) | (1.49) | (1.16) |
| BK | -1.11*** | -4.64*** | -1.47 | -2.17*** |
| | (12.59) | (11.55) | (1.11) | (4.33) |
| BK × TOP5 | 0.19 | 0.16 | -0.53 | -0.50*** |
| | (1.09) | (0.94) | (1.38) | (2.99) |
| Constant | 1.50*** | 4.27*** | -0.56 | 0.61*** |
| | (5.1) | (16.75) | (1.47) | (3.24) |
| Observations | 6,703 | 6,703 | 316 | 1,887 |
| $R^2$ | 0.189 | 0.439 | 0.695 | 0.479 |

Source: Author's calculations.

Notes: The dependent variable in these models is the bond spread in the primary market (computed over the Treasury security with the same maturity as the bond). TOP5 is a dummy variable for the top-five issuers by asset size. BK is a dummy variable for bonds issued by banks. All of the models include year-quarter dummy variables. Additionally, models 2 through 4 include dummy variables for the S&P rating of the bond, MATURITY, LAMOUNT, and the interaction of these variables with BK. Models estimated with robust standard errors clustered at the bond issuer. The *t*-statistics are reported in parentheses.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

when we estimate the model separately on the bonds rated double A and single A, the most common ratings of the bonds issued by the largest institutions in the two groups, we see that largest banks benefit from a bigger discount than the largest nonbanks, which is statistically significant in the case of bonds rated double A.

We get a similar picture when we compare banks with nonfinancial corporations (Table 6). Again, the largest banks do not appear to benefit from a bigger discount when we consider all of the bonds together (models 1 and 2). However, when we estimate the model separately on the bonds of each rating category, we see that the largest banks do benefit from a bigger discount than the largest nonfinancial corporations, and the difference is statistically significant in the case of bonds rated single A.

## 5.1 Robustness Tests

In this exercise, we considered bonds issued since 1985 because the claim that some banks were too big to fail was first made in connection with the demise of Continental Illinois in 1984. However, our use of a long sample period may give rise to certain concerns. For example, several bank regulations were introduced in the post-1984 period. One in particular, the depositor preference rule, introduced in 1993, could be important because it likely increased the compensation that bondholders demand to invest in banks. However, we have year-quarter fixed effects in all of our models. Further, limiting the sample period to the years after 1994 does not affect our key findings in any meaningful way.

Another potential concern with the length of the sample period is that it allows for several changes in the top-five firms in each sector of activity, either because of firms' different

organic growth rates or because of mergers and acquisitions. Recall that we rank firms in each sector of activity according to their size each year. Again, shortening the sample period and restricting it to, for example, the last decade does not affect our key findings.

Yet another potential concern derives from our focus on the top-five firms in each sector of activity. The number of firms investors perceive to be too big to fail is likely to vary over time and across sectors of activity. We experimented with other cutoffs, including using the top-ten firms in each sector of activity, and obtained similar results.

### 5.2 Is the Too-Big-to-Fail Discount Economically Relevant?

The evidence presented thus far indicates that the largest banks do benefit from a discount in the bond market that is statistically different from zero. A related question is whether this discount is economically meaningful. A possible way to investigate this question is to compute the savings that the largest banks enjoy per bond issue relative to their smaller counterparts.

Looking at Table 2, we see that the largest banks that issue bonds rated double A benefit from a reduction in their cost of bond financing of about 121 basis points compared with smaller banks that also issue double-A-rated bonds. The largest banks that issue bonds rated single A benefit from a reduction of about 31 basis points in the cost of bond financing. Taking into account the average bond issue by the largest banks in each group, this reduction in spreads translates into savings of about $80 million and $3 million for an average issue, respectively.

As noted above, these calculations will likely overestimate the too-big-to-fail subsidy that the largest banks enjoy in the bond market. A more conservative way of estimating that subsidy is to determine the additional cost savings of the largest banks (relative to their smaller peers) as opposed to the cost savings that the largest nonbanks enjoy (also relative to their smaller peers). Table 5 shows that the discount (relative to their smaller peers) of the largest banks that issue bonds rated double A is about 91 basis points bigger than the discount for the largest nonbanks relative to their smaller peers. This translates into cost savings for the largest banks of about $60 million for an average bond issue. Doing the same exercise for the largest banks that issue bonds rated single A reveals that they enjoy cost savings of about $1.5 million.

In sum, the findings reported in this section confirm the results from models 1 and 2 that the largest banks benefit from a bigger discount (relative to smaller banks) when they raise funding in the bond market than do either the largest nonbank financial institutions or the largest nonfinancial corporations. The results reported in this section further show that the discount the largest banks enjoy is statistically different from that of the largest nonbanks or the largest nonfinancial corporations. This difference suggests that investors believe that the largest banks are likelier to be classified as too big to fail, and thus to be rescued if they run into financial trouble, than either the largest nonbanks or the largest nonfinancial corporations.

## 6. Conclusion

The evidence presented in this article—demonstrating the additional discount that bond investors offer the largest banks compared with the return they demand from the largest nonbanks and nonfinancial corporations—is novel and consistent with the idea that investors perceive the largest U.S. banks to be too big to fail.

Since the sample ends in 2009, these findings do not reflect any changes in bond investors' expectations resulting from the regulatory interventions that occurred during the financial crisis. Similarly, our findings do not account for any effects that the regulatory changes introduced following the financial crisis may have had, in particular those changes aimed at addressing the too-big-to-fail problem. However, our findings are pertinent to the ongoing debate on requiring bank holding companies to raise part of their funding with long-term bonds, particularly if the post-crisis regulatory changes are unable to fully address the too-big-to-fail status of the largest banks.

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Gara Afonso, João A. C. Santos, and James Traina

# Do "Too-Big-to-Fail" Banks Take On More Risk?

- Large or complex banks might have a greater appetite for risk if they expect future rescues.
- Using data for more than 200 banks in 45 countries, the authors find higher levels of impaired loans after an increase in government support, as measured by Fitch Ratings' support rating floors (SRFs).
- A one-notch rise in the SRF increases an average bank's impaired loan ratio by roughly 8 percent; the authors show similar effects on net charge-offs and for U.S. banks only.
- The authors also show that riskier banks are more likely to take advantage of potential government support.
- The findings suggest that banks classified by rating agencies as more likely to receive government support engage in more risk taking.

## 1. Introduction

In 1984, U.S. regulators made the unprecedented move of insuring all of Continental Illinois's liabilities. The Comptroller of the Currency indicated during the hearings after Continental's resolution that regulators would not allow the eleven largest banks in the Unites States to fail. Ever since, there have been many concerns with banks deemed "too big to fail."[1]

These concerns derive from the belief that the too-big-to-fail status gives large banks a competitive edge and incentives to take on additional risk. If investors believe the largest banks are too big to fail, they will be willing to offer them funding at a discount. Together with expectations of rescues, this discount gives the too-big-to-fail banks incentives to engage in riskier activities. This, in turn, could drive the smaller banks that compete with them to take on further risks,

[1] Continental Illinois, which was the seventh-largest bank by deposits, experienced runs by large depositors following news that it had incurred significant losses in its loan portfolio. Concerns that a failure of Continental would have significant adverse effects on other banks that had deposits with it led the Federal Reserve Board, the Federal Deposit Insurance Corporation (FDIC), and the Comptroller of the Currency, together with twenty-four U.S. banks, to announce a $7.3 billion bailout. The rescue package comprised a $2 billion capital injection by the FDIC and the group of twenty-four banks and a $5.3 billion unsecured line of credit from the banks.

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The authors thank Christian Cabanilla, Nicola Cetorelli, Mark Flannery, David Marqués-Ibañez, Stavros Peristiani, William Riordan, and Tony Rodrigues for valuable comments. They are grateful to Alex Entz for research assistance. The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

exacerbating the negative effects of having too-big-to-fail banks in the financial system.

The debate around too-big-to-fail banks has given rise to a large literature. Part of this literature attempts to determine whether bank investors, including depositors, believe the largest banks are too big to fail. Some studies seek to answer this question by investigating spreads on bank bonds (Flannery and Sorescu 1996; Sironi 2003; Morgan and Stiroh 2005; Anginer and Warburton 2010; Balasubramnian and Cyree 2011; Santos, forthcoming). Other studies consider spreads on bank credit default swap contracts (Demirgüç-Kunt and Huizinga 2013; Li, Qu, and Zhang 2011), bank stock returns (Correa et al. 2012), and deposit costs (Baker and McArthur 2009). Yet others focus on the premiums that banks pay in mergers and acquisitions (Brewer and Jagtiani 2007; Molyneux, Schaeck, and Zhou 2011).

Another part of that literature investigates whether too-big-to-fail banks behave differently by looking at balance-sheet data (Gropp, Hakenes, and Schnabel 2011), syndicated loans (Gadanecz, Tsatsaronis, and Altunbas 2012), and bank z-scores (Brandão Marques, Correa, and Sapriza 2013), among other measures.

Our paper is closer to the latter studies in that we are also interested in finding out whether the too-big-to-fail status affects bank behavior. Specifically, we study whether banks that rating agencies classify as likely to receive government support increase their risk-taking.

An important novelty of our paper is the way we measure the likelihood of a bank receiving government support. Previous studies, including Haldane (2010), Lindh and Schich (2012), and Hau, Langfield, and Marqués-Ibañez (2013), attempt to infer support from the difference between Moody's all-in credit ratings (long-term bank deposit ratings, which capture a bank's ability to repay its deposit obligations and include external support) and Moody's stand-alone ratings (bank financial strength ratings, which exclude external support). The difference between Moody's all-in credit and stand-alone ratings is commonly known as a ratings "uplift." Using uplifts, however, presents two potential issues. First, a change in uplift may arise from movement in either of the two underlying ratings, with completely different implications. Second, uplift incorporates any type of external support, including from governments, parent companies, and other institutions.

To avoid the first concern, some studies rely on support ratings issued by Fitch Ratings (Gropp, Hakenes, and Schnabel [2011] and Molyneux, Schaeck, and Zhou [2010], among others). As with uplift, support ratings also include institutional, cooperative, local government, and regional government support. We sidestep both problems by considering a new Fitch rating. Starting in March 2007, Fitch began to issue support rating floors (SRFs), which reflect its opinion of potential sovereign support only (including a government's ability to support a bank). The main advantage of using this rating is that, in contrast with earlier approaches used in the literature, the support rating floor explicitly captures government support. That is, it does not incorporate other forms of external support, such as the institutional support of a high-holder in a banking organization to a bank within its own hierarchy.[2]

The results of our investigation show that a greater likelihood of government support leads to a rise in bank risk-taking. Following an increase in government support, we see a larger volume of bank lending becoming impaired. Further, and in line with this finding, our results show that stronger government support translates into an increase in net charge-offs. Additionally, we find that the effect of government support on impaired loans is stronger for riskier banks than safer ones, as measured by their issuer default ratings.

Our findings offer novel evidence that government support does play a role in bank risk-taking incentives. The results are also important because they already include the effects of the government interventions undertaken throughout the latest financial crisis. At the same time, however, not enough time has elapsed since the crisis for our results to reflect the impact of the regulatory changes enacted in its wake.

The rest of our paper is organized as follows. The next section introduces our measure of government support. Section 3 describes the data sources and characterizes our sample. Section 4 introduces our methodology. Section 5 discusses our results. Section 6 presents robustness analysis. Section 7 concludes with some final remarks.

[2] Fitch Ratings (2013a) explicitly defines support rating floors as based on potential sovereign support (not on the intrinsic credit quality of the bank). In the case of the landesbanks, Fitch assumes that Germany's and the German states' creditworthiness are linked. For example, in August 2013, Landesbank Baden-Wuerttemberg (LBBW) had a support rating floor of A+ even though Fitch does not rate the State of Baden-Wuerttemberg. The assessment implicitly assumes that the creditworthiness of the support "is underpinned by the strength of the German solidarity system, which links the state's creditworthiness to that of the Federal Republic of Germany (AAA/Stable)" (Fitch Ratings 2013b).

## 2. Measuring the Likelihood of Government Support

There are a number of different methods for measuring sovereign support based on rating agency assessments. Previous work uses two ratings published by Moody's to derive a measure of government support (Haldane [2010], Lindh and Schich [2012], and Hau, Langfield, and Marqués-Ibañez [2013], among others). Moody's issues bank deposit ratings based on its opinion of a bank's ability to repay punctually its deposit obligations. These ratings are all-in credit ratings that reflect intrinsic financial strength, sovereign transfer risk (for foreign currency deposits), and both implicit and explicit external support elements. Moody's also issues bank financial strength ratings, which exclude sovereign risk and external support. Uplifts—calculated as the difference between these two ratings—provide an estimate of the implicit guarantees. This measure incorporates any type of external support (not just sovereign support), including institutional backing from parent companies. To control for this support, some recent studies exclude all bank subsidiaries from their samples and focus their analysis on high-holders of banking organizations only (Brandão Marques, Correa, and Sapriza [2013], among others). Uplifts also capture cooperative, local government, and regional government support.

Although intuitive, this methodology assumes a linear functional form for the difference between these two ratings, but the relationship between external support and stand-alone ratings may be more complex. It also makes it difficult to identify the source of variation in uplifts. For example, suppose there is a one-notch increase in the stand-alone rating, but no change in the all-in credit rating. Uplift would decrease, indicating weaker external support when, in practice, there has been no change. Moreover, even if both ratings were to change, differences in Moody's publication timing would lead to spurious variation in external support.

An alternative approach relies on ratings issued by Fitch that explicitly measure external support, independent of the intrinsic credit quality of the bank. Support ratings (SRs) rely on Fitch's assessment of a supporter's propensity and ability to support a bank. Supporters can be of two types: sovereign states and institutional owners. Studies that use SRs include Gadanecz, Tsatsaronis, and Altunbas (2012) and Gropp, Hakenes, and Schnabel (2011).

In addition to support ratings, Fitch issues support rating floors based on its opinion of potential sovereign support only (including a government's ability to support a bank).[3]

### Comparison of Ratings Issued by Moody's and Fitch Ratings

| | Moody's | | Fitch Ratings | | |
|---|---|---|---|---|---|
| | Long-term bank deposit rating | Bank financial strength | Long-term issuer default rating | Support rating | Support rating floor |
| Intrinsic credit quality | ✓ | ✓ | ✓ | ✗ | ✗ |
| Institutional support | ✓ | ✗ | ✓ | ✓ | ✗ |
| Sovereign support | ✓ | ✗ | ✓ | ✓ | ✓ |

Sources: Moody's and Fitch Ratings.

Notes: Comparison of several ratings issued by Moody's and Fitch Ratings that are typically used in the calculation of government support. A check mark denotes that the definition of a given rating includes one of three characteristics listed in the table above. An "x" indicates that a characteristic is not included in the definition of the rating. For example, bank financial strength measures intrinsic credit quality, but not institutional or sovereign support.

The main difference with respect to SRs is that SRFs do not incorporate external support other than sovereign support, such as the institutional support of a high-holder in a banking organization to a bank within its own hierarchy. Isolating the support coming from the government is crucial to addressing the question of whether too-big-to-fail banks increase their risk-taking, because, in contrast to other sources of external support, sovereign support is typically unpriced and not risk-sensitive. The exhibit shows a comparison of these ratings-based approaches to measuring sovereign support.

To stress the difference between these two ratings, let us consider the case of Bank of America. Table 1 shows the history of changes in support ratings and support rating floors for Bank of America Corporation (the parent company) and Bank of America National Association (the largest national bank within the organization). Fitch expresses SRs on a five-notch, 1-to-5 scale, where a rating of 1 denotes a bank with extremely high probability of external support. SRFs use the AAA long-term scale, where AAA ratings indicate an extremely high probability of government support. SRFs include one additional point on the scale, "no floor" (NF),

[3] According to Fitch Ratings (2013a), support typically extends to the following obligations: senior debt (secured and unsecured), including insured and uninsured deposits (retail, wholesale, and interbank); obligations arising from derivatives transactions and from legally enforceable guarantees and indemnities, letters of credit, and acceptances; trade receivables; and obligations arising from court judgments.

Table 1
Example of Fitch Ratings

| | Bank of America Corporation | | | Bank of America National Association | | |
|---|---|---|---|---|---|---|
| Date | IDR | SR | SRF | IDR | SR | SRF |
| 06/01/88 | BBB | • | • | • | • | • |
| 02/01/89 | BBB+ | • | • | • | • | • |
| 02/15/89 | A | • | • | • | • | • |
| 06/01/90 | A | • | • | • | 1 | • |
| 02/01/91 | A+ | • | • | • | 1 | • |
| 05/27/94 | A+ | • | • | AA- | 1 | • |
| 10/03/95 | A+ | 5 | • | AA | 1 | • |
| 04/11/96 | A | 5 | • | AA | 1 | • |
| 04/26/96 | AA- | 5 | • | AA | 1 | • |
| 05/20/96 | A+ | 5 | • | AA | 1 | • |
| 10/01/98 | AA- | 5 | • | AA | 1 | • |
| 10/15/99 | AA- | 5 | • | AA | 2 | • |
| 07/22/03 | AA- | 5 | • | AA | 2 | • |
| 09/29/03 | AA | 5 | • | AA | 2 | • |
| 04/01/04 | AA- | 5 | • | AA- | 1 | • |
| 02/15/07 | AA | 5 | • | AA | 1 | • |
| 03/16/07 | AA | 5 | NF | AA | 1 | A- |
| 07/16/08 | A+ | 5 | NF | AA- | 1 | A- |
| 01/16/09 | A+ | 1 | A+ | A+ | 1 | A+ |
| 12/15/11 | A | 1 | A | A | 1 | A |

Source: Fitch Ratings.

Notes: History of long-term issuer default ratings (IDRs), support ratings (SRs), and support rating floors (SRFs) of Bank of America Corporation and Bank of America National Association. NF is "no floor."

bringing the total number of notches to twenty. According to Fitch, NF designates no reasonable presumption of potential support and translates to a probability of support of less than 40 percent (Fitch Ratings 2013a).

From March 16, 2007, to January 16, 2009, Bank of America Corporation (the parent) had the lowest level of external support (SR = 5), while Bank of America National Association enjoyed the highest level of external support (SR = 1). By looking at support ratings only, we cannot disentangle if the strong support of Bank of America National Association comes from the government or from the parent company. To answer this question, we turn to its support rating floor. The SRF of Bank of America National Association was A- over this period, indicative of strong government support.

The evolution of Bank of America National Association's support rating floors also shows how sovereign support to the national bank heightened two notches in January 2009 and lessened one notch in December 2011, while external support (measured by SRs) remained constant. The difference in granularity between these two ratings is yet another advantage to using SRFs over SRs since they allow for higher precision and more variability in support.

A similar measure based on S&P ratings is currently not available since S&P does not issue ratings that allow measurement of sovereign support.

## 3. Data and Sample Characterization

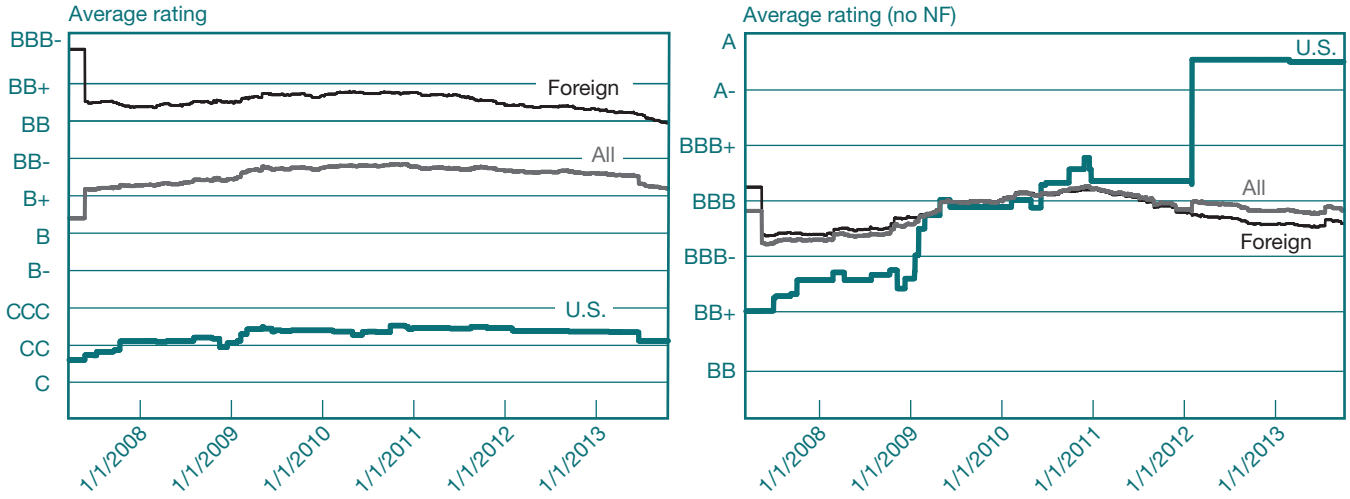
### 3.1 Data

The data for this paper come from several sources. We use Bureau van Dijk's Bankscope to gather balance-sheet data on banks in our sample, including our key measures of bank risk-taking—impaired loans and net charge-offs. In addition, we use two data sets from Fitch Ratings: one containing information on government support ratings (described in detail in section 2 above) and the other containing information on bank strength ratings (long-term issuer default ratings [IDRs]). IDRs reflect Fitch's opinion on an entity's relative vulnerability to default on its financial obligations. IDRs are Fitch's primary issuer rating for financial institutions and are expressed on a AAA long-term scale, where AAA ratings denote the lowest expectation of default. IDRs incorporate not only intrinsic strength, but also external support. Even though stand-alone ratings are a cleaner measure of a bank's intrinsic strength than IDRs, we cannot rely on these ratings in our analysis because of the lack of a consistent time series during our sample period.[4]

[4] Historically, Fitch issued individual ratings on an A-E scale to assess a bank's creditworthiness on a stand-alone basis. Similar to Moody's bank financial strength ratings, these ratings aimed to capture the strength of a bank if it was unable to rely on external support. On March 7, 2011, Fitch announced a revision to the methodology used to calculate the stand-alone ratings, as well as a change from a nine-point scale (using letter ratings such as A and A/B) to a lowercase variation of the traditional nineteen-point long-term rating scale (using letter ratings such as aaa and aa+). On July 20, 2011, Fitch introduced new stand-alone ratings called viability ratings, designed to reflect the same core risks as individual ratings but with renewed definitions and greater granularity.

Chart 1

Government Support by Origin




Source: Authors' calculations, based on data from Fitch Ratings.

Notes: The left panel displays the average government support (measured by the support rating floor [SRF]) from March 16, 2007, to August 15, 2013, including "no floor" (NF) ratings. The right panel shows the average SRF excluding NF ratings. Trend lines capture daily ratings.

## 3.2 Sample Characterization

To construct our data set, we start with the universe of banks that have support rating floors, which Fitch began issuing on March 16, 2007. Though the most recent ratings are easily accessible online, historical ratings need manual collection. Our sample includes daily SRF observations for 612 banks (bank holding companies, commercial banks, and savings banks) from March 16, 2007, to August 15, 2013. The data span 92 countries, with 182 banks from the United States.

Our sample of changes in support rating floors comprises increases and decreases in ratings. The first change in our sample occurs on July 2, 2007, and the last one on August 14, 2013. There are 446 changes in SRFs (234 increases and 212 decreases) across 234 unique banks and 177 unique event dates. On average, each change shifts the rating about two notches.

The left panel of Chart 1 seems to support the commonly understood idea that foreign countries tend to provide stronger support to their banks than the United States does. We see the average support rating floor of a foreign bank is about four times larger than that of a U.S. bank.[5] Interestingly, this pattern changes dramatically when we zoom in on the set of banks with an SRF different from an NF rating: the "supported" banks. As the right panel of Chart 1 shows, average sovereign support remains slightly humped in foreign countries (according to Fitch's ratings), but the pattern changes significantly for the United States, where, over the last six years, average government support has increased markedly. Since 2010, average sovereign support for U.S. banks has been stronger than that for foreign banks.

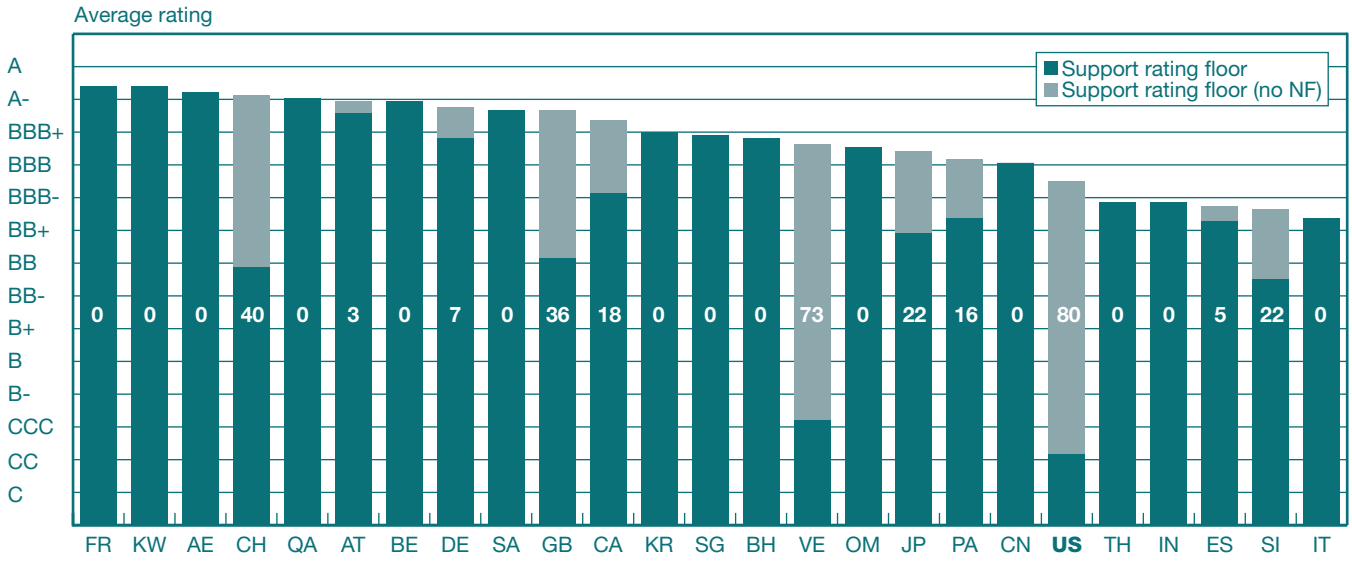
This difference in patterns seems to be driven by the larger proportion of U.S. banks that have a probability of government support lower than 40 percent. The data show that 80 percent of banks in the United States have "no floor" ratings compared with 21 percent in foreign countries. The larger the number of banks in a country with "no floor" ratings, the starker the difference between the left and right panels of Chart 1. Whether or not government support to banks is more prevalent in the United States than abroad depends on whether we take "no floor" ratings into account. Making this distinction matters because it portrays a different picture of how government support has evolved in the United States.[6]

[5] As standard in the ratings literature, we assign numeric values to the notches on the rating scale, where a value of nineteen denotes a AAA rating and zero a "no floor" rating.

[6] The heat map in Chart 4 highlights the unique character of the "no floor" (NF) rating. At first glance, since SRFs act as a floor for IDRs, one might think the NF rating is located one notch below D on the SRF scale. However, the distribution of IDRs for banks with NF SRFs is significantly different from IDRs for banks with SRFs expressed on the AAA scale. While banks with SRFs ranging from CCC to AA- typically have an IDR between zero to two notches higher, a bank with an NF SRF is more likely to have a BBB or A- IDR rating. This suggests a definition of average government support that excludes banks with NF ratings.

Chart 2

## Government Support by Country




Source: Authors' calculations, based on data from Fitch Ratings.

Notes: Average government support (measured by the support rating floor) by country from March 16, 2007, to August 15, 2013. Dark green bars represent average SRFs including "no floor" ratings; light green bars exclude NF ratings. The numbers in the middle of the bars indicate the percentage of "no floor" ratings in each country: France (FR), Kuwait (KW), United Arab Emirates (AE), Switzerland (CH), Qatar (QA), Austria (AT), Belgium (BE), Germany (DE), Saudi Arabia (SA), United Kingdom (GB), Canada (CA), Republic of Korea (KR), Singapore (SG), Bahrain (BH), Venezuela (VE), Oman (OM), Japan (JP), Panama (PA), China (CN), United States (US), Thailand (TH), India (IN), Spain (ES), Slovenia (SI), and Italy (IT).

Chart 2 captures this idea. It presents, for the top twenty-five countries with the strongest government support, average support rating floors including "no floor" ratings (dark green) and excluding "no floor" ratings (light green).

The cases of the United States and Venezuela stand out in that overall average sovereign support is weak but average support to banks that have a rating other than "no floor" (the "supported" banks) is very strong. Consistent with the findings of Ueda and Weder di Mauro (2012), banks headquartered in Switzerland, France, and Germany enjoy high probability of sovereign support. We also find that Arabic countries, including Kuwait, the United Arab Emirates, and Qatar, provide strong support to their banks. Table 2 shows the average level of sovereign support for the top twenty-five countries with the strongest government support as well as the number of banks per country rated by Fitch. There is significant heterogeneity in the number of rated banks per country, perhaps reflective of differences in size of each country's financial system and in the level of concentration of their banking sectors.

For information on credit quality and exposure to default, we use long-term issuer default ratings issued by Fitch. For each bank in our sample, we obtain the history of changes in IDRs from January 1, 1988, to August 15, 2013. To present summary statistics on a comparable sample, we restrict our attention to IDR observations for which we also see an SRF. Chart 3 shows the distribution of SRFs (left) and IDRs (right) for the sample of 612 banks.

Recall from sections 2 and 3 that support rating floors reflect government support while long-term issuer default ratings incorporate both intrinsic and external support. As such, a bank's SRF acts as a floor for its IDR. Chart 4 highlights this relationship by presenting the distribution of IDRs by SRFs. The intensity of each symbol denotes the frequency (that is, a darker square indicates a more frequent relationship).

As expected, many bank ratings lie on the diagonal, indicating that Fitch's assessment of a bank's relative vulnerability to default and of a government's propensity to support a bank are identical. The rest of the observations are on the upper diagonals of the heat map, which denote that the overall strength of a bank exceeds its sovereign support. It is also interesting to note that banks rated with a probability of sovereign support of less than 40 percent (SRF = NF) are rated with IDRs ranging

Table 2

## Average Government Support

| | Name | SRF (no NF) | SRF | Percent NF | Banks | Days | Observations |
|---|---|---|---|---|---|---|---|
| 1 | France | 14.3 | 14.3 | 0 | 5 | 2,345 | 9,303 |
| 2 | Kuwait | 14.3 | 14.3 | 0 | 5 | 2,283 | 11,415 |
| 3 | United Arab Emirates | 14.1 | 14.1 | 0 | 8 | 2,283 | 15,866 |
| 4 | Switzerland | 14.0 | 8.4 | 40 | 5 | 2,345 | 11,725 |
| 5 | Qatar | 13.9 | 13.9 | 0 | 5 | 2,283 | 9,283 |
| 6 | Austria | 13.8 | 13.4 | 3 | 5 | 2,345 | 7,295 |
| 7 | Belgium | 13.8 | 13.8 | 0 | 5 | 2,345 | 9,687 |
| 8 | Germany | 13.6 | 12.6 | 7 | 7 | 2,345 | 12,215 |
| 9 | Saudi Arabia | 13.5 | 13.5 | 0 | 9 | 2,283 | 20,547 |
| 10 | United Kingdom | 13.4 | 8.7 | 36 | 20 | 2,345 | 39,843 |
| 11 | Canada | 13.2 | 10.8 | 18 | 6 | 2,345 | 13,100 |
| 12 | Republic of Korea | 12.8 | 12.8 | 0 | 5 | 2,283 | 11,415 |
| 13 | Singapore | 12.7 | 12.7 | 0 | 5 | 2,345 | 11,725 |
| 14 | Bahrain | 12.6 | 12.6 | 0 | 5 | 2,283 | 8,589 |
| 15 | Venezuela | 12.3 | 3.4 | 73 | 8 | 2,345 | 16,901 |
| 16 | Oman | 12.3 | 12.3 | 0 | 5 | 2,283 | 8,330 |
| 17 | Japan | 12.2 | 9.5 | 22 | 10 | 2,345 | 21,480 |
| 18 | Panama | 11.9 | 10.0 | 16 | 7 | 2,283 | 12,222 |
| 19 | China | 11.8 | 11.8 | 0 | 13 | 2,283 | 14,233 |
| 20 | United States | 11.1 | 2.3 | 80 | 186 | 2,345 | 342,905 |
| 21 | Thailand | 10.5 | 10.5 | 0 | 8 | 2,345 | 14,836 |
| 22 | India | 10.5 | 10.5 | 0 | 8 | 2,345 | 13,949 |
| 23 | Spain | 10.4 | 9.9 | 5 | 17 | 2,345 | 22,677 |
| 24 | Slovenia | 10.2 | 8.0 | 22 | 5 | 2,283 | 11,240 |
| 25 | Italy | 10.0 | 10.0 | 0 | 8 | 2,345 | 16,365 |

Source: Authors' calculations, based on data from Fitch Ratings.

Notes: The table reports each country's mean support rating floor (SRF) for countries with at least five rated banks (top twenty-five only). Ratings were issued from March 16, 2007, to August 15, 2013. NF is "no floor."

from D to AA+. Having risky banks among those with a probability of sovereign support of less than 40 percent suggests that risk alone does not drive the probability of government support. This would be the case, for example, for small banks that may not receive government support regardless of their overall financial strength.

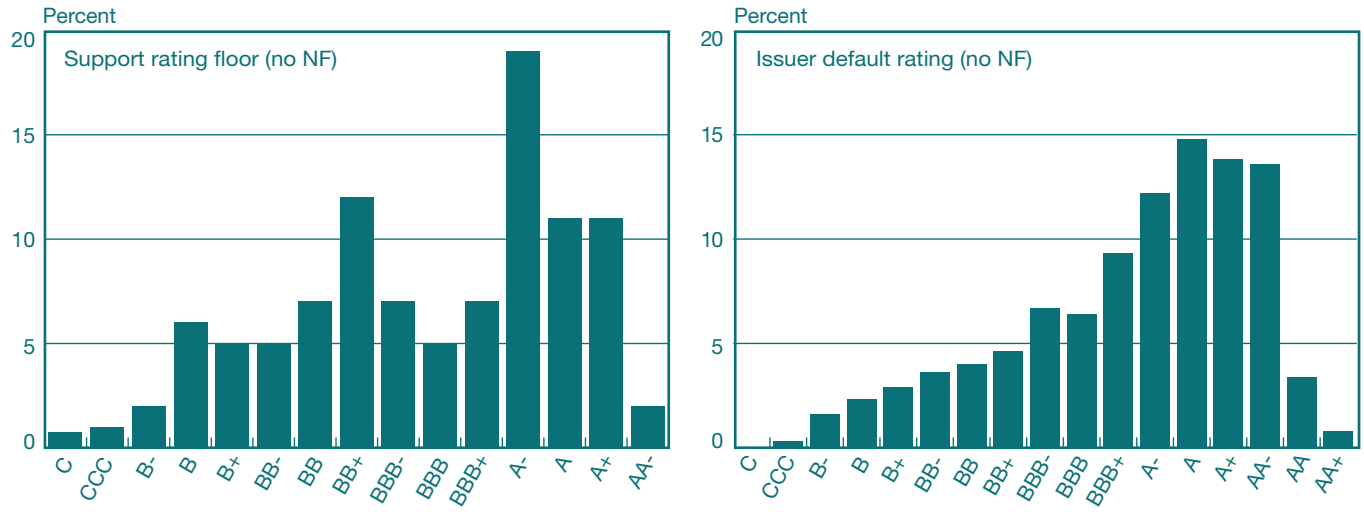
Finally, we use the Bankscope database to augment the ratings data with quarterly information on bank characteristics spanning 2007:Q1 to 2013:Q3. Fitch issues support rating floors at the entity level, so we keep in our sample parent banks and their subsidiaries when there are multiple entities for a consolidated bank in Bankscope. The matched sample consists of 11,929 bank-quarter observations for 601 banks.

Because of the global nature of our data, we are missing balance-sheet information for approximately 59 percent of our bank-quarter observations for which we have SRFs. To alleviate this problem, we linearly interpolate adjacent data if they are missing for less than one year in duration. Interpolation recovers approximately 15 percent of our potential data, reducing the proportion missing to 44 percent.[7] After matching and interpolation, we further limit our sample

[7] Results are qualitatively similar in the analysis without interpolation.

Chart 3

## Distribution of Fitch Ratings

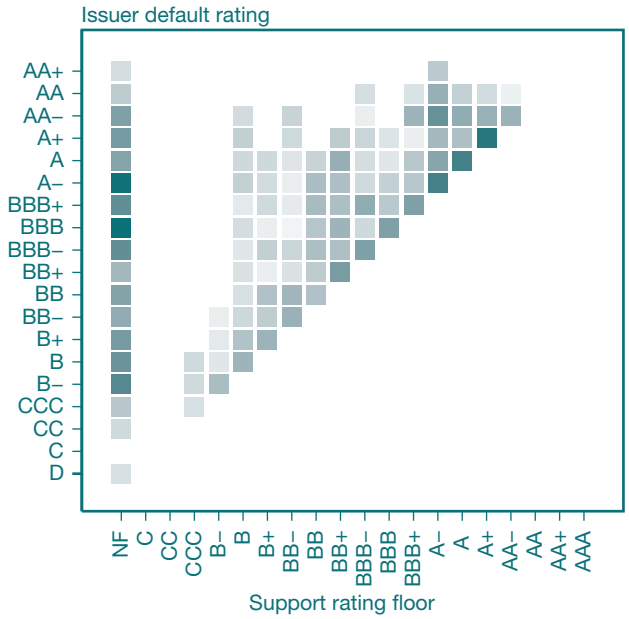



Source: Authors' calculations, based on data from Fitch Ratings.

Notes: Histograms include observations for banks with support rating floors and issuer default ratings from March 16, 2007, to August 15, 2013. Both panels exclude observations where the banks have a support rating floor of "no floor" (NF).

Chart 4

## Fitch Ratings Heat Map

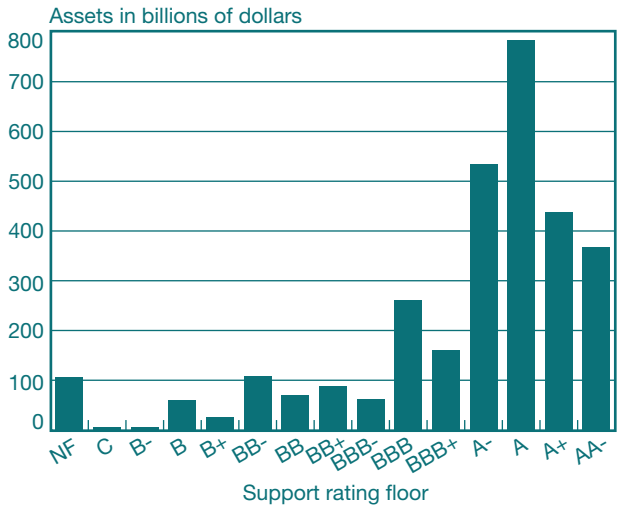



Source: Authors' calculations, based on data from Fitch Ratings.

Notes: The chart shows the distribution of issuer default ratings by support rating floor. The intensity of each symbol indicates the frequency; darker squares denote a more frequent relationship.

Chart 5

## Distribution of Bank Size by Government Support




Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Note: The chart shows total assets of banks with support rating floors and issuer default ratings from March 16, 2007, to August 15, 2013, by category of government support.

Table 3
## Summary Statistics

| | | Support Rating Floors | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | NF | C-CCC | B | BB | BBB | A | AA-AAA | Total |
| Total assets | Mean | 110 | 4.2 | 53 | 92 | 150 | 600 | 370 | 200 |
| | Median | 16 | 4.2 | 33 | 46 | 51 | 190 | 180 | 22 |
| | Standard deviation | 380 | • | 45 | 110 | 180 | 780 | 690 | 500 |
| Impaired loans | Mean | 2.50 | 1.81 | 3.23 | 2.48 | 2.78 | 2.24 | 1.82 | 2.48 |
| | Median | 1.97 | 1.81 | 2.96 | 1.80 | 0.95 | 1.38 | 1.77 | 1.85 |
| | Standard deviation | 2.46 | • | 1.99 | 2.44 | 4.56 | 2.77 | 0.45 | 2.61 |
| Net charge-offs | Mean | 0.66 | 0.44 | 0.66 | 0.34 | 0.17 | 0.50 | 0.07 | 0.59 |
| | Median | 0.29 | 0.44 | 0.51 | 0.07 | 0.05 | 0.10 | 0.06 | 0.22 |
| | Standard deviation | 1.02 | • | 0.66 | 0.56 | 0.27 | 1.22 | 0.11 | 1.01 |
| Return on assets | Mean | 0.17 | 1.09 | 0.25 | 0.64 | 0.55 | 0.40 | 0.41 | 0.27 |
| | Median | 0.21 | 1.09 | 0.14 | 0.56 | 0.63 | 0.27 | 0.33 | 0.24 |
| | Standard deviation | 0.59 | • | 0.57 | 0.50 | 0.85 | 0.45 | 0.30 | 0.59 |
| Tier 1 capital | Mean | 11.34 | 6.44 | 8.45 | 8.99 | 7.78 | 11.24 | 6.03 | 10.89 |
| | Median | 9.38 | 6.44 | 8.60 | 8.54 | 7.38 | 7.40 | 4.99 | 8.86 |
| | Standard deviation | 11.16 | • | 1.79 | 3.00 | 2.99 | 14.23 | 2.45 | 11.08 |
| Trading assets | Mean | 1.16 | 0.10 | 2.22 | 2.07 | 3.21 | 3.72 | 3.14 | 1.83 |
| | Median | 0.04 | 0.10 | 1.10 | 0.67 | 0.73 | 0.50 | 3.29 | 0.13 |
| | Standard deviation | 4.27 | • | 3.45 | 3.47 | 4.20 | 5.35 | 2.49 | 4.53 |
| Observations | | 1,153 | 1 | 52 | 131 | 65 | 327 | 10 | 1,739 |

Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The table presents summary statistics on total assets and our risk variable ratios by bins of government support. We rely on the following variables from Bankscope (series in parentheses): total assets (DATA2025), impaired loans (DATA2170), net charge-offs (DATA2150), net income (DATA2115), tier 1 capital (DATA2140), and trading assets (DATA29190). We normalize each risk measure by total assets, converted to 2012 U.S. dollars and presented in millions. NF is "no floor."

to banks with information on total assets, impaired loans, net charge-offs, tier 1 capital, and trading assets. This step leads to a final data set with 1,739 bank-quarter observations.

Most banks in the sample (75 percent) have investment-grade ratings. Many (38 percent) also have government support of BBB- or above. The median bank has total assets of $22 billion, while the average bank has assets of $200 billion. Size, however, changes significantly by level of government support, with highly supported banks being typically larger. The bank with a C-CCC rating (the lowest SRF in our sample) has close to $4 billion in total assets while those with an AA-AAA rating are almost 100 times larger on average. Chart 5 shows this pattern, which is consistent with the literature that documents a positive relationship between size and government support.

Banks with a higher probability of government support also have more trading assets on average. However, as shown in Table 3, we do not find a similar pattern with return on assets (ROA), impaired loans, net charge-offs, or tier 1 capital. In our sample, the average bank has an ROA of 0.27 percent, an impaired loan ratio of 2.48 percent, a net charge-off ratio of 0.59 percent, and a tier 1 capital ratio of 10.89 percent. Table 3 tabulates descriptive statistics for our sample.

## 4. Methodology And Empirical Strategy

The goal of our analysis is to investigate whether banks with higher government support engage in riskier activities. To test this hypothesis, we use a panel of bank-level data. After matching and interpolating, we further limit our sample to banks with information on total assets, impaired loans, net charge-offs, tier 1 capital, and trading assets. This restriction leads to a final panel data set with 1,739 bank-quarter observations. Although 85 percent of our bank-quarter observations correspond to domestic banks, our sample retains a global nature, spanning 224 banks in 45 countries.

We first measure the riskiness of a bank's activities by the ratio of impaired loans to total assets. We also present results for alternative measures of risk, including ratios of net charge-offs, net income, tier 1 capital, and trading assets to total assets.[8] Specifically, we investigate whether the ratio of impaired loans to total assets relates to government support of banks. Since we expect that a bank's response to sovereign support might take time to show up on its balance sheet, we estimate specifications of our model with progressively higher lags for all right-hand-side variables. To that end, we estimate the following model:

$$1) \qquad Risk_{b,t} = \beta * SRF_{b,t-i} + \delta * IDR_{b,t-i} + \eta * Assets_{b,t-i} + \mu * OtherRisk_{b,t-i} + \gamma * Z_b + \tau * X_t + \varepsilon_{b,t} ,$$

where $b$ indexes banks, $t$ denotes time in quarters, and $i = \{1,...,11\}$ indicates the number of lags. The availability of data determines the maximum number of lags (eleven). The dependent variable $Risk_{b,t}$ is a measure of bank riskiness. In our baseline specification, we measure riskiness as the ratio of impaired loans to total assets. $SRF_{b,t}$ denotes the support rating floor of bank $b$ at the end of quarter $t$; $IDR_{b,t}$ indicates the long-term issuer default rating of bank $b$ at the end of quarter $t$; and $Assets_{b,t}$ is the natural logarithm of total assets in U.S. dollars, normalized using the consumer price index.[9] $OtherRisk_{b,t}$ is a vector of our remaining risk measures as bank controls. In the baseline specification, this vector includes net charge-offs/total assets, return on assets (net income/total assets), tier 1 capital/total assets, and trading assets/total assets.

[8] Data on these risk measures are from Bankscope. In particular, we use the following series: DATA2170 (impaired loans), DATA2025 (total assets), DATA2115 (net income), DATA2140 (tier 1 capital), DATA2150 (net charge-offs), and DATA29190 (total trading assets).

[9] We use 2012 dollars as the baseline. We pull the "All Urban Consumers, All Items, Not Seasonally Adjusted" series from Federal Reserve Economic Data.

$\varepsilon_{b,t}$ is the error term. All specifications control for country fixed effects $Z_b$ and quarter-year fixed effects $X_t$. We also consider specifications in which we control for bank-fixed effects instead of country-fixed effects. We refer to this alternative specification as Model 2. The standard errors are robust and adjusted to control for clustering at the bank level.

Finally, since a bank's creditworthiness will likely play a role in the effect of government support on its risk-taking activities, we also consider a version of our model that includes the interaction between the support rating floor and the long-term issuer default rating, $\varphi * SRF_{b,t-i} * IDR_{b,t-i}$.

## 5. Results

### 5.1 Impaired Loans

Impaired loans are those that are either in default or close to default. These loans are typically behind in payments or restructured from a previous loan. They constitute a good measure of the amount of bad debt currently in the loan portfolio of a bank. Regulatory agencies require banks to write down loans as impaired under specific delinquency criteria, which may vary by country. Typically, regulators classify loans that are delinquent for ninety days (one quarter) as impaired.

In our analysis, we use impaired loans (from Bankscope) as our baseline measure of a bank's riskiness. The main hypothesis that we intend to test is that banks with higher government support engage in riskier (lending) activities. Specifically, if the level of government support affects bank preferences for risk, we would expect that banks with stronger SRFs would engage in riskier lending activity. This, in turn, implies that more loans would become delinquent, resulting in an increase in impaired loans in the following quarters.

Table 4 summarizes our results. It presents the value of the coefficient $\beta$ on the SRF in our models of risk for different lags (one to eleven quarters) of sovereign support. The top rows of panel A show the effect of government support on the level of impaired loans. The main finding is that stronger sovereign support is associated with an increase in the ratio of impaired loans to total assets. In the model that includes country-fixed effects but no bank-fixed effects (Model 1), this result is statistically significant at the 1 percent level and the effect is economically meaningful; each notch increase in the SRF increases the impaired loan ratio by just under 0.2, which is an approximately 8 percent increase for the average

Table 4

## Bank Risk Response to Government Support

Panel A: Risk Measures

| Variable | Model | Lags | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Impaired loans | 1 | 0.17*** | 0.18*** | 0.18*** | 0.19*** | 0.18*** | 0.19*** | 0.20*** | 0.20*** | 0.20*** | 0.20*** | 0.21*** |
| | 2 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.24* | 0.26** | 0.24* | 0.20** | 0.12*** |
| Net charge-offs | 1 | -0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 2 | 0.02*** | 0.02*** | 0.02** | 0.02* | 0.03*** | 0.02 | 0.08*** | 0.08*** | 0.05*** | 0.03*** | 0.06*** |
| Observations | | 1,491 | 1,313 | 1,149 | 1,003 | 888 | 790 | 697 | 613 | 528 | 443 | 363 |

Panel B: Other Measures

| Variable | Model | Lags | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Return on assets | 1 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 |
| | 2 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.01 | 0.02 | 0.02 | 0.03 | 0.02 | -0.02 |
| Tier 1 capital | 1 | 0.38* | 0.38* | 0.39* | 0.40* | 0.42* | 0.42** | 0.41** | 0.40** | 0.41** | 0.36** | 0.25* |
| | 2 | -0.04* | -0.04** | -0.05* | -0.02 | 0.04 | 0.17 | 1.36 | 1.50 | 1.76 | 1.32 | 0.85 |
| Trading assets | 1 | 0.06 | 0.07 | 0.07 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 | 0.06 |
| | 2 | -0.06 | -0.08* | -0.08 | -0.10 | -0.02 | -0.05 | -0.09 | -0.05 | -0.03 | 0.02 | 0.06 |
| Observations | | 1,491 | 1,313 | 1,149 | 1,003 | 888 | 790 | 697 | 613 | 528 | 443 | 363 |

Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The table presents results on the relationship between government support and bank risk-taking. For each measure of bank risk, we report the value of the estimated coefficient on the support rating floor for different lags (one to eleven quarters). Model 1 corresponds to the analysis with country-fixed effects and without bank-fixed effects. Model 2 includes bank-fixed effects, but no country-fixed effects. Each specification uses robust standard errors clustered by bank.

*** Statistically significant at the 1 percent level.

** Statistically significant at the 5 percent level.

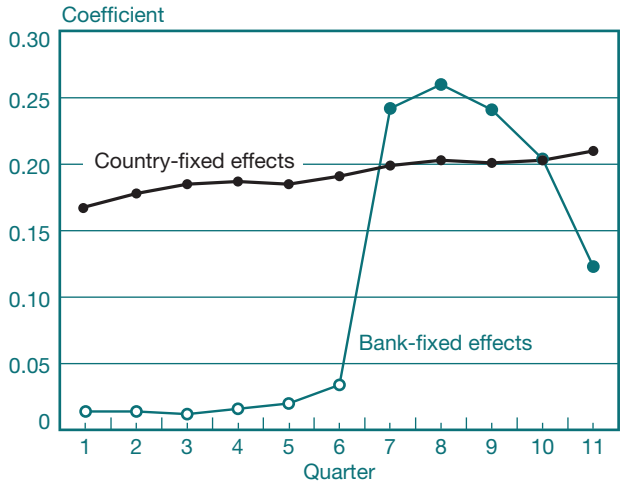
* Statistically significant at the 10 percent level.

bank. The effect is persistent and roughly constant through the following ten quarters.

Results are similar but weaker in the analysis that includes bank- instead of country-fixed effects (Model 2). In particular, we find a statistically and economically significant effect of sovereign support on the proportion of a bank's impaired loans approximately seven quarters ahead. The lack of within-bank variation in government support may drive this weakness, as suggested by the lower *t*-statistics.

Chart 6 presents the relevant coefficients for both models. The circles and closed circles correspond, respectively, to the values and significance at the 10 percent level of the support-rating floor coefficient through time. This graphing of our results illustrates the importance of timing after a change in the SRF. The black line of Chart 6 shows that an increase in sovereign support leads to a rise in the ratio of impaired loans as early as a quarter after the change in support in the model with country-fixed effects. We also see that this result is persistent and statistically significant through the following ten quarters. The green line presents the results of the specifications that control for bank-fixed effects (but no country-fixed effects). An increase in government support to a bank also leads to a higher impaired loan ratio, but the effect is only significant seven quarters after the change.

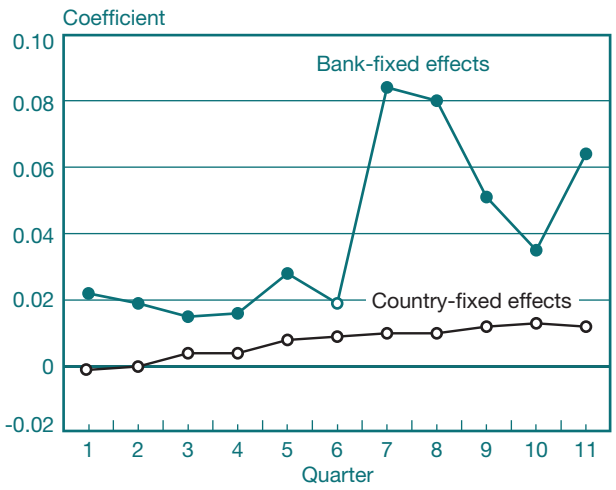
Chart 6
Effect of Government Support on Impaired Loans




Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The chart presents results on the relationship between government support and impaired loans. The circles illustrate the value of the estimated coefficient on the support rating floor through time (one- to eleven-quarter lags). The closed circles denote significance at the 10 percent level. The black and green lines correspond to Models 1 and 2, respectively. Each specification uses robust standard errors clustered by bank.

Chart 7
Effect of Government Support on Net Charge-Offs




Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The table presents results on the relationship between government support and net charge-offs. The circles illustrate the value of the estimated coefficient on the support rating floor through time (one- to eleven-quarter lags). The closed circles denote significance at the 10 percent level. The black and green lines correspond to Models 1 and 2, respectively. Each specification uses robust standard errors clustered by bank.

## 5.2 Net Charge-Offs

For robustness, we also look at alternative measures of a bank's riskiness. Net charge-offs are often used as a proxy for bank risk because they tend to increase with riskier lending activities. They are defined as the difference between charge-offs and recoveries, where charge-offs are debts that a bank declares likely uncollectible and recoveries are collections on debts that a bank had previously written down as charge-offs. As with impaired loans, we scale net charge-offs by the total assets of the bank. Similar to our test based on impaired loans, if changes in sovereign support affect bank preferences for risk, then we expect that increases in support rating floors would lead to riskier lending activity, resulting in an increase in net charge-offs.

The second set of rows in panel A of Table 4 presents the results of the analysis where the dependent variable is net charge-offs, with country-fixed (Model 1) and bank-fixed (Model 2) effects. Our findings support and complement our previous result that stronger sovereign support is associated with an increase in riskier lending activity. When we control for bank-fixed effects (Model 2), we find that the effect is statistically and economically meaningful, comprising a change in net charge-offs of approximately 0.04 per SRF notch, or 7 percent of an average bank's net-charge-off level. Chart 7 shows these results. The coefficients on sovereign support are positive but not statistically significant in the model with country-fixed effects.

The dynamics and timing of debt charge-offs are complex. On the one hand, there is guidance from governments and regulators to encourage early charge-offs through tax exemptions and regulatory enforcement. On the other hand, banks still retain some discretion and may prefer to delay charging off debt within the timing established by the regulatory guidelines. Consistent with this pattern in the timing of charge-offs, we find that the effect is strongly significant for the two quarters following a change in support; it becomes weaker for the third to sixth quarters and then strongly significant after seven quarters.

Table 5

## Impaired Loan Response, Interaction

Panel A: Model 1

| Coefficient | Lags | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| SRF | 0.75** | 0.81** | 0.86** | 0.93** | 1.04** | 1.05** | 1.19** | 1.29** | 1.34** | 1.35** | 1.30** |
| | (2.23) | (2.24) | (2.21) | (2.22) | (2.39) | (2.38) | (2.41) | (2.43) | (2.52) | (2.55) | (2.54) |
| SRF * IDR | -0.04* | -0.04* | -0.04* | -0.05* | -0.06* | -0.06* | -0.06** | -0.07** | -0.07** | -0.07** | -0.07** |
| | (-1.78) | (-1.80) | (-1.76) | (-1.79) | (-1.97) | (-1.94) | (-2.00) | (-2.04) | (-2.14) | (-2.17) | (-2.14) |
| IDR | -0.46*** | -0.45*** | -0.44*** | -0.41** | -0.39** | -0.38** | -0.37** | -0.35* | -0.33* | -0.33* | -0.34** |
| | (-3.38) | (-3.18) | (-2.91) | (-2.58) | (-2.27) | (-2.17) | (-2.04) | (-1.97) | (-1.87) | (-1.90) | (-2.00) |
| Observations | 1,491 | 1,313 | 1,149 | 1,003 | 888 | 790 | 697 | 613 | 528 | 443 | 363 |

Panel B: Model 2

| Coefficient | Lags | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| SRF | 0.28 | 0.29 | 0.34 | 0.41** | 0.60*** | 0.63* | 0.80** | 0.63** | 0.60** | 0.47* | 0.35* |
| | (1.35) | (1.31) | (1.61) | (2.01) | (3.88) | (1.85) | (2.42) | (2.16) | (2.37) | (1.89) | (1.93) |
| SRF * IDR | -0.02 | -0.02 | -0.02 | -0.03* | -0.04*** | -0.04* | -0.04* | -0.02 | -0.02 | -0.02 | -0.01 |
| | (-1.29) | (-1.26) | (-1.56) | (-1.93) | (-3.72) | (-1.79) | (-1.88) | (-1.39) | (-1.66) | (-1.13) | (-1.33) |
| IDR | -0.24 | -0.12 | 0.03 | 0.19 | 0.25* | 0.21** | 0.22*** | 0.16 | 0.22*** | 0.18** | 0.24*** |
| | (-1.65) | (-0.88) | (0.20) | (1.47) | (1.89) | (2.26) | (2.88) | (1.44) | (2.83) | (2.35) | (3.72) |
| Observations | 1,491 | 1,313 | 1,149 | 1,003 | 888 | 790 | 697 | 613 | 528 | 443 | 363 |

Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The table presents results on the relationship between government support, credit quality, and impaired loans. We report the value of the estimated coefficient on the support rating floor (SRF), issuer default rating (IDR), and their interaction for different lags (one to eleven quarters). Model 1 in panel A corresponds to the analysis with country-fixed effects and without bank-fixed effects. Model 2 in Panel B includes bank-fixed effects, but no country-fixed effects. Each specification uses robust standard errors clustered by bank.

*** Statistically significant at the 1 percent level.

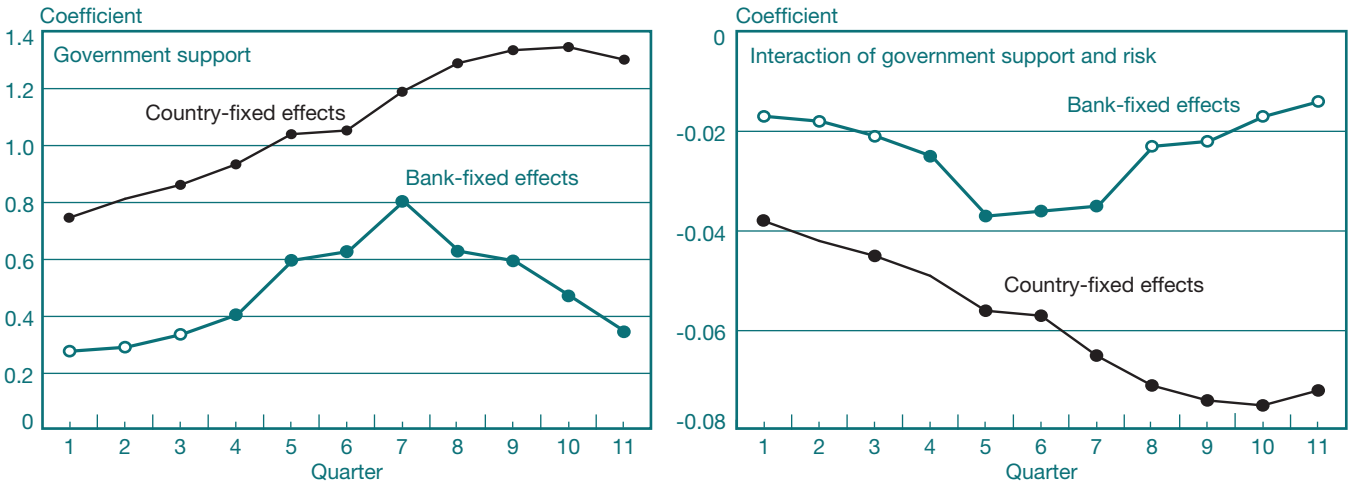
** Statistically significant at the 5 percent level.

* Statistically significant at the 10 percent level.

### 5.3 Does Government Support Have a Bigger Effect on Riskier Banks?

The results that we have reported thus far suggest that government support influences bank preference for risk. Given that finding, a natural question to ask is whether the link between government support and bank risk-taking varies with a bank's creditworthiness. We are particularly interested in finding out whether the link is stronger for riskier banks because, all else equal, we would expect these banks to be more prone to taking on additional risks. To test this hypothesis, we extend our impaired-loans regression analysis and include a term for the interaction of the support rating floor and the issuer default rating. The size of the interaction captures the marginal effect of government support for safe banks relative to risky banks. As before, we estimate two models: one with country-fixed effects, Model 1, and the other with bank-fixed effects, Model 2. We include the same controls for bank size and risk, that is, (the natural logarithm of) assets and our remaining risk ratios (net charge-offs/total assets, ROA [net income/total assets], tier 1 capital/total assets, and trading assets/total assets). In each model, we estimate the different specifications for one- through eleven-quarter lags.

Chart 8
Effects on Impaired Loans, Interaction




Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The chart presents results on the relationship between government support, credit quality, and impaired loans in our interaction regressions. The left panel represents the support rating floor coefficient; the right panel represents the support rating floor interacted with the issuer default rating coefficient. The circles illustrate the respective values of the estimated coefficients through time (one- to eleven-quarter lags). The closed circles denote significance at the 10 percent level. The black and green lines correspond to Models 1 and 2, respectively. Each specification uses robust standard errors clustered by bank.

Table 5 summarizes our results. Our main variables of interest are SRF and SRF * IDR. For completeness, we also present the coefficient on the IDR. Panel A shows Model 1, which includes country-fixed effects, while panel B presents Model 2, which includes bank-fixed effects. Each column indicates a different quarter-lag specification. Chart 8 illustrates the timing of the SRF and SRF * IDR coefficients in the left and right panels, respectively.

Looking across the eleven specifications in Model 1, each with a different lag, we find a persistent, statistically significant relationship for all three coefficients. As before, the level of impaired loans in a bank loan portfolio increases directly with the level of government support. Reflecting the timing of impairment, this effect increases with higher lags. Similarly, the interaction of the SRF and the IDR grows increasingly negative and significant, indicating that riskier banks are more likely to take advantage of potential sovereign support. In other words, though all banks increase impaired loans proportionately to their SRF, riskier banks do so even more. For each one-notch level of the IDR, a one-notch change in the SRF increases the impaired loan ratio by approximately 2 percent for the average bank. When we control for bank-fixed effects in Model 2, the interaction effect is still present, but it is significant only if we examine lags four through seven.

## 6. Robustness

### 6.1 Other Measures of Risk

For completeness of our analysis, we consider three additional measures of bank risk: the tier 1 capital ratio (tier 1 capital/total assets), return on assets (net income/total assets), and trading assets (trading assets/total assets). The traditional rationale behind capital requirements is that capital acts as a buffer for protection against unexpected losses. In that sense, a higher capital ratio implies a safer bank. However, capital can also act as a measure of bank risk: The amount of capital a bank needs for protection against losses is closely related to the risk profile of the bank that will ultimately lead to those losses. From this perspective, a higher capital ratio is indicative of a riskier bank because of the requirement of a higher buffer against losses. ROA captures the profitability of a bank's assets. Banks with higher ROA typically have riskier asset portfolios and, as such, ROA can be considered a proxy for the risk preference of a bank. In a related spirit, trading assets can also act as an indirect measure of bank risk. Trading

Table 6

## Bank Risk Response to Government Support, Domestic Subsample

Panel A: Baseline

| Variable | Coefficient | Model | Lags | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Impaired loans | SRF | 1 | 0.18*** | 0.19*** | 0.19*** | 0.19*** | 0.19*** | 0.19*** | 0.20*** | 0.20*** | 0.20*** | 0.20*** | 0.21*** |
| | | 2 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.04 | 0.24* | 0.26** | 0.24* | 0.20** | 0.12*** |
| Net charge-offs | SRF | 1 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | | 2 | 0.02*** | 0.02*** | 0.02** | 0.02* | 0.03*** | 0.02 | 0.09*** | 0.08*** | 0.05*** | 0.04*** | 0.06*** |
| Observations | | | 1,267 | 1,155 | 1,047 | 943 | 854 | 768 | 684 | 604 | 522 | 440 | 361 |

Panel B: Interactions

| Variable | Coefficient | Model | Lags | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Impaired loans | SRF | 1 | 1.30** | 1.32** | 1.30** | 1.25** | 1.29** | 1.22** | 1.28** | 1.29** | 1.34** | 1.35** | 1.30** |
| | | 2 | 0.30 | 0.29 | 0.34 | 0.41** | 0.60*** | 0.65* | 0.81** | 0.63** | 0.60** | 0.47* | 0.35* |
| Impaired loans | SRF * IDR | 1 | -0.07** | -0.07** | -0.07** | -0.07** | -0.07** | -0.07** | -0.07** | -0.07** | -0.07** | -0.08** | -0.07** |
| | | 2 | -0.02 | -0.02 | -0.02 | -0.03* | -0.04*** | -0.04* | -0.04* | -0.02 | -0.02* | -0.02 | -0.01 |
| Observations | | | 1,267 | 1,155 | 1,047 | 943 | 854 | 768 | 684 | 604 | 522 | 440 | 361 |

Source: Authors' calculations, based on data from Fitch Ratings and Bureau van Dijk's Bankscope.

Notes: The table presents results on the relationship between government support and bank risk-taking for U.S. banks only. Panel A corresponds to the baseline specification. Panel B corresponds to the interactions specification. We report the value of the relevant estimated coefficient for different lags (one to eleven quarters). Model 1 corresponds to the analysis with country-fixed effects and without bank-fixed effects. Model 2 includes bank-fixed effects, but no country-fixed effects. Each specification uses robust standard errors clustered by bank. SRF is the support rating floor. IDR is the long-term issuer default rating.

*** Statistically significant at the 1 percent level.

** Statistically significant at the 5 percent level.

* Statistically significant at the 10 percent level.

assets are securities that banks hold for reselling at a profit (as opposed to investment purposes). As a result, we could expect that banks with a higher ratio of trading assets to total assets would engage in riskier activities. We do not discuss composite measures of bank risk, such as z-scores, because of data-availability limitations.

As shown in panel B of Table 4, banks with stronger government support have a higher tier 1 capital ratio, ROA, and trading asset ratio in the specifications with country-fixed effects. The effect is statistically significant only for the tier 1 capital ratio. As an additional robustness test to this interesting result, we consider an alternative definition of the capital ratio, calculated as the ratio of tier 1 capital to risk-weighted assets. This analysis takes into account the riskiness of bank asset portfolios. Results are similar (statistically significant at the 5 percent level in the model with country-fixed effects) and consistent with the second interpretation of bank capital, in which riskier banks hold higher capital.[10]

### 6.2 Domestic Banks

In our analysis, we derive all of our results with country-fixed effects (Model 1) or bank-fixed effects (Model 2). Nonetheless, one may still worry about the large diversity of countries included in our sample. To address this concern, we limit our sample to include only banks headquartered in the

[10] Analysis not included, available upon request.

United States, which is the country with the largest number of banks in the sample. We are interested in understanding if the relationship between sovereign support and risk-taking documented in sections 5.1-5.3 is also present in the United States. Table 6 summarizes our main results.

We see in panel A of Table 6, consistent with our previous findings, that an increase in government support leads to a higher ratio of impaired loans and to higher net charge-offs. Similar to our results for the global sample, the effect on impaired loans is stronger for riskier banks, reflecting the fact that they are more likely to exploit potential sovereign support by engaging in even riskier activities than their safer counterparts do (panel B of Table 6).

### 6.3 Alternative Hypothesis

In this paper, we find evidence that suggests that banks with stronger sovereign support engage in riskier lending activities, which translates into a higher ratio of impaired loans. One alternative hypothesis could be that financial conditions were already deteriorating, which would lead to a higher ratio of impaired loans. Although we cannot completely rule out this premise, all of our specifications control for bank credit quality. Specifically, as shown in section 4, we control for the long-term issuer default rating of each bank at the end of each quarter to take into account variation in bank financial strength.

In addition, our results in Table 4 and Chart 6 show that the effect becomes stronger, rather than weaker, over time (that is, the value of the coefficient on government support is increasing with the number of lags). This finding is inconsistent with a story in which the deterioration was already taking place and the change in sovereign support is a response to worsening conditions.

Also inconsistent with the alternative hypothesis are our findings on the tier 1 capital ratio. If stronger government support was the response to a bank's weaker conditions, we would expect the tier 1 capital ratio to decrease rather than increase (panel B of Table 4).

As an additional robustness test, we also consider a variation of our sample in which we exclude banks that experience a simultaneous (within-quarter) change in both sovereign support and credit quality. The idea behind this analysis is to consider a sample without potential contamination of the identification. After dropping such banks from our sample (23 percent of SRF changes), we find qualitatively similar results. Overall, all these findings support our initial hypothesis that banks with stronger government support take on more risk.

## 7. Final Remarks

This study offers new and relevant evidence on a long-debated question: Does the too-big-to-fail status increase bank risk-taking incentives? Our evidence is novel because it focuses on Fitch's new support rating floors, which aim at isolating the likelihood of governmental support from other sources of external support. Of course, SRFs only reflect Fitch's opinion of potential government support and of the government's ability to support a bank. As is the case in all studies based on ratings, our results hinge on this assessment's reliability. The key advantage of our approach is that support rating floors only include (Fitch's views on) sovereign support, and exclude parent corporations' support.

Our findings are also innovative in that we focus on impaired loans to measure bank risk-taking incentives. This analysis is important because impaired loans, in contrast to other, more general measures of risk, are more directly under bank control. Our results account for the governmental interventions during the financial crisis, but do not reflect the long-term effects that may arise from the regulatory changes introduced in its aftermath. An interesting area for future research would be to investigate to what extent the new regulations, in particular those dealing with the too-big-to-fail banks, affect the link we unveiled between the likelihood of governmental support and bank risk-taking policies.

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Samuel Antill, David Hou, and Asani Sarkar

# Components of U.S. Financial-Sector Growth, 1950-2013

- The U.S. financial sector grew steadily relative to the entire business sector from 1975 until its growth was interrupted in the recent financial crisis. Recovery has been tepid since.
- Large financial firms have had moderately higher average growth rates than small financial firms, especially since the 1990s. The shift followed regulatory changes that facilitated bank consolidation.
- Shadow banking grew rapidly at the expense of traditional banks, becoming a significant portion of the financial sector in the mid-1990s and peaking just before the crisis.
- The study's results show that growth in finance has mainly occurred in opaque, complex, and less-regulated subsectors of finance.

## 1. Introduction

There has been a resurgence of interest in the issue of whether financial-sector growth is necessarily good for the economy.[1] Earlier literature generally supported the idea that financial and economic development go together (King and Levine 1993; Rajan and Zingales 1998) or even that financial growth is a precondition for economic development (Wright 2002). More recently, the "dark" side of finance has been emphasized, with commentators questioning the social value of certain financial activities.[2] This change is an outcome, in part, of the experience of the recent financial crisis. For example, Turner (2010) argues that the financial sector extracts rent from the nonfinancial sector. Other studies (Philippon 2012; Greenwood

[1] See, for example, the symposium issue on "The Growth of the Financial Sector" in the *Journal of Economic Perspectives*, Spring 2013.

[2] Wouter den Haan, "Why Do We Need a Financial Sector?" *Vox*, October 24, 2011, http://www.voxeu.org/debates/why-do-we-need-financial-sector.

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and Scharfstein 2013; Philippon and Reshef 2013) find that, globally, the size of finance relative to gross domestic product (GDP) has been increasing and reached a historical maximum before the recent financial crisis. It is difficult to reconcile this fact with standard models of growth (Philippon 2012).

It is important to understand the evolution of finance and its subsectors since it weighs on many questions of policy interest. First, to what extent is credit being intermediated by shadow banks rather than by commercial banks, which have traditionally been the main conduits of funds to households and businesses?[3] The relative growth of shadow banks has implications for regulatory policies geared toward enhancing the safety and soundness of commercial banks (such as those governing deposit insurance, central bank liquidity, and capital requirements). Second, what was the relative growth of large financial firms that pose risk for the rest of the economy? Third, what was the role of leverage in the growth of firms, especially of large firms, given that leverage constraints are now an important tool in bank regulation? Finally, to what extent has growth occurred within privately held firms that are more opaque than publicly listed companies?

To investigate these questions, we must first measure the size of the financial sector. So far, the literature has produced measures based on value-added and on liabilities of broad sectors using data from the Bureau of Economic Analysis (BEA) and the Federal Reserve Board's Flow of Funds Accounts (FOF).[4] Others rely on aggregate wages and income. These measures, however, cannot be used to estimate accurately the growth of shadow banks or publicly listed firms. Accordingly, this paper provides new descriptive measures of financial-sector size using firm-level balance sheet data from the Center for Research in Security Prices (CRSP) and Compustat from the first quarter of 1975 to the first quarter of 2013. Our disaggregated approach allows us to examine how financial-sector growth relates to firm size, financing choice (whether equity or debt), and industry type.

The balance sheet data have the disadvantage of excluding private firms which are an important source of economic growth.[5] To address this concern, we also measure the size of finance based on the FOF data reporting total liabilities for private and publicly listed firms at the sectoral level. In addition, we examine data for individual commercial banks from the Federal Financial Institutions Examination Council's *Consolidated Reports of Condition and Income* (Call Reports) that include both private and publicly listed banks. These data provide a second source for examining the relative growth of the commercial banking sector.

Our measures are of the form $\frac{S}{F+NF}$, where $S$, $F$, and $NF$ are sizes of a particular financial subsector $S$, the entire financial sector $F$, and the entire nonfinancial sector $NF$, respectively. When $S = F$, we are estimating the size of the finance sector relative to the total business (that is, financial plus nonfinancial) sector. By normalizing by the size of the business sector, we control for economy-wide factors that impact all firms. For firm-level or bank-level data, size is the value of firm or bank assets (comprising either debt plus equity or equity only).[6] For FOF data, size equals the total liabilities of a sector.[7]

Using these measures, we find that the U.S. financial sector grew steadily relative to the entire business sector from 1975 until the recent financial crisis. Further, publicly listed financial firms had lower average size relative to the total business sector than private financial firms. For example, while publicly listed financial firms were about 50 percent of the business sector based on total asset values (representing debt plus equity) on average, financial-sector liabilities inclusive of private financial firms were almost 70 percent of total liabilities based on the FOF data.

We also measure the size of the credit intermediation subsectors, starting with shadow banks. Following an approach described in Financial Stability Board (2011) and Financial Stability Board (2012), we consider all nonbank credit intermediation activities and use FOF sector categories to identify the corresponding liabilities. For our CRSP-Compustat measures, we identify shadow banks by using the Standard Industrial Classification (SIC) and the North American Industrial Classification System (NAICS) codes that map to the FOF sectors. This broad measure of shadow banking is consistent with Financial Stability Board (2011, 3), which argues that "authorities should cast the net wide, looking at all nonbank credit intermediation to ensure that data gathering and surveillance cover all areas where shadow banking–related risks to the financial system might potentially arise." For comparison, we also report a narrower measure of shadow banking developed by Adrian and Ashcraft (2012) using specific types of FOF liabilities.

[3] Shadow banks are entities such as structured investment vehicles that (like traditional banks) perform credit intermediation services, but (unlike banks) lack central bank liquidity or public sector credit guarantees (Pozsar, Adrian, Ashcraft, and Boesky 2013).

[4] The FOF data release is now titled *Financial Accounts of the United States*.

[5] The growth potential of private firms is indicated by evidence that these firms invest more than publicly listed firms of similar sizes (Asker, Farre-Mensa, and Ljungqvist 2013).

[6] Many small publicly listed firms do not file with the Securities and Exchange Commission and, thus, we do not have debt data available. To account for these firms, we also report the equity-only measure of size.

[7] Sectoral assets and liabilities need not be equal in the FOF data since these are not aggregated from firm-level balance sheets. However, our results are qualitatively the same whether we use assets or liabilities.

In keeping with the previous literature, we find that the share of shadow banking in the total business sector has grown from less than 4 percent in 1975 to a high of between 9 percent and 37 percent in recent years (depending on the measure). Growth in shadow banking has been fueled by rapid expansion in credit intermediation services performed by asset management and securities firms (including open-end investment funds and securities and commodities brokerages). We also see that housing-related credit intermediation (provided by real estate credit firms and real estate investment trusts [REITs]) is a substantial part of shadow banking, but its share has been declining since the 1980s. The average share of shadow banking in the business sector was at least twice as large when calculated with private liabilities (about 16 percent) than without (about 4 percent to 8 percent). Our results, which are qualitatively similar using broad and narrow definitions of shadow banking, emphasize the predominantly private nature of shadow bank liabilities and thereby heighten concerns about the opacity of the sector.

Shadow banks are a potential source of systemic risk (Adrian and Ashcraft 2012) in part because their activities are intertwined with those of traditional banks and depository credit institutions (DCIs) (Cetorelli and Peristiani 2012; Cetorelli, McAndrews, and Traina 2013). Boyd and Gertler (1995) find that between 1976 and 1993 the share of commercial banks in financial intermediation was stable. Recent evidence shows that shadow banks have grown relative to DCIs (Pozsar et al. 2013; Adrian and Ashcraft 2012). Greenwood and Scharfstein (2013) suggest that incremental growth in household credit origination was due to securitization, implying a growth in shadow banks at the expense of traditional banks. We measure the share of shadow banks in total credit intermediation (TCI) as $\frac{SB}{SB + DCI}$, where *DCI* (*SB*) is the size of the DCI (shadow banking) sector.

We find that the share of shadow banking in TCI grew from less than 9 percent in 1975 to a high of at least 33 percent in the period from 2004 to 2013. The estimate may understate the share of shadow banking in TCI because DCIs have increasingly acquired shadow banks, with this type of acquisition occurring at a greater rate than the reverse (Cetorelli et al. 2013). After being acquired, these shadow banks may be counted as part of the DCI sector, provided that DCI activity is considered the main business of the merged firm by SIC and NAICS. In this case, the shadow banking activity becomes part of the DCI sector.[8]

[8] In some cases, SIC codes may be reclassified and changed retroactively. We were unable to verify how frequently this occurs, but it appears that at least in some cases a firm will have different SIC and NAICS codes in different periods due to corporate structure changes, as discussed here.

Large financial firms (those in the top 10 percent of firms by value) were a substantially greater share of all large firms than small financial firms (those in the bottom 90 percent of firms by value) were of all small firms. Further, large financial firms had moderately higher average growth rates than small financial firms, especially since the 1990s. Size-related differences were most pronounced in the DCI sector, with large DCIs outgrowing small DCIs by an average of at least 3 percent over the sample period. Some of this shift followed regulatory changes that facilitated bank consolidation (such as the Riegle-Neal Act of 1994 and the Graham-Leach-Bliley Act of 1999).

The recent financial crisis adversely affected the size of the financial sector, but its impact differed by subsector and type of firm. For example, the shadow banking subsector did poorly relative to other sectors by most measures, with its size shrinking from the peak pre-crisis quarter to the trough crisis quarter more than that of the financial sector as a whole. These effects were even more pronounced when we excluded government-sponsored enterprises (GSEs) from our sample of financial firms. While small financial firms generally suffered the most of all firms during the crisis, larger shadow banks did worse than small shadow banks. Large DCIs actually grew in size during the crisis based on book values, especially during 2008 and 2009 when the Federal Deposit Insurance Corporation (FDIC) guaranteed the debt issuances by these firms. We estimate that the size of DCIs issuing guaranteed debt between October 2008 and October 2009 under this program increased by an average of roughly 11 percent compared with all other firms, an economically but not statistically significant number.

To understand the effect of balance sheet leverage on the size of financial firms, we look at total assets versus equity-only measures for publicly listed firms. We find that, on average, financial firms are three times smaller, shadow banks are one-and-a-half times smaller, and DCIs are five times smaller under equity-only measures than they are by total asset value, attesting to the importance of leverage in the capital structure of financial firms and of DCIs in particular.

This article contributes to the literature by proposing new firm-based and sector-based measures of financial-sector size in line with an approach by the Financial Stability Board (2012, 5), which recommends the use of more granular data and market prices "to adequately capture the magnitude and nature of risks in the shadow banking system." While our metrics do not speak to risk exposures directly, they may be used as starting points for determining the location of vulnerabilities. Our findings also have policy implications, such as for the regulation of shadow banks, that we discuss more fully in the conclusion.

The remainder of our article is organized as follows. We review the literature in Section 2 and explain our measures of financial-sector size in Section 3. In Section 4, we describe our results on the size and growth of the financial sector. Section 5 discusses the effects of leverage, firm size, and financial regulation on financial-sector growth. Section 6 summarizes our findings. Results discussed in the article but not reported in the tables and charts can be found in the online appendixes.[9]

## 2. Literature Survey

One of the earliest papers on trends in financial-sector size is Boyd and Gertler (1995), who use value-added data from the BEA and other measures to examine whether the commercial banking sector was declining or not. Already in the mid-1990s, there was concern over the growth of nonbank credit intermediaries—shadow banks, in today's terminology—and its effect on traditional banks. The authors conclude that the share of banking in total financial intermediation was generally stable, with small losses in the 1980s and 1990s, and that financial intermediation had grown relative to GDP. They suggest that the apparent decline in banking reflects the movement of activities from on-balance-sheet to off-balance-sheet as well as the significant increase in the share of foreign-owned banks in U.S. banking activity.

More recently, a number of papers that were part of a *Journal of Economic Perspectives* Spring 2013 symposium examined the evolution of finance. Specifically, Greenwood and Scharfstein (2013) and Philippon and Reshef (2013) propose metrics of financial-sector size and evaluate hypotheses on the sources of growth, while Cochrane (2013) argues that the focus should be on the functions of financial firms and not on their sizes. Separately, Philippon (2012) and Philippon and Reshef (2012) have also contributed to this literature.

Greenwood and Scharfstein examine financial-sector size using several measures, including value-added and liabilities data for broad sectors from the BEA and the FOF, as well as industry output, fees, and traded value for more specific sectors (such as asset management). They find that financial-sector growth has accelerated since 1980, fueled by the securities and credit intermediation sectors, and accounted for a quarter of the growth in the services sector as a whole. Considering the source of financial growth, the authors emphasize the role of asset management, which grew as a class largely because of the increase in stock market valuations, and the provision of household credit, especially residential mortgages, which increased through fees derived from loan origination, underwriting, and trading activities. They also question the social value of this growth, given the high cost and persistent underperformance of professional asset management and the fallout from an excess of credit-financed consumption.

Cochrane (2013) argues that the growth in finance was an outcome of increased demand for financial services and higher wages for finance employees with scarce skills (although both these arguments appear to be inconsistent with the results of Philippon [2012], whose work is described below). Cochrane proposes a supply-and-demand model, based on Berk and Green (2004), to explain the underperformance of actively managed funds. He points to the persistence of proportional fees across different professions and over time to suggest that asset management fees may not represent suboptimal contracts. More generally, he makes an important distinction between form and function of firms that we discuss further in the conclusion.

Philippon (2012) shows that, while the income of financial intermediaries as a share of GDP has generally varied over time, it increased rapidly from 1980 to 2010. Using value-added data from the BEA, liabilities data from the FOF, and financial flow variables (such as for corporate issuance and mergers-and-acquisitions), he constructs a measure of financial-intermediation output as the weighted average of various types of credit, equity issuances, and liquid assets, with the relative weights based on theory. He finds that the annual unit cost of financial intermediation (defined as income over output) is around 2 percent and relatively stable over time. Philippon and Reshef (2012) examine wages, complexity of jobs, and skill levels in finance, relative to the economy, and find that they all follow a U-shaped pattern, peaking before World War II and then again from 1980 on. They point out, however, that growth in the financial industry and growth in skills and wages of finance employees did not always go together. Philippon and Reshef (2013) investigate the income share of finance in international data, using the ratio of bank loans to GDP as a proxy for financial-sector output.

These papers indicate the difficulty of measuring financial-sector output consistently over time and across countries in the context of financial innovation and other structural changes and given differences in accounting methodologies. Our balance-sheet-based measures are also open to the same critique, as they are affected by changes in accounting systems over time, assets moving off balance sheet, and changes in industry structure (in particular, mergers and acquisitions) that make industry classification ambiguous.

[9] The online appendixes for this article are available at http://www.newyorkfed.org/research/epr/2014/1412anti_appendixA-D.pdf.

We discuss these issues further in the conclusion. The benefits of our measures, relative to the earlier literature, are the level of disaggregation (that is, firm-level observation) and the ability to use the same data sources (CRSP and Compustat) consistently for measuring sizes of all sectors. Previous papers use different data sets depending on which sector is being measured.

Unconventional measures have also been suggested, sizing the sector, for example, by the percentage of firms on the Forbes 400 list whose wealth is derived primarily from financial activities (Kaplan and Rauh 2013) or by the percentage of graduates from top colleges entering into financial services employment (Goldin and Katz 2008).

## 3. Methodology

We propose seven measures of financial-sector size, which are summarized in Table 1 along with their respective sample periods, data sources, and definitions. Appendix A describes the data used.

The first set of metrics is based on firm-level balance sheet data which are aggregated to the sectoral level to derive measures of sectoral size:

$$(1) \qquad Size_t^S = \frac{\sum_{i \epsilon S} Value_{i,t}}{\sum_{j \epsilon F,NF} Value_{j,t}},$$

where $Value_{i,t}$ is the value of firm $i$ in day or quarter $t$, $S$ is either the entire financial sector or a financial subsector, $F$ denotes the entire financial sector, and $NF$ denotes the entire nonfinancial sector. In other words, we define the size of a sector $S$ as the value of all firms in sector $S$ relative to the value of all firms in the nonfinancial and financial sectors. Financial sectors $S$ are classified using the SIC and NAICS systems, as described in Appendix B. When $S = F$, our metric is a measure of the size of finance relative to the total business sector. This methodology of calculating the size of a financial sector relative to the nonfinancial sector, similar to Philippon and Reshef (2012), controls for a spurious increase in the size of finance due to a general increase in the number of publicly listed firms over time.

The first four rows of Table 1 list the metrics derived from firm-level data, which correspond to whether we use equity value, total value (debt plus equity), the market value of equity (MVE), or the book value of equity (BVE).[10] The measures

[10] For asset management firms, we capture only liabilities of the firm, not funds held by a firm for other companies. So long as these funds belong to publicly listed companies in the same sector, the sectoral aggregates will remain unaffected.

Table 1
### Relative Size Measures

| Name of Measure | Sample | Formula |
|---|---|---|
| $Tsize - bv$ | 1975:Q1-2013:Q1 | $Tsize - bv_t^S = \frac{\sum_{i \epsilon S}(BVE_{i,t} + BVD_{i,t})}{\sum_{j \epsilon F,NF}(BVE_{j,t} + BVD_{j,t})}$ |
| $Tsize - qmv$ | 1975:Q1-2013:Q1 | $Tsize - qmv_t^S = \frac{\sum_{i \epsilon S}(MVE_{i,t} + BVD_{i,t})}{\sum_{j \epsilon F,NF}(MVE_{j,t} + BVD_{j,t})}$ |
| $Esize - bv$ | 1975:Q1-2013:Q1 | $Esize - bv_t^S = \frac{\sum_{i \epsilon S} BVE_{i,t}}{\sum_{j \epsilon F,NF} BVE_{j,t}}$ |
| $Esize - mv$ | 1950:Q1-2013:Q1 | $Esize - mv_t^S = \frac{\sum_{i \epsilon S} MVE_{i,t}}{\sum_{j \epsilon F,NF} MVE_{j,t}}$ |
| $Fsize$ | 1952:Q1-2013:Q1 | $Fsize_t^S = \frac{\sum_{s \epsilon S} Liabilities_{s,t}}{\sum_{j \epsilon F,NF} Liabilities_{j,t}}$ |
| $AA$ | 1990:Q2-2013:Q1 | $AA = \frac{\sum_{k \epsilon SB} Liabilities_{k,t}}{\sum_{j \epsilon F,NF} Liabilities_{j,t}}$ |
| $Csize$ | 1975:Q1-2013:Q1 | $Csize_t = \frac{\sum_{i \epsilon B}(BVE_{i,t} + BVD_{i,t})}{\sum_{j \epsilon F,NF} Liabilities_{j,t}}$ |

Notes: This table defines the relative size measures used in this article and their sample periods.

The size of a sector is defined as the value of assets in the sector relative to the asset values of the financial and nonfinancial sectors.

*MVE* is market value of equity. The data for MVE are from the Center for Research in Security Prices.

*BVE* is book value of equity. *BVD* is book value of liabilities. The data for BVD and BVE are from Compustat.

For the $Tsize - qmv$ and $Esize - mv$ measures, an observation is the asset value of a firm $i$ in day $t$ belonging to a sector $S$.

Since *BVD* and *BVE* are only observed at the quarterly level, the quarterly value is repeated each day of the quarter for $Tsize - qmv$.

For the $Tsize - bv$ and $Esize - bv$ measures, an observation is the asset value of a firm $i$ in day $t$ belonging to a sector $S$.

When $S = F$ or $S = NF$, the $F$ and the $NF$ indicate the financial and nonfinancial sectors, respectively.

For *Fsize*, an observation is the liability of a sector $S$ in quarter $t$.

For *AA*, the numerator is the liability of a financial instrument $k$ aggregated over all shadow banking (*SB*) instruments. The *SB* instruments are commercial paper, repo, debt, pools of mortgages backed by government-sponsored enterprises, asset-backed securities, and money market mutual funds. The denominator of *AA* is the aggregate liabilities of the financial and nonfinancial sectors (which is the same as the denominator of *Fsize*). The data source for *Fsize* and *AA* is the Federal Reserve Board's Flow of Funds Accounts.

For *Csize*, the numerator is the book value of assets of a commercial bank $j$, obtained from Call Reports data aggregated over the banking sector $B$.

The denominator of *Csize* is the aggregate liabilities of the financial and nonfinancial sectors from flow-of-funds data (which is the same as the denominator of *Fsize* and *AA*).

using equity value are *Esize − mv* (based on MVE) and *Esize − bv* (based on BVE). The measures using total value are *Tsize − qmv* (based on MVE plus the book value of debt [BVD])[11] and *Tsize − bv* (based on BVE plus BVD).

For firm *i* and day *t*, the MVE-based measures are:

$$(2) \qquad Esize - mv_t^S = \frac{\sum_{i \epsilon S} MVE_{i,t}}{\sum_{j \epsilon F,NF} MVE_{j,t}},$$

$$(3) \qquad Tsize - qmv_t^S = \frac{\sum_{i \epsilon S} (MVE_{i,t} + BVD_{i,t})}{\sum_{j \epsilon F,NF} (MVE_{j,t} + BVD_{i,t})},$$

Since MVE is reported daily and BVD quarterly, the latter is carried over for each day of the quarter in order to obtain a daily measure of *Tsize − qmv*. For comparability, all measures are reported at the quarterly frequency and so *Esize − mv* and *Tsize − qmv* are averaged quarterly. We focus on the MVE-based measures 2 and 3 for most of the paper.

For firm *i* and day *t*, the book-value based measures, discussed in Section 5.2, are:

$$(4) \qquad Esize - bv_t^S = \frac{\sum_{i \epsilon S} BVE_{i,t}}{\sum_{j \epsilon F,NF} BVE_{j,t}},$$

$$(5) \qquad Tsize - bv_t^S = \frac{\sum_{i \epsilon S} (BVE_{i,t} + BVD_{i,t})}{\sum_{j \epsilon F,NF} (BVE_{j,t} + BVD_{j,t})}.$$

A downside of our firm-level measures is that, because they comprise only publicly listed firms, the estimated sizes are affected by the relative shares of private firms in the financial and nonfinancial sectors. Over time, these effects are magnified if financial and nonfinancial firms go public at different rates. To address these concerns, we consider an additional measure based on FOF data, which captures most assets and liabilities in the economy, although it is available only at the sectoral level:

$$(6) \qquad Fsize_t^S = \frac{\sum_{s \epsilon S} Liabilities_{s,t}}{\sum_{j \epsilon F,NF} Liablities_{j,t}},$$

where $Liabilities_{s,t}$ is the total liability of sector s in quarter *t*. Thus, for the shadow banking sector, for example, we sum the liabilities of the subsectors s making up the shadow banking industry and express that figure as a ratio to the total liabilities of the business sector. When $S = F$, we are measuring total financial liabilities relative to total business sector liabilities.

To further address the potential biases of using only publicly listed firms, we provide an alternative measure of the size of the DCI sector using Call Reports data that include public and private banks:

$$(7) \qquad Csize_t = \frac{\sum_{i \epsilon B} (BVE_{i,t} + BVD_{i,t})}{\sum_{j \epsilon F,NF} Liabilities_{j,t}},$$

where *B* is the commercial banking sector, equity and debt values of commercial banks are from Call Reports, and the denominator represents the total liabilities of the financial and nonfinancial sectors from the FOF data (which is identical to the denominator of equation 6).

As a check, we compare the total book value (BVE plus BVD) of banks for all our metrics and find that the mean is smaller using Call Reports data (about $4.36 trillion) than with the FOF data ($5.9 trillion) or the CRSP-Compustat data (about $7.9 trillion). This discrepancy may be due to the fact that Call Reports provide data for individual commercial banks while the other data sets report information for bank holding companies.[12]

Finally, we also calculate an alternative measure of shadow banking using an approach developed by Adrian and Ashcraft (2012) based on specific types of FOF liabilities.[13] The measure sums all liabilities recorded in the flow of funds that relate to securitization activity including mortgage-backed securities (MBS), asset-backed securities (ABS), and other GSE liabilities, as well as all short-term money market liabilities that are not backstopped by deposit insurance (such as repos, commercial paper, and other money market mutual fund liabilities). We adjust the aggregate to mitigate double-counting. So, we have:

$$(8) \qquad AA_t^{SB} = \frac{\sum_{k \epsilon SB} Liabilities_{k,t}}{\sum_{j \epsilon F,NF} Liabilities_{j,t}}.$$

[11] We only calculate *Tsize − qmv* when both CRSP MVE data and Compustat BVD data are available.

[12] For more consistency across databases, we could have used Federal Reserve Y-9C forms that are filed by all bank holding companies of a certain size, which report consolidated data that include both commercial banking activity as well as other activity (such as investment banking) unrelated to commercial banking. Since we only want to focus on commercial banking activity, we prefer to use Call Reports.

[13] We thank the authors for providing the data. The liabilities are described in Table 1.

where $Liabilities_{k,t}$ is a particular liability $k$ (such as MBS) used by the shadow banking sector $SB$ in quarter $t$. The denominator represents the total liabilities of the financial and nonfinancial sectors from the FOF data (which is identical to the denominator of equation 6).

## 4. The Size and Growth of Finance and Its Subsectors

In this section, we describe evolution of the aggregate financial sector, the DCI and shadow banking credit intermediation subsectors, and the remaining subsectors, in particular, asset management, securities, and insurance. While the subsets of asset management and securities firms involved in credit intermediation are included in the shadow banking sector, this analysis encompasses the asset management and securities industries as a whole.

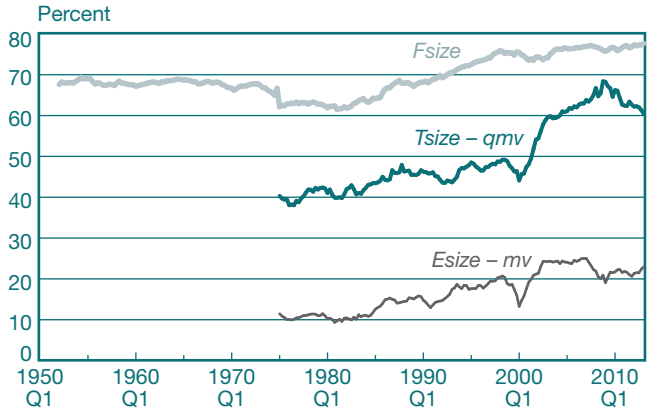
### 4.1 Growth of Finance

We find that, for all measures, the relative size of finance was growing consistently, particularly in the 1980s and from 2000 until just before the crisis in the third quarter of 2007. Chart 1 plots the values of *Tsize* − *qmv*, *Esize* − *mv*, and *Fsize*, while Table 2 reports summary statistics of these metrics for the full sample, pre-crisis (1980 to the third quarter of 2007), and crisis (the fourth quarter of 2007 to first quarter of 2013) periods. Chart 2 shows the median percent changes of the size measures for the pre-1980 period and subsequent decades. We report median instead of mean growth rates because the distribution of quarterly growth rates is skewed right, especially in the earlier part of the sample when some of our measures started from a low value (resulting in unusually high growth rates).

The financial sector was smaller but grew faster when measured using publicly listed firm assets instead of total (private and publicly listed) sectoral liabilities. Thus, the sample means for *Tsize* − *qmv* of about 50 percent and for *Esize* − *mv* of 17 percent were smaller than the mean for *Fsize* of almost 70 percent (see Table 2). The average growth over the full sample in the size of finance using *Fsize* was half that using public firm-based measures (0.40 percent for *Fsize* versus more than 0.80 percent for *Tsize* − *qmv* and *Esize* − *mv*) (Chart 2). Moreover, the growth in the relative size of publicly listed financial firms occurred even before 1980, whereas the *Fsize* measure had negative median

Chart 1

The Relative Size of Finance




Source: Authors' calculations.

Notes: This chart shows measures of the size of finance relative to the financial and nonfinancial sectors. See Table 1 for variable definitions.

growth during this period. This result is consistent with that obtained by using BEA data (which also include private firm liabilities).[14] Finally, the relative size of finance was larger using *Tsize* − *qmv* instead of *Esize* − *mv* (Chart 1), and the gap was increasing over time, which is indicative of rising leverage ratios for finance relative to the nonfinancial sector, as discussed further in Section 5.2.

As expected, the financial crisis had a deleterious effect on the size of the financial sector. From the peak pre-crisis quarter (the third quarter of 2007 for *Tsize* − *qmv* and *Fsize* and the first quarter of 2007 for *Esize* − *mv*) to the trough crisis quarter (the first quarter of 2009 for *Fsize* and *Esize* − *mv* and the first quarter of 2013 for *Tsize* − *qmv*), its total value shrank between 2 and 6 percentage points relative to the nonfinancial sector (Table 2).[15] The *Esize* − *mv* and *Fsize* measures indicate that finance barely recovered to pre-crisis levels by the first quarter of 2013 whereas *Tsize* − *qmv* shows that the relative

[14] For example, Greenwood and Scharfstein (2013) and Philippon (2012) find that finance became prominent in the 1980s.

[15] Unlike the other measures, *Tsize* − *qmv* does not reach its minimum during the depth of the crisis (first quarter of 2009). However, the crisis period declines in finance remain similar across measures even if we use a common measurement period (such as the third quarter of 2007 to the first quarter of 2009). For the interested reader, the value for *Esize* − *mv* in the third quarter of 2007 was 23.22 percent and the value for *Tsize* − *qmv* in the first quarter of 2009 was 68.26 percent.

Table 2
## The Relative Size of Finance

| | Full Sample | | |
|---|---|---|---|
| | *Tsize — qmv* | *Esize — mv* | *Fsize* |
| Observations | 8,017,993 | 17,099,300 | 245 |
| Mean | 49.73 | 16.84 | 69.43 |
| Median | 46.5 | 17.36 | 68.18 |
| Min / min quarter | 38.04 / 1976:Q3 | 9.34 / 1980:Q4 | 61.47 / 1981:Q1 |
| Max / max quarter | 68.40 / 2008:Q4 | 25.03 / 2007:Q1 | 77.67 / 2013:Q1 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | |
| | *Tsize — qmv* | *Esize — mv* | *Fsize* |
| Observations | 6,242,561 | 11,433,458 | 111 |
| Mean | 48.51 | 17.02 | 70.51 |
| Median | 46.41 | 16.26 | 71.54 |
| Min / min quarter | 39.8 / 1981:Q3 | 9.34 / 1980:Q4 | 61.47 / 1981:Q1 |
| Max / max quarter | 64.00 / 2007:Q3 | 25.03 / 2007:Q1 | 77.17 / 2007:Q3 |
| | Crisis Period (2007:Q4-2013:Q1) | | |
| | *Tsize — qmv* | *Esize — mv* | *Fsize* |
| Observations | 1,293,724 | 3,487,929 | 22 |
| Mean | 64.34 | 21.4 | 76.68 |
| Median | 64.43 | 21.55 | 76.66 |
| Min / min quarter | 60.41 / 2013:Q1 | 19.05 / 2009:Q1 | 75.74 / 2009:Q1 |
| Max / max quarter | 68.40 / 2008:Q4 | 22.96 / 2013:Q1 | 77.67 / 2013:Q1 |

Source: Authors' calculations.

Notes: This table reports summary statistics of measures of the size of finance relative to the financial and nonfinancial sectors. Observation units are firm days for *Tsize — qmv* and *Esize — mv* and quarters for *Fsize*. Units for all other statistics are percentages. For *Tsize — qmv* and *Esize — mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions. Min (max) quarter refers to the quarter in which the measure achieves its minimum (maximum) value in the sample.

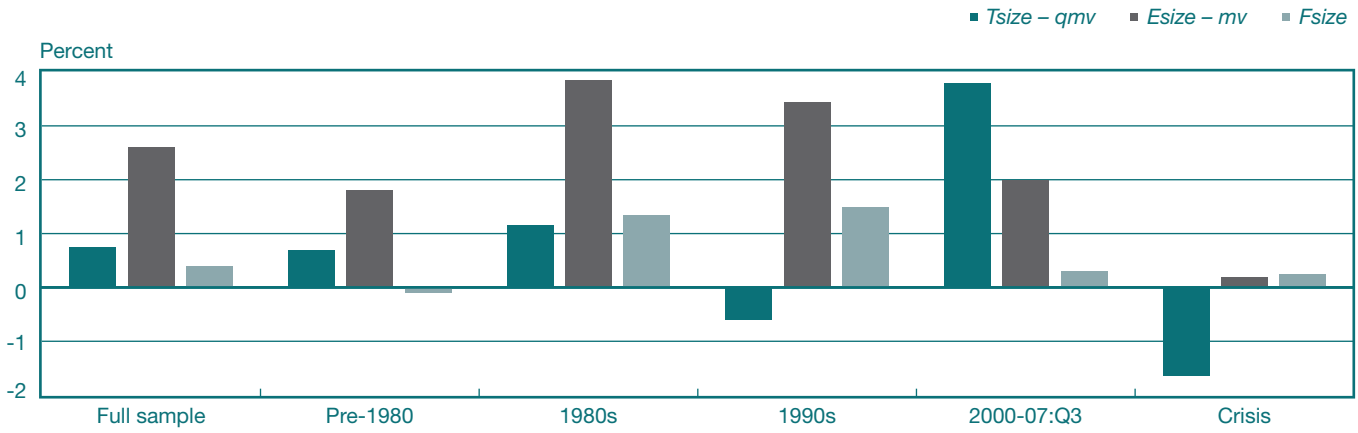
size of finance remains almost 2 percent lower than its peak in the pre-crisis quarter (Chart 2).

While the post-crisis recovery in finance has been tepid by any measure, it would have been even worse if we excluded GSEs from our sample. As discussed in Appendix B, we consider GSEs to be financial firms (in keeping with Financial Stability Board [2011] and Financial Stability Board [2012]). To examine the effect of GSEs on size measures, we recalculate our metrics excluding GSEs and agency- and GSE-backed mortgages from our definitions of both finance and nonfinance. Although they typically account for a small share of finance, GSEs expanded greatly during the recent crisis in response to the credit crunch. For example, if we subtract GSEs, the peak in finance shifts from the first quarter of 2013 to third quarter of 2007 using *Fsize*.

While our results show that finance grew relative to the nonfinancial sector in the sample period, that increase may have been part of a general growth in services. Using SIC and NAICS codes to classify the services industry, we find that finance grew even relative to the nonfinancial services sector, consistent with Greenwood and Scharfstein (2013) and Philippon (2012).

Chart 2

Median Percentage Change in the Relative Size of Finance, by Period




Source: Authors' calculations.

Notes: This chart shows median annualized quarter-to-quarter percentage changes in the relative size of finance for each measure for specific periods. Size is relative to the financial andnonfinancial sectors. For *Tsize – qmv* and *Esize – mv*, we first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

## 4.2 The Size and Growth of Credit Intermediation

While credit intermediation has always been an essential component of finance, its nature has changed over time. Traditional credit intermediation is carried out by DCIs or banks that take insured deposits and give loans, and are regulated by and receive liquidity support from the central bank. Increasingly, though, shadow banks outside the purview of regulatory authorities intermediate credit. In this section, we discuss the growth of shadow banking and its sources, the size of the traditional banking and DCI sectors, and the relative share of shadow banking in total credit intermediation.

### *Shadow Banking*

Shadow banking is, in essence, any form of nondepository credit intermediation. Pozsar et al. (2013) explain that shadow banking credit is intermediated by a variety of nonbank financial specialists such as asset managers, broker-dealers, and finance companies. For the *Fsize* measure, we follow Financial Stability Board (2011) and Financial Stability Board (2012) and use FOF sector categories to define the shadow banking sector. For our CRSP-Compustat measures, we define equivalent sectors by using SIC and NAICS industry codes that map to the FOF sectors.[16] We also report an *AA* measure using the approach of Adrian and Ashcraft (2012), who size the shadow banking sector based on specific types of FOF liabilities (see Section 3 for more discussion).

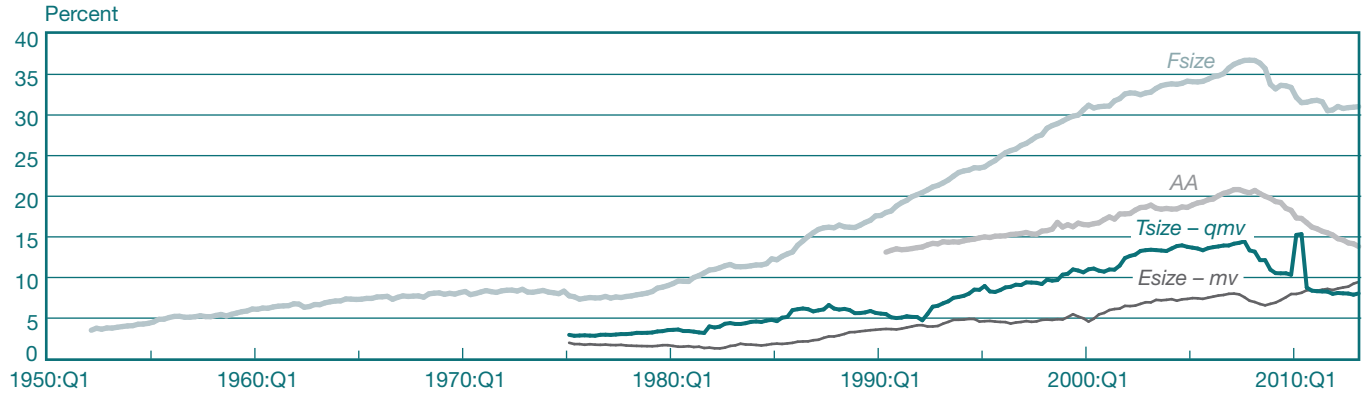
All measures show shadow banking growing relative to the rest of the economy from at least the 1980s until the recent financial crisis. The sector was small and growing unevenly in the 1970s. Then its growth accelerated in the 1980s and 1990s before slowing down in the 2000s and finally plummeting in the crisis (Charts 3 and 4). This result is consistent with Pozsar et al. (2013), Adrian and Ashcraft (2012), and Financial Stability Board (2012). The relative size of the shadow banking sector was less than 4 percent of the business sector in 1975 but reached a high of between 9 and 37 percent (depending on the measure) in the recent decade (Table 3). As for finance in general, the relative size of shadow banking is smaller when public firm-based measures are used. For example, the sample mean relative size of shadow banking is 8 percent based on *Tsize* — *qmv* and about 16 percent per the *Fsize* and *AA* measures.

The share of shadow banking in the business sector decreased during the recent financial crisis based on all measures, with pre-crisis peak quarter to crisis trough quarter declines of at least 6 percentage points by all measures except *Esize* — *mv* (Table 3). The average

[16] Details of this mapping are in Appendix B.

Chart 3

## The Relative Size of Shadow Banking

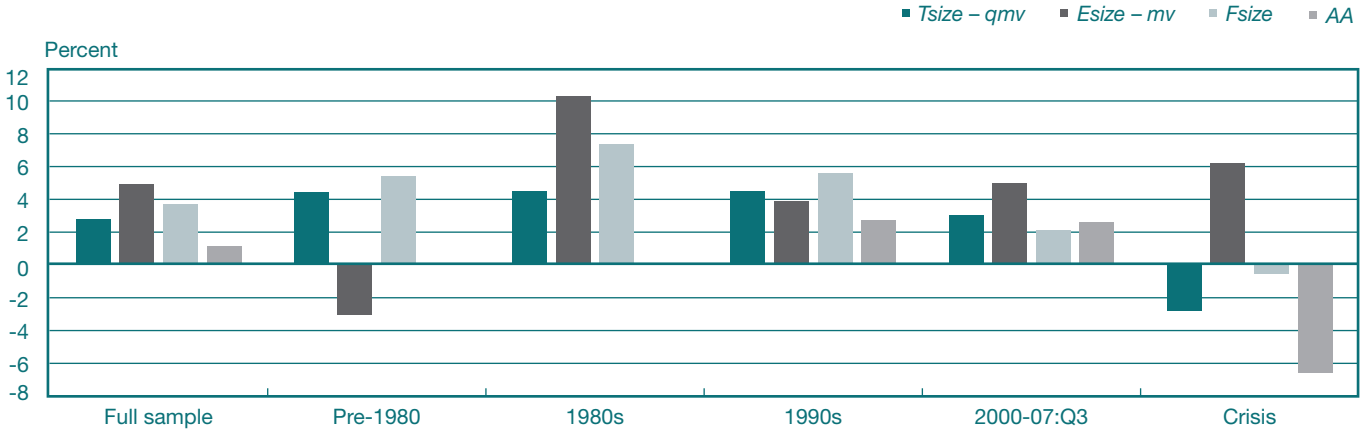



Source: Authors' calculations.

Notes: This chart shows measures of the size of shadow banking relative to the financial and nonfinancial sectors. See Table 1 for variable definitions.

Chart 4

## Median Percentage Change in the Relative Size of Shadow Banking, by Period




Source: Authors' calculations.

Notes: This chart shows median annualized quarter-to-quarter percentage changes in the relative size of shadow banking for each measure for specific periods. Size is relative to the financial and nonfinancial sectors. For *Tsize — qmv* and *Esize — mv*, we first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

decline in the share of shadow banking during the crisis was particularly sharp using the *AA* measure, which is based on financial liabilities such as commercial paper and asset-backed securities that suffered the most during the crisis (Chart 4). In contrast, the *Esize — mv* measure shows only a modest decline from pre-crisis peak to crisis trough quarters and, in fact, indicates a positive median growth rate in shadow banking since the crisis.

As for finance overall, the crisis effect was harsher for shadow banks when GSEs and agency- and GSE-backed mortgages are excluded. Indeed, when Fannie Mae and Freddie Mac are not counted, the crisis-period spike in *Tsize — qmv* (Chart 3) disappears entirely. However, the general trend of a growing shadow banking sector in the pre-crisis period is robust to whether GSEs are included or excluded from the sample.

Table 3
## The Relative Size of Shadow Banking

| | Full Sample | | | |
|---|---|---|---|---|
| | *Tsize — qmv* | *Esize — mv* | *Fsize* | *AA* |
| Observations | 1,524,082 | 7,186,652 | 245 | 91 |
| Mean | 7.85 | 4.49 | 16.36 | 16.71 |
| Median | 7.75 | 4.52 | 11.32 | 16.48 |
| Min / min quarter | 2.83 / 1975:Q2 | 1.27 / 1982:Q2 | 3.51 / 1952:Q1 | 13.12 / 1990:Q2 |
| Max / max quarter | 15.34 / 2010:Q2 | 9.45 / 2013:Q1 | 36.74 / 2007:Q4 | 20.82 / 2007:Q2 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | | |
| | *Tsize — qmv* | *Esize — mv* | *Fsize* | *AA* |
| Observations | 1,243,879 | 4,199,269 | 111 | 69 |
| Mean | 8.25 | 4.3 | 22.74 | 16.56 |
| Median | 7.61 | 4.51 | 22.93 | 16.36 |
| Min / min quarter | 3.17 / 1981:Q3 | 1.27 / 1982:Q2 | 9.25 / 1980:Q1 | 13.12 / 1990:Q2 |
| Max / max quarter | 14.46 / 2007:Q3 | 8.02 / 2007:Q3 | 36.72 / 2007:Q3 | 20.82 / 2007:Q2 |
| | Crisis Period (2007:Q4-2013:Q1) | | | |
| | *Tsize — qmv* | *Esize — mv* | *Fsize* | *AA* |
| Observations | 165,822 | 2,311,902 | 22 | 22 |
| Mean | 10.2 | 7.99 | 32.71 | 17.19 |
| Median | 9.55 | 8.25 | 31.78 | 17.01 |
| Min / min quarter | 7.88 / 2012:Q4 | 6.57 / 2008:Q3 | 30.53 / 2011:Q3 | 13.82 / 2013:Q1 |
| Max / max quarter | 15.34 / 2010:Q2 | 9.45 / 2013:Q1 | 36.74 / 2007:Q4 | 20.72 / 2008:Q1 |

Source: Authors' calculations.

Notes: This table reports summary statistics of measures of the size of finance relative to the financial and nonfinancial sectors. Observation units are firm days for *Tsize — qmv* and *Esize — mv* and quarters for *Fsize*. Units for all other statistics are percentages. For *Tsize — qmv* and *Esize — mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions. Min (max) quarter refers to the quarter in which the measure achieves its minimum (maximum) value in the sample.

To understand the source of growth of shadow banking, we examine the types of credit intermediation that make up shadow banking: securities credit intermediation (SCI) (such as securities and commodities brokerages and investment banking), asset management credit intermediation (AMCI) (including mutual funds, closed-end funds, exchange-traded funds, and other financial vehicles), and real estate credit intermediation (RECI) (like mortgage credit, mortgage brokerages, agency GSEs, agency- and GSE-backed mortgages, and REITs). We define these sectors consistently in all our data sets (although, due to differences in data construction, it is unlikely that the industry composition of sectors is identical in the different data sets). Table 4 reports the relative shares of various types of credit intermediation in shadow banking for the full sample and subsamples of interest.

We see that AMCI and RECI liabilities make up the bulk of total shadow banking liabilities, per the *Fsize* measure. For example, the share of AMCI liabilities in shadow banking (based on *Fsize*) grew from 28 percent in the 1980s to almost 43 percent in the crisis period of 2007-13. In contrast, and perhaps surprisingly, the share of RECI declined steadily from 42 percent in the 1980s to 32 percent in the crisis, based on *Fsize*. Of publicly listed

Table 4

## Share of Shadow Banking, by Types of Credit Intermediation

| | Full Sample | | |
|---|---|---|---|
| | *Tsize − qmv* | *Esize − mv* | *Fsize* |
| SCI | 29.04 | 15.02 | 8.64 |
| AMCI | 0.00 | 22.99 | 29.63 |
| RECI | 2.06 | 5.21 | 30.50 |
| Other | 68.89 | 56.78 | 31.23 |
| | Pre-crisis Period (Start-2007:Q3) | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* |
| SCI | 27.01 | 17.62 | 8.70 |
| AMCI | 0.00 | 27.97 | 28.36 |
| RECI | 1.96 | 6.08 | 30.35 |
| Other | 71.02 | 48.32 | 32.58 |
| | 1980:Q1-1989:Q4 | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* |
| SCI | 53.88 | 37.35 | 5.97 |
| AMCI | 0.00 | 28.55 | 28.22 |
| RECI | 2.76 | 12.73 | 42.04 |
| Other | 43.35 | 21.36 | 23.76 |
| | 1990:Q1-1999:Q4 | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* |
| SCI | 51.27 | 19.45 | 7.32 |
| AMCI | 0.00 | 36.04 | 36.72 |
| RECI | 3.69 | 9.72 | 36.14 |
| Other | 45.03 | 34.79 | 19.82 |
| | 2000:Q1-2007:Q3 | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* |
| SCI | 47.48 | 23.61 | 8.86 |
| AMCI | 0.00 | 29.29 | 38.24 |
| RECI | 2.78 | 6.05 | 31.95 |
| Other | 49.74 | 41.05 | 20.95 |
| | Crisis Period (2007:Q4-2013:Q1) | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* |
| SCI | 50.39 | 16.15 | 8.05 |
| AMCI | 0.00 | 69.62 | 42.97 |
| RECI | 3.12 | 2.3 | 31.97 |
| Other | 46.49 | 11.94 | 17.00 |

Source: Authors' calculations.

Notes: This table shows the sample averages for the share of total shadow banking for which each type of credit intermediation accounts. All statistics are percentages of the total size of shadow banking. See Table 1 for variable definitions. AMCI stands for asset management credit intermediation, which we define as the component of asset management which occurs in the shadow banking sector. SCI and RECI are securities credit intermediation and real estate credit intermediation, respectively. Exact definitions of these types of credit intermediation can be found in Appendix B.

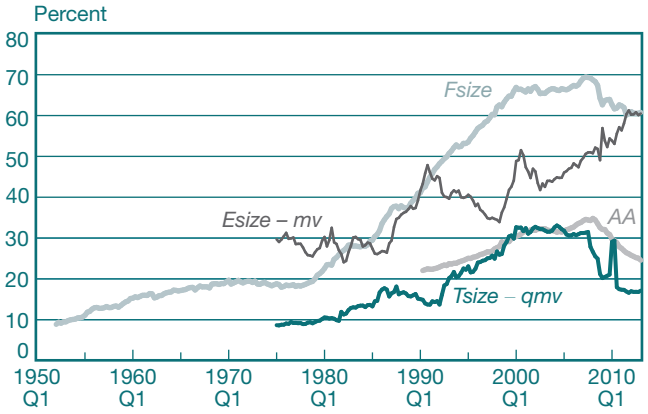
shadow banks, SCI firms accounted for the largest shares by *Tsize − qmv* and *Esize − mv*. Greenwood and Scharfstein (2013) note that the rise of asset management firms is closely correlated with asset prices, which rose strongly in the 1990s. Consistent with this finding, publicly listed AMCI firms grew from about 29 percent in the 1980s to 36 percent in the 1990s, according to the *Esize − mv* metric. Interestingly, the market capitalization of AMCI firms grew strongly even during the recent crisis, with their share using *Esize − mv* jumping from about 29 percent of all shadow banking in the early 2000s to about 70 percent in the crisis. Since many of these AMCI firms are funds which do not file quarterly or annual reports with the Securities and Exchange Commission, we do not have balance sheet data for them and thus exclude them from all *Tsize − qmv* calculations. The share of publicly listed "other" shadow banks was also large and growing in the pre-crisis period, mostly due to increases in assets of secondary market financing and general finance companies.

To determine how shadow banking has evolved relative to the traditional banking sector, we measure the share of shadow banks in total credit intermediation (TCI). In particular, we look at ratios of the form $\frac{SB}{SB + DCI}$, where *DCI (SB)* is either the asset or equity value of DCI (shadow banking) firms in CRSP-Compustat or the total liability of the DCI (shadow banking) sector in the FOF data.

The share of shadow banking in TCI has grown steadily since 1980 (Chart 5). While shadow banking has always made up a nontrivial portion of TCI (at least 9 percent), it grew to a peak of between 33 percent and 69 percent post-2004, depending on the measure) as Table 5 shows. By all measures except *Esize*, the share of shadow banking in TCI grew consistently until the period between 2000 and the third quarter of 2007, when the growth rate decelerated while remaining positive, and then turned negative in the recent crisis (Chart 6).

Chart 5

The Share of Shadow Banking in Total Credit Intermediation




Source: Authors' calculations.

Notes: This chart shows measures of the share of shadow banking in total credit intermediation (TCI). The TCI sector is the sum of credit intermediation by the shadow banking sector and the depository credit institutions sector. See Table 1 for variable definitions.

### *Depository Credit Intermediation*

Did the DCI sector shrink over time or did it simply expand at a slower pace than shadow banking? To examine its size and evolution, we also consider the metric *Csize*, based on commercial bank assets reported in Call Reports (as described in Section 3).

The *Fsize* and *Csize* measures show a striking pattern of persistent decline for the DCI sector (Chart 7). These measures attain their peak early in the sample (the fourth quarter of 1954 for *Fsize* and the fourth quarter of 1975 for *Csize*; see Table 6) and have negative average growth rates over the entire sample period (-0.95 percent for *Fsize* and -2.20 percent for *Csize*; see Chart 8). The median growth rates based on these measures became particularly negative in the 1980s and 1990s and were only mildly positive in the 2000s (Chart 8). Growth rates for publicly listed DCIs, per *Tsize − qmv*, were also negative on average. Only the *Esize − mv* measure shows positive average growth for DCIs over the whole sample period.

## 4.3 Asset Management, Securities, Real Estate, and Insurance

We next focus on the size of the entire asset management, securities and real estate sectors, rather than specifically examining their credit intermediation components. We also examine the insurance sector. The results are not reported here but are available in Appendix C online.

For the asset management sector, Table C1 indicates almost 5.7 million firm-day observations for the *Esize − mv* sample, but only about 600,000 firm-day observations in the *Tsize − qmv* sample. This difference is because most open-end funds do not report balance sheet data, and so we exclude them from our *Tsize − qmv* calculations (see Appendix A).

Table 5

## Share of Shadow Banking in Total Credit Intermediation

| | Full Sample | | | |
|---|---|---|---|---|
| | *Tsize − qmv* | *Esize − mv* | *Fsize* | *AA* |
| Observations | 1,524,082 | 7,186,652 | 245 | 91 |
| Mean | 19.94 | 39.58 | 35.53 | 28.58 |
| Median | 17.39 | 39.84 | 27.86 | 29.1 |
| Min / min quarter | 8.61 / 1975:Q2 | 24.07 / 1982:Q1 | 8.86 / 1952:Q1 | 22.04 / 1990:Q2 |
| Max / max quarter | 33.08 / 2004:Q2 | 61.26 / 2011:Q4 | 69.42 / 2007:Q2 | 34.81 / 2008:Q1 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* | *AA* |
| Observations | 1,222,813 | 4,199,269 | 111 | 69 |
| Mean | 21.73 | 38.36 | 49.44 | 28.35 |
| Median | 20.67 | 39.62 | 52.33 | 29.1 |
| Min / min quarter | 9.73 / 1981:Q3 | 24.07 / 1982:Q2 | 22.53 / 1980:Q1 | 22.04 / 1990:Q2 |
| Max / max quarter | 33.08 / 2004:Q2 | 51.53 / 2000:Q3 | 69.42 / 2007:Q2 | 34.57 / 2007:Q2 |
| | Crisis Period (2007:Q4-2013:Q1) | | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* | *AA* |
| Observations | 165,346 | 2,311,902 | 22 | 22 |
| Mean | 20.69 | 55.9 | 63.15 | 29.31 |
| Median | 19.08 | 55.96 | 62.5 | 29.12 |
| Min / min quarter | 16.60 / 2011:Q4 | 49.01 / 2008:Q4 | 60.1 / 2011:Q3 | 24.56 / 2013:Q1 |
| Max / max quarter | 29.38 / 2010:Q2 | 61.26 / 2011:Q4 | 69.2 / 2007:Q4 | 34.81 / 2008:Q1 |

Source: Authors' calculations.

Notes: This table shows the summary statistics of measures of the share of shadow banking in total credit intermediation (TCI). TCI is the sum of credit intermediation by the shadow banking sector and the depository credit institutions sector. Observation units are firm days for *Tsize − qmv* and *Esize − mv* and quarters for *Fsize* and *AA*. Units for all other statistics are percentages. For *Tsize − qmv* and *Esize − mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions.

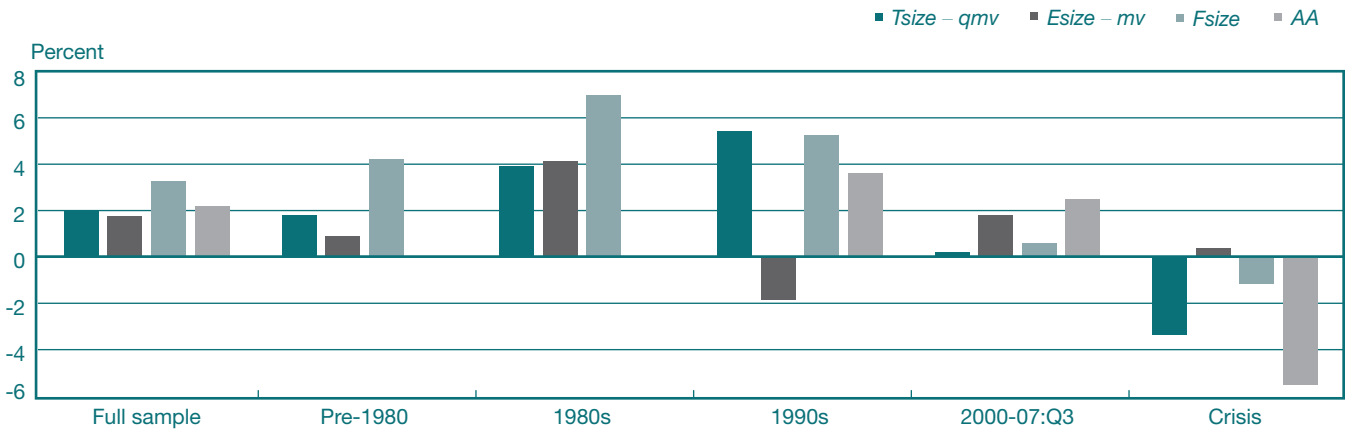
Accordingly, we place more emphasis on the results based on *Esize − mv* when evaluating the performance of the asset management sector.

Asset management had a relatively small average share of the business sector ranging from about 2 percent to 3 percent using the MVE-based measures to 6 percent by *Fsize* (see Table C1). However, the sector has been growing rapidly by all measures except *Tsize − qmv*. The *Fsize* and *Esize − mv* measures show average growth rates of about 8 percent and 4 percent in the sample, respectively, including during the recent crisis (Chart C1). While the *Fsize* measure marks consistent growth in all decades, the MVE-based measures suggest more intermittent growth that has surged since 2000, consistent with Greenwood and Scharfstein (2013), who find a similar pattern of rapid recent growth based on industry revenues.

The securities sector has been about 1 percent to 4 percent of the business sector on average, peaking at 2 percent to 8 percent just before the recent crisis (Table C2). We find a consistent pattern of growth in most decades, with an acceleration since 2000, in contrast with Greenwood and Scharfstein (2013), who find that securities growth peaked in 2001 (see Chart C2). Our measures unanimously show securities firms shrinking during the crisis.

Chart 6

Median Percentage Change in the Share of Shadow Banking in Total Credit Intermediation, by Period




Source: Authors' calculations.

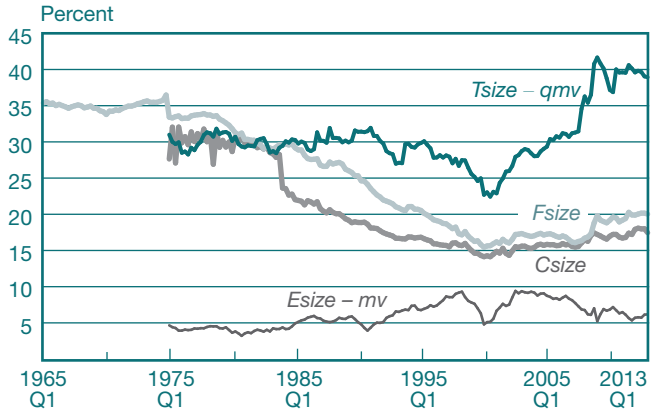
Notes: This chart shows median annualized quarter-to-quarter percentage changes in the share of shadow banking in total credit intermediation (TCI) for each measure over several periods. The TCI sector is the sum of credit intermediation by the shadow banking sector and the depository credit institutions sector. For *Tsize — qmv* and *Esize — mv*, we first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

The size and evolution of the real estate sector present sharply contrasting pictures depending on whether we use the MVE-based measures or the *Fsize* measure. Real estate firms were small relative to the universe of publicly listed firms over the whole period, based on *Tsize — qmv* and *Esize — mv*, with sample averages under 0.40 percent of total publicly listed firm assets (Table C3), but they have grown since the 1980s and especially during the crisis (Chart C3). In contrast, the *Fsize* metric shows that real estate accounted for more than 5 percent of total liabilities on average, with its share peaking at 12 percent in first quarter of 2003 (constituting almost a third of all shadow banking liabilities) before shrinking during the crisis (Table C3).

Finally, the insurance sector is the largest of the noncredit intermediation sectors, with an average relative size of more than 21 percent over the sample period (peaking at 27 percent in first quarter of 1998) per *Fsize* and about 9 percent (peaking at 15 percent in the third quarter of 2004) per *Tsize — qmv* (Table C4). The sector grew steadily but moderately over most of the sample period and then crashed in the recent crisis (Chart C4).

Chart 7

The Relative Size of Depository Credit Institutions




Source: Authors' calculations.

Notes: This chart shows measures of the size of depository credit institutions relative to the financial and nonfinancial sectors. See Table 1 for variable definitions.

Table 6

## The Relative Size of Depository Credit Institutions

| | Full Sample | | | |
|---|---|---|---|---|
| | *Tsize − qmv* | *Esize − mv* | *Fsize* | *Csize* |
| Observations | 4,237,897 | 5,236,753 | 245 | 1,816,776 |
| Mean | 30.49 | 6.09 | 27.69 | 20.21 |
| Median | 29.88 | 5.81 | 29.7 | 17.28 |
| Min / min quarter | 22.43 / 2000:Q3 | 4.71 / 1976:Q3 | 15.44 / 2000:Q1 | 14.14 / 2000:Q3 |
| Max / max quarter | 41.66 / 2009:Q1 | 16.17 / 2013:Q1 | 36.59 / 1954:Q4 | 32.04 / 1975:Q4 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* | *Csize* |
| Observations | 3,225,438 | 4,063,827 | 111 | 1,349,320 |
| Mean | 28.87 | 6.38 | 22.23 | 19.04 |
| Median | 29.37 | 6.04 | 20.87 | 16.79 |
| Min / min quarter | 22.43 / 2000:Q3 | 3.21 / 1980:Q4 | 15.44 / 2000:Q1 | 14.14 / 2000:Q3 |
| Max / max quarter | 31.94 / 1991:Q1 | 9.42 / 2002:Q3 | 31.81 / 1980:Q1 | 30.78 / 1980:Q4 |
| | Crisis Period (2007:Q4-2013:Q1) | | | |
| | *Tsize − qmv* | *Esize − mv* | *Fsize* | *Csize* |
| Observations | 745,412 | 766,541 | 22 | 166,487 |
| Mean | 38.89 | 6.28 | 19.05 | 17.12 |
| Median | 39.59 | 6.18 | 19.3 | 17.14 |
| Min / min quarter | 34.56 / 2007:Q4 | 5.23 / 2009:Q1 | 16.35 / 2007:Q4 | 16.05 / 2007:Q4 |
| Max / max quarter | 41.66 / 2009:Q1 | 7.18 / 2010:Q2 | 20.27 / 2011:Q3 | 18.08 / 2012:Q2 |

Source: Authors' calculations.

Notes: This table reports summary statistics of measures of the size of depository credit institutions relative to the financial and nonfinancial sectors. Observation units are firm days for *Tsize − qmv*, *Esize − mv,* and *Csize* and quarters for *Fsize*. Units for all other statistics are percentages. For *Tsize − qmv* and *Esize − mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions. Min (max) quarter refers to the quarter in which the measure achieves its minimum (maximum) value in the sample.

## 5. Firm Size and Heterogeneity, Leverage, and Regulation

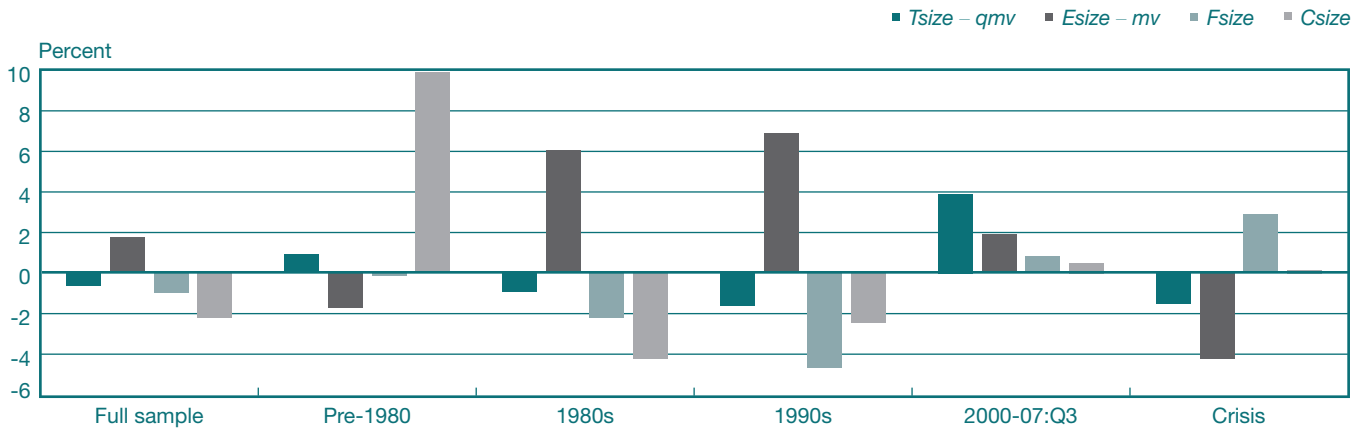
In this section, we examine the effects of firm size and heterogeneity, leverage, and regulation on financial-sector growth. Philippon and Reshef (2013) suggest that increased concentration in the banking sector may be responsible for the increasing income share of finance. Policy initiatives have sought to mitigate negative externalities generated by too-big-to-fail firms.[17] Motivated by these concerns, we estimate our size measures for large and small financial firms separately. Regarding firm heterogeneity, Philippon (2012) notes that the mixture of new and old firms changes significantly over time, reflecting waves of technological change (Jovanovic and Rousseau 2005) and affecting measures of financial-sector size. We adjust for firm-level heterogeneity through firm fixed effects in a panel regression. Heightened awareness of the risks of leverage led to a minimum leverage ratio of 3 percent for banks under the Basel III regulatory framework as well as a proposal for additional capital requirements for large bank holding companies by U.S. regulators.[18] Calomiris and Nissim (2012)

[17] See http://www.federalreserve.gov/newsevents/reform_milestones.htm for examples of policy proposals for regulation of large and complex institutions.

[18] See https://www.bis.org/publ/bcbs270.htm for Basel III leverage ratio requirements and http://www.federalreserve.gov/newsevents/press/bcreg/20130709a.htm for the proposal to strengthen leverage ratio standards by the Federal Reserve, the FDIC, and the Office of the Comptroller of the Currency.

Chart 8

Median Percentage Change in the Relative Size of Depository Credit Institutions, by Period




Source: Authors' calculations.

Notes: This chart shows median annualized quarter-to-quarter percentage changes in the relative size of depository credit institutions for each measure for specific periods. Size is relative to the financial and nonfinancial sectors. For *Tsize − qmv* and *Esize − mv*, we first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

find that leverage is an important determinant of the market value of commercial banks. Thus, to investigate the effect of leverage on our size measures, we compare equity-only with total asset-based measures. Finally, we consider the effect of select financial regulations on changes in financial-sector size. Philippon and Reshef (2012) suggest that regulation discourages skilled workers and conclude that it is the main determinant of the demand for skill and wages in the U.S. financial sector. Philippon and Reshef (2013) find that, with some exceptions, countries that deregulate more also experience larger increases in the relative skill intensity in finance.

## 5.1 Firm Size and Heterogeneity

Our disaggregated data allow us to evaluate whether the growth of finance is mainly due to the growth of large financial firms or whether it is more broadly based. We first take a look at trends in the Herfindahl-Hirschman index (HHI) of market concentration for the financial and nonfinancial sectors. Both sectors show low levels of concentration that have changed little over time. Given the low and stable concentration in both the financial and nonfinancial sectors, we estimate the relative size of small and large financial firms separately. For each metric and each year, we partition firms at the beginning of the year into two subsets. Large firms are those in the top 10 percent of firms, while small firms are defined as the remaining 90 percent of firms, based on *Tsize − qmv* or *Esize − mv*.[19] We then estimate the share of value of large (small) firms in sector *S* as a percentage of the total value of large (small) firms in the financial and nonfinancial sectors.[20] Thus, for large firms *i* on day *t*, the size measure for sector *S* is:

$$(9) \qquad Size^{S}_{Large,t} = \frac{\sum_{j \epsilon S}{}^{Large} Value_{i,t}}{\sum_{j \epsilon F}{}^{Large}{}_{,NF}{}^{Large} Value_{j,t}}.$$

Similarly, for small firms *i* on day *t*, the size metric for sector *S* is:

$$(10) \qquad Size^{S}_{Small,t} = \frac{\sum_{j \epsilon S}{}^{Small} Value_{i,t}}{\sum_{j \epsilon F}{}^{Small}{}_{,NF}{}^{Small} Value_{j,t}}.$$

[19] We also tried a lower cutoff for small firms (such the bottom 50 percent of firms) and obtained similar mean shares but substantially larger volatility in the shares from year to year.

[20] The share of finance in small firms may increase because large financial firms have decreased in size and become small, or vice versa. Likewise, an increase in the share of finance in large firms could be due to small financial firms growing and joining the large sample. Thus, growth in the share of finance in the large (small) firm sample need not be the same as the relative growth of large (small) finance firms. We use $S^{Large}$ ($S^{Small}$) to denote the intersection of sector *S* with the top ten percent (bottom 90 percent) of all firms.

Table 7

## The Relative Size of Large and Small Financial Firms

| | Full Sample | | | |
|---|---|---|---|---|
| | *Tsize* − *qmv*_small | *Tsize* − *qmv*_large | *Esize* − *mv*_small | *Esize* − *mv*_large |
| Observations | 6,396,748 | 1,892,004 | 6,396,748 | 1,892,004 |
| Mean | 18.54 | 55.56 | 8.21 | 16.81 |
| Median | 19.25 | 51.44 | 8.34 | 16.43 |
| Min / min quarter | 8.76 / 1984:Q1 | 46.60 / 1976:Q3 | 3.41 / 1975:Q4 | 9.53 / 1981:Q3 |
| Max / max quarter | 27.86 / 1994:Q2 | 73.15 / 2008:Q4 | 12.94 / 2003:Q1 | 26.12 / 2006:Q3 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | | |
| | *Tsize* − *qmv*_small | *Tsize* − *qmv*_large | *Esize* − *mv*_small | *Esize* − *mv*_large |
| Observations | 5,010,409 | 1,468,739 | 5,010,409 | 1,468,739 |
| Mean | 18.26 | 53.73 | 8.77 | 17.35 |
| Median | 19.14 | 50.96 | 9.53 | 16.43 |
| Min / min quarter | 8.76 / 1984:Q1 | 47.17 / 1983:Q1 | 3.81 / 1981:Q1 | 9.53 / 1981:Q3 |
| Max / max quarter | 27.86 / 1994:Q2 | 69.68 / 2007:Q3 | 12.94 / 2003:Q1 | 26.12 / 2006:Q3 |
| | Crisis Period (2007:Q4-2013:Q1) | | | |
| | *Tsize* − *qmv*_small | *Tsize* − *qmv*_large | *Esize* − *mv*_small | *Esize* − *mv*_large |
| Observations | 1,094,084 | 217,514 | 1,094,084 | 217,514 |
| Mean | 20.81 | 70.10 | 8.98 | 19.28 |
| Median | 20.76 | 70.09 | 8.67 | 19.52 |
| Min / min quarter | 19.20 / 2012:Q1 | 67.12 / 2013:Q1 | 8.20 / 2011:Q3 | 16.07 / 2009:Q1 |
| Max / max quarter | 24.03 / 2008:Q4 | 73.15 / 2008:Q4 | 11.05 / 2008:Q4 | 22.11 / 2007:Q4 |

Source: Authors' calculations.

Notes: This table reports, for each size measure, summary statistics of the relative size of large and small financial firms in the sample. For each year and each size measure, we rank all publicly listed firms by *Tsize* − *qmv*. The top 10 percent of firms are included in the large firm sample, while the remaining firms are included in the small firm sample. We estimate our size measures separately for the large and small firm samples. Observation units are firm days for *Tsize* − *qmv* and *Esize* − *mv*. Units for all other statistics are percentages. For *Tsize* − *qmv* and *Esize* − *mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions. Min (max) quarter refers to the quarter in which the measure achieves its minimum (maximum) value in the sample.

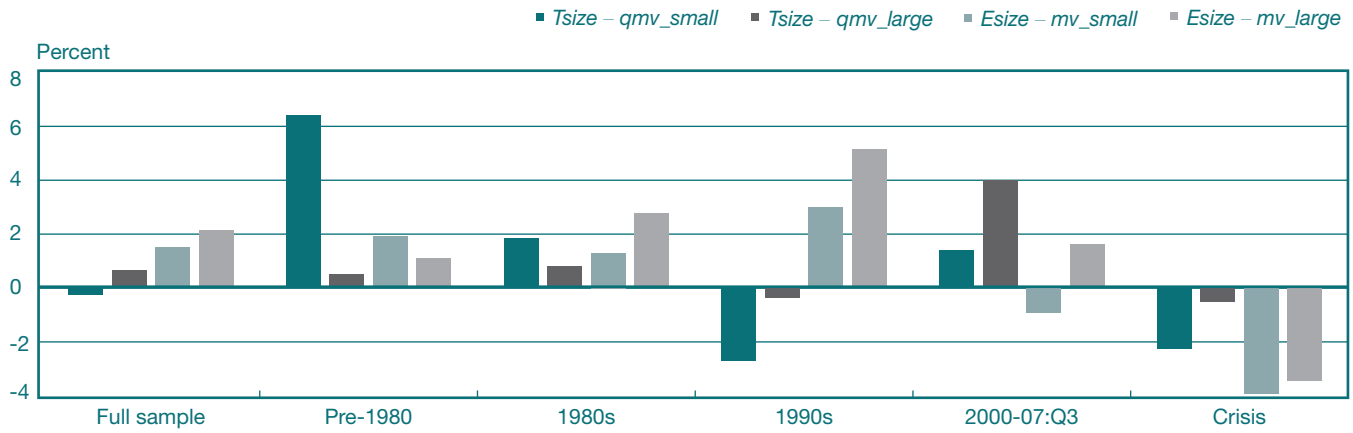
We find that financial firms are far more prevalent in the sample of large firms than they are in the sample of small firms. Within any period and for any measure, the relative size of finance is two to three times bigger in the large firm sample than in the small firm sample (Table 7). For example, by *Tsize* − *qmv*, large financial firms account for 56 percent of all large firms on average whereas small financial firms are 19 percent of all small firms on average for the full sample.

Median annualized growth rates show the relative size of large financial firms growing moderately more than the small financial firms (Chart 9). According to *Tsize* − *qmv*, small financial firms grew more until the 1990s, but large financial firms have grown more (or declined less) since then. *Esize* − *mv* shows large financial firms growing more in every decade since the 1980s. Both metrics show that small financial firms did worse than large financial firms during the crisis.

Large shadow banks also make up a larger proportion of all large firms than do small shadow banks of all small firms, although the difference is not as pronounced as for financial firms in general. Thus, the sample mean of the relative size of large shadow banks is over 8 percent whereas it is less than 3 percent for smaller shadow banks, according to *Tsize* − *qmv* (Table 8).

Chart 9

Median Percentage Change in the Relative Size of Large and Small Financial Firms




Source: Authors' calculations.

Notes: This chart shows, for each size measure, the median annualized quarter-to-quarter percentage changes in the relative size of large and small financial firms in the sample. We estimate our measures separately for the large and small firm samples. We first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

The corresponding means for *Esize* − *mv* are 3 percent of the large firm sample and 2 percent of the small firm sample. The share of large shadow banks in the large firm sample has grown more than the share of smaller shadow banks, although the difference is moderate according to *Esize* − *mv* (Chart 10). We do see that the recent crisis had a harsher effect on large shadow banks whose share in the large firm sample declined by more than 4 percent during the crisis, while the share of smaller shadow banks grew in the same period.

Large DCIs are a bigger share of all large firms than are small DCIs of all small firms, and the difference is substantial. For example, the sample mean of the relative size of large DCIs is about 34 percent by *Tsize* − *qmv*, more than three times the sample mean of 11 percent for small DCIs (Table 9). In addition, the gap between the relative shares of small and large DCIs has been increasing. We see in Chart 11 that the relative size of small DCIs has been declining over time, whereas the reverse is true for large DCIs. Moreover, large DCIs have consistently outgrown small DCIs in most decades since the 1980s. In the recent crisis period, small DCIs shrank more than large DCIs by *Tsize* − *qmv* while the opposite was true based on *Esize* − *mv*.

Firm-size effects illustrate the impact of firm heterogeneity generally. Since our measures are aggregated up to sectors from firm-level data, the sectoral means are potentially affected by firm-level heterogeneity. To account for this, we estimate a firm-level panel regression using firm size (relative to the total size of the business sector, as in the denominator of equation 1) as the dependent variable. We include all financial firms in the sample and regress the relative firm-size variable upon period and firm fixed effects. Chart 12 shows estimates of these period fixed effects, divided by the estimate of the regression intercept, using *Tsize* − *qmv* as the size measure. We find that, when firm-level heterogeneity is accounted for, financial-sector growth becomes more consistent. In particular, the dips in size around 2000, and during the crisis, are considerably muted, suggesting that these may have been largely firm-level effects.

To quantify the effect of firm heterogeneity on the size of different credit intermediation subsectors, we regress estimates of the period fixed effects, in a second stage, on sector-level dummy variables, omitting the nonfinancial sector. The results confirm the descriptive statistics. Specifically, the coefficient on the shadow banking sector is positive and significant for all measures, while the coefficient on the DCI sector is negative and significant for *Fsize* and positive and significant for *Tsize* − *qmv*, indicating the relative expansion of the shadow banking sector and the relative decline of the DCI sector per the *Fsize* measure.

Table 8

## The Relative Size of Large and Small Shadow Banking Firms

| | Full Sample | | | |
|---|---|---|---|---|
| | *Tsize — qmv*_small | *Tsize — qmv*_large | *Esize — mv*_small | *Esize — mv*_large |
| Observations | 1,372,634 | 195,870 | 1,372,634 | 195,870 |
| Mean | 2.81 | 8.63 | 1.81 | 2.68 |
| Median | 2.68 | 8.42 | 1.56 | 2.3 |
| Min / min quarter | 1.46 / 1981:Q4 | 2.98 / 1976:Q2 | 0.91 / 1975:Q4 | 0.64 / 1975:Q4 |
| Max / max quarter | 4.64 / 1998:Q3 | 17.02 / 2010:Q2 | 3.56 / 1997:Q4 | 6.28 / 2004:Q1 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | | |
| | *Tsize — qmv*_small | *Tsize — qmv*_large | *Esize — mv*_small | *Esize — mv*_large |
| Observations | 1,129,896 | 148,134 | 1,129,896 | 148,134 |
| Mean | 3.00 | 9.07 | 2.09 | 3.01 |
| Median | 3.02 | 8.34 | 1.91 | 2.54 |
| Min / min quarter | 1.46 / 1981:Q4 | 3.65 / 1981:Q3 | 0.95 / 1981:Q4 | 0.74 / 1982:Q1 |
| Max / max quarter | 4.64 / 1998:Q3 | 16.09 / 2007:Q3 | 3.56 / 1997:Q4 | 6.28 / 2004:Q1 |
| | Crisis Period (2007:Q4-2013:Q1) | | | |
| | *Tsize — qmv*_small | *Tsize — qmv*_large | *Esize — mv*_small | *Esize — mv*_large |
| Observations | 135,935 | 33,416 | 135,935 | 33,416 |
| Mean | 2.29 | 11.22 | 1.12 | 2.73 |
| Median | 2.19 | 10.51 | 1.10 | 2.78 |
| Min / min quarter | 1.9 / 2008:Q4 | 8.64 / 2012:Q4 | 0.91 / 2009:Q1 | 1.77 / 2009:Q1 |
| Max / max quarter | 2.9 / 2012:Q4 | 17.02 / 2010:Q2 | 1.33 / 2012:Q4 | 4.31 / 2007:Q4 |

Source: Authors' calculations.

Notes: This table reports, for each size measure, summary statistics of the relative size of large and small shadow banking firms in the sample. For each year and each size measure, we rank all publicly listed firms by *Tsize — qmv*. The top 10 percent of firms are included in the large firm sample, while the remaining firms are included in the small firm sample. We estimate our size measures separately for the large and small firm samples. Observation units are firm days for *Tsize — qmv* and *Esize — mv*. Units for all other statistics are percentages. For *Tsize — qmv* and *Esize — mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions. Min (max) quarter refers to the quarter in which the measure achieves its minimum (maximum) value in the sample.

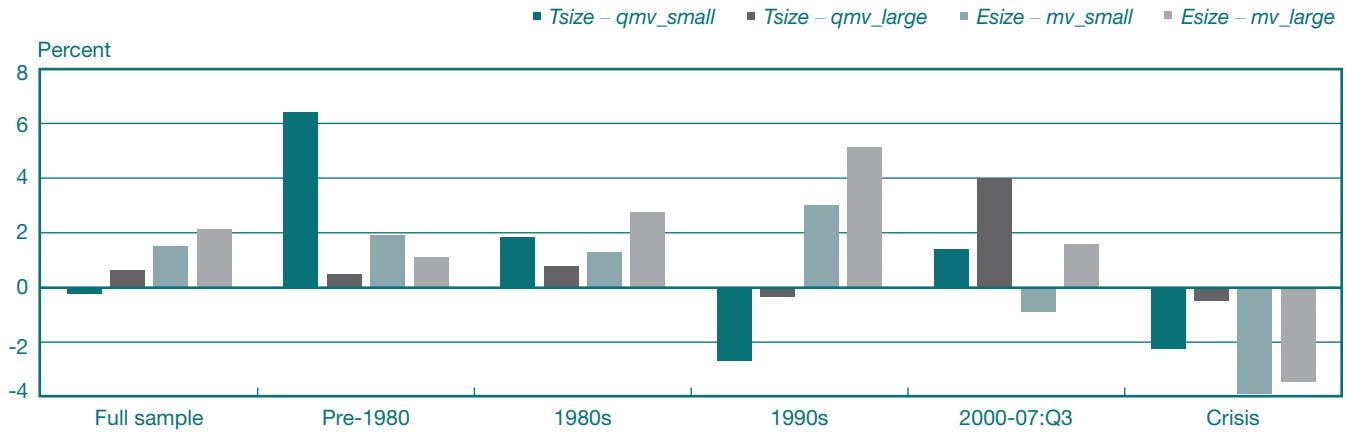
### 5.2 Leverage

To examine the effect of leverage on the growth pattern of financial firms, we consider the equity-only metrics *Esize — mv* and *Esize — bv* and compare them with the total value measures *Tsize — qmv* and *Tsize — bv*, respectively. The *Esize — bv* and *Tsize — bv* measures use the BVE rather than the MVE of firms, as shown in Table 1. The BVE-based results are reported in Appendix D online.

The equity-only measures show finance to be smaller than the total liabilities measures, but growing at a faster rate. Thus, *Esize* measures had sample means of 19 percent or less (Tables 2 and D1) compared with at least 50 percent using the *Tsize* measures. The difference increased during the crisis, with the *Esize* measures being 40 percentage points lower than the respective *Tsize* measures. This result indicates that balance sheet leverage has become relatively more prevalent in the capital structure of financial firms

Chart 10

Median Percentage Change in the Relative Size of Large and Small Shadow Banking Firms

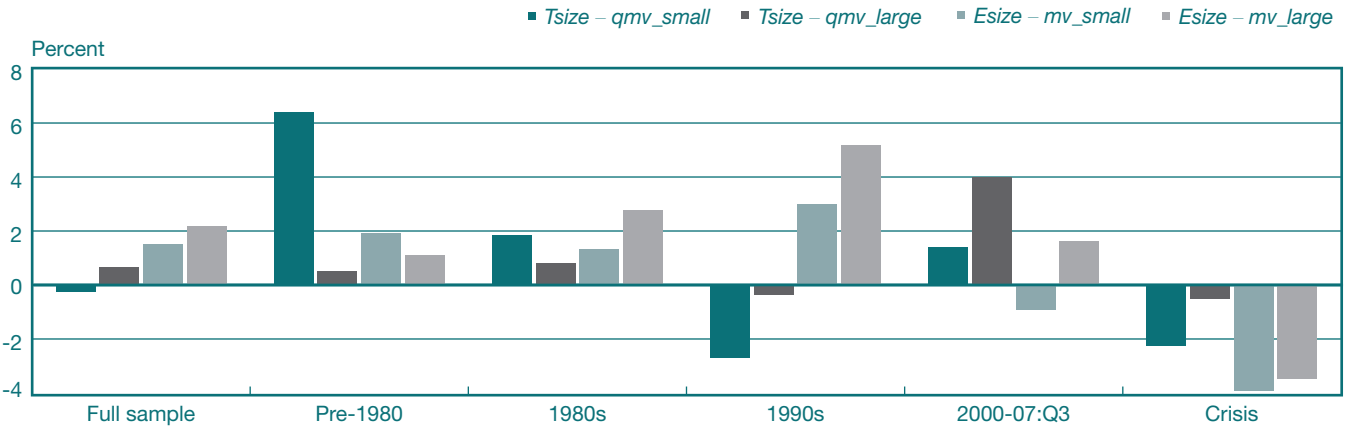



Source: Authors' calculations.

Notes: This chart shows, for each size measure, the median annualized quarter-to-quarter percentage changes in the relative size of large and small shadow banking firms in the sample. We estimate our measures separately for the large and small firm samples. We first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

Chart 11

Median Percentage Change in the Relative Size of Large and Small Depository Credit Institutions




Source: Authors' calculations.

Notes: This chart shows, for each size measure, the median annualized quarter-to-quarter percentage changes in the relative size of large and small depository credit institutions in the sample. We estimate our measures separately for the large and small firm samples. We first aggregate from the firm level to the sector level and then calculate quarterly changes. See Table 1 for variable definitions.

than in that of nonfinancial firms. The median annualized growth rate for finance was higher using the equity-only metrics, being 2.6 percent to 3.6 percent for the whole sample according to the *Esize* measures compared with 0.75 percent to 1.9 percent for the *Tsize* measures (Charts 2 and D1).

Our measures also highlight the importance of balance sheet leverage for the DCI subsector, more so than for shadow banks. For example, the mean relative size of DCI over the sample period is between 6 percent and 9 percent for the equity-only measures (Tables 6 and D3) and between 30 percent and 33 percent

Table 9

## The Relative Size of Large and Small Depository Credit Institutions

| | Full Sample | | | |
|---|---|---|---|---|
| | *Tsize* − *qmv*_small | *Tsize* − *qmv*_large | *Esize* − *mv*_small | *Esize* − *mv*_large |
| Observations | 3,199,397 | 1,140,087 | 3,199,397 | 1,140,087 |
| Mean | 10.75 | 34.36 | 2.30 | 7.60 |
| Median | 12.35 | 34.35 | 2.20 | 7.40 |
| Min / min quarter | 2.99 / 1984:Q2 | 23.99 / 2000:Q3 | 0.35 / 1984:Q3 | 4.66 / 1980:Q4 |
| Max / max quarter | 17.37 / 1994:Q2 | 44.75 / 2011:Q3 | 4.97 / 2003:Q1 | 11.12 / 2003:Q4 |
| | Pre-crisis Period (1980:Q1-2007:Q3) | | | |
| | *Tsize* − *qmv*_small | *Tsize* − *qmv*_large | *Esize* − *mv*_small | *Esize* − *mv*_large |
| Observations | 2,413,211 | 903,242 | 2,413,211 | 903,242 |
| Mean | 10.07 | 32.23 | 2.35 | 7.76 |
| Median | 12.15 | 33.21 | 2.25 | 7.52 |
| Min / min quarter | 2.99 / 1984:Q2 | 23.99 / 2000:Q3 | 0.35 / 1984:Q3 | 4.66 / 1980:Q4 |
| Max / max quarter | 17.37 / 1994:Q2 | 37.73 / 1980:Q2 | 4.97 / 2003:Q1 | 11.12 / 2003:Q4 |
| | Crisis Period (2007:Q4-2013:Q1) | | | |
| | *Tsize* − *qmv*_small | *Tsize* − *qmv*_large | *Esize* − *mv*_small | *Esize* − *mv*_large |
| Observations | 663,933 | 91,295 | 663,933 | 91,295 |
| Mean | 12.12 | 42.47 | 2.62 | 8.15 |
| Median | 12.21 | 43.64 | 2.45 | 8.30 |
| Min / min quarter | 10.31 / 2013:Q1 | 37.37 / 2007:Q4 | 2.19 / 2011:Q2 | 6.33 / 2009:Q1 |
| Max / max quarter | 15.62 / 2008:Q4 | 44.75 / 2011:Q3 | 4.19 / 2008:Q4 | 9.49 / 2010:Q2 |

Source: Authors' calculations.

Notes: This table reports, for each size measure, summary statistics of the relative size of large and small depository credit institutions in the sample. For each year and each size measure, we rank all publicly listed firms by *Tsize* − *qmv*. The top 10 percent of firms are included in the large firm sample, while the remaining firms are included in the small firm sample. We estimate our size measures separately for the large and small firm samples. Observation units are firm days for *Tsize* − *qmv* and *Esize* − *mv*. Units for all other statistics are percentages. For *Tsize* − *qmv* and *Esize* − *mv*, we first sum over firms, then average across days for each quarter, and finally take means and medians of quarterly averages. See Table 1 for variable definitions. Min (max) quarter refers to the quarter in which the measure achieves its minimum (maximum) value in the sample.

for the total value-based measures. While the shadow banking subsector also had a larger measured size based on leverage, its dependence on balance sheet leverage was not as stark.[21] However, given the importance of off-balance-sheet leverage for shadow banks, this result need not indicate a lower overall dependence on leverage of shadow banks.

[21] For example, the sample means of the relative size of shadow banks using the equity-only measures were about 3 to 6 percentage points (Tables 3 and D2) smaller than those using total value measures. The two DCI measures differed by more than 20 percentage points.

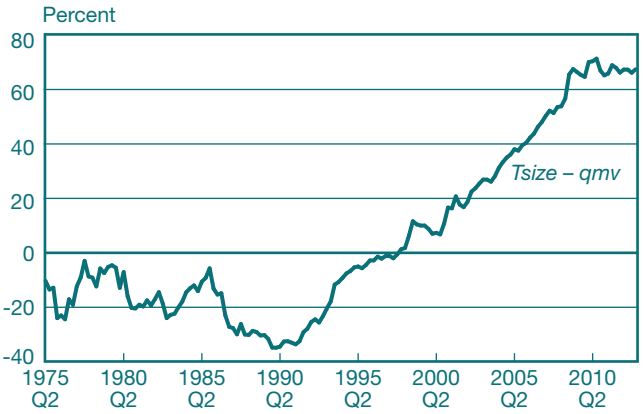
### 5.3 Regulation

We examine the effects of three important pieces of banking regulation on financial-sector size: the Riegle-Neal Act, the Gramm-Leach-Bliley Act, and the FDIC program of debt guarantees. The Riegle-Neal Act repealed interstate bank branching restrictions and allowed interstate bank mergers, while the Gramm-Leach-Bliley Act rolled back additional restrictions on bank consolidations.[22] By facilitating bank mergers and

[22] See http://en.wikipedia.org/wiki/Bank_Holding_Company_Act.

Chart 12

The Relative Size of Finance, Accounting for Firm Heterogeneity




Source: Authors' calculations.

Notes: This chart shows estimates of period fixed effects as a percentage of the estimated intercept from these regressions. Using only finance firms, we create a quarterly firm-level panel of relative size, as measured by *Tsize – qmv*. We estimate a panel regression of *Tsize – qmv* on firm level and period fixed effects. See Table 1 for *Tsize – qmv* definition.

consolidations, these acts may have led to an increase in the relative share of large banks in all large firms, as compared with the relative share of small banks in all small firms. We find evidence consistent with this hypothesis. For example, before the fourth quarter of 1999, the relative share of large DCIs in all large firms compared with small DCIs in small firms was about 1.4 percentage points higher on average (by *Tsize* − *qmv*). But after that time, the relative share of large DCIs in all large firms was 6.6 percentage points higher on average than that of small DCIs in small firms. This difference of five percentage points is statistically significant. We see a similar increase in the relative size of large DCIs after the passage of the Riegle-Neal Act.

The shrinkage of finance during the crisis may have been mitigated, at least temporarily, by the FDIC's Temporary Liquidity Guarantee Program (TLGP) program, which backed in full the senior unsecured debt issued by participating entities between October 14, 2008, and October 31, 2009.[23] We investigate the effect of the TLGP program by comparing banks that issued guaranteed debt under the program with the rest of the firms in our sample. We find a positive treatment effect that is economically meaningful (that is, an 11 percent increase in the book value of banks issuing guaranteed debt compared with all other firms), but statistically insignificant.[24]

## 6. Conclusion

In this article, we provide a comprehensive picture of the historical growth of finance and its subsectors using a variety of firm- and sector-level size measures. We define financial-sector size relative to the business sector (financial plus nonfinancial). We find that, with one exception, finance grew relative to the nonfinancial sector, especially from the late 1980s, whether one considers publicly listed firm liabilities or total sectoral liabilities (inclusive of private firms), equity or total asset values, large or small firms, or book or market values. The only exception is that, based on total value (market value of equity plus book value of debt), small financial firms did not increase their relative size on average, mainly due to the effects of the recent financial crisis. Indeed, the finance sector shrank relative to the nonfinancial sector during the recent crisis, and its recovery has been tepid.

Our analysis further shows that shadow banking grew rapidly at the expense of traditional banks, becoming a significant portion of the financial sector in the mid-1990s, and peaking just before the crisis, consistent with the literature. The growth in shadow banking was driven by the securities and asset management subsectors, and we find that small and large shadow banks grew similarly. The traditional banking sector, in contrast, declined by some measures, with growth in this sector being mostly explained by large banks.

Finance was smaller but grew faster when measured based on the liabilities of publicly listed firms than when measured based on the liabilities of all firms. That financial liabilities make up a substantially larger portion of total liabilities when private firms are included may be of importance to policymakers. Private firms not only face less regulation than publicly listed firms, but also operate with far less transparency. Indeed, comprehensive and reliable data on private firms are not available and most private firms are not required to submit quarterly financial statements to regulators. Similar concerns have been raised about shadow banks, leading to an internationally coordinated effort to collect data on shadow banks as well as proposals to regulate

[23] See http://www.fdic.gov/regulations/resources/TLGP/index.html.

[24] We used a two-period difference-in-difference specification, where the dependent variable was the change in average relative size from the year of the TLGP (fourth quarter of 2008 to fourth quarter of 2009) to the year preceding the program (third quarter of 2007 to third quarter of 2008). It was regressed on a dummy for the program year, a dummy for the issuing banks, and an interaction term between the two. Results are available upon request.

the sector (Financial Stability Board 2012). However, no such initiative exists generally for private firms. While many private firms are small and may not pose significant systemic risk presently, opacity can hide the buildup of vulnerabilities.

Financial firms are relatively larger based on their total asset values (equity plus debt) than on their equity values only. Large traditional banks are particularly dependent on balance sheet leverage, which indicates that the leverage restrictions on banks, as proposed under the Basel III agreement, can be effective policy tools for restricting the size of banks. By contrast, shadow banks are less dependent on leverage, suggesting that policymakers might need a different toolkit to monitor and regulate them.

A concern with our approach (and of the literature) is the inability to distinguish sufficiently between form and function (for example, when considering how to categorize a traditional bank that carries on shadow banking activities). We use NAICS and SIC codes to classify firms into industries. These classifications are based on the primary business of a company, which may lead to classification errors in some cases. For example, though many financial holding companies may be bank holding companies, if NAICS has determined that banking is not their primary business, we do not categorize them as banks or DCIs but rather as "finance, other." Fortunately, given the small number of firms in this category, these potential misclassifications have little effect on our results. Moreover, we can mitigate these errors to some extent. In some cases, we use Call Reports to identify banks directly. In particular, if our mapping indicates that a publicly listed company is a Call Report–filing commercial bank, then we call it a DCI regardless of what NAICS calls it. Further, to the extent that market prices accurately incorporate information about a firm's activities, our use of market values may mitigate this concern. Nevertheless, more research is needed on this issue.[25]

[25] Cetorelli and Peristiani (2012) and Cetorelli, McAndrews, and Traina (2014) are important steps in this direction. Cetorelli and Peristiani (2012) find that regulated banks played a dominant role in all aspects (issuance, underwriting, trustee, and servicing) of the securitization of asset-backed securities between 1978 and 2008. Cetorelli, McAndrews, and Traina (2014) find that banks expanded horizontally by acquiring shadow banking firms.

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Nicola Cetorelli, James McAndrews, and James Traina

# Evolution in Bank Complexity

- In the 1980s, the top ten bank holding companies accounted for about 20 percent of total bank assets; that percentage is now above 50 percent.
- Bank holding companies have not only grown in size, but they have also become substantially more complex, incorporating a large number of subsidiaries that span the entire spectrum of business activities within the financial sector.
- The authors document and analyze banks' organizational evolution, posing questions about the forces driving the industry and firm structures evident today.
- The findings suggest that greater complexity is a natural adaptation on the part of banks to a new model of finance oriented to securitization.

## 1. Introduction

The financial intermediation industry has experienced significant structural transformations over the past twenty to thirty years. Some of these changes are well known. Since the 1980s, for instance, the number of commercial banks operating in the United States fell from about 14,000 to 6,000. Most of this reduction was the result of a well-documented process of consolidation, encouraged in large part by geographic deregulation. Along the way, both the average size of bank holding companies (BHCs) and their market shares increased remarkably. In the 1980s, the top ten BHCs accounted for about 20 percent of total bank assets; that percentage is now above 50 percent. Not only did they grow in size, but the remaining entities also grew substantially in organizational complexity, incorporating a large and growing number of subsidiaries spanning the entire spectrum of business activities within the financial sector.

In particular, the transformation of the financial intermediation industry has generated a few banking behemoths, and public debate has focused on ways to regulate such supersized institutions. There are a number of proposed

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The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

approaches to such regulation, including breakups, size caps, or business activity limits. Other suggestions include enhanced regulations in the form of capital and long-term debt requirements, capital surcharges, stress tests, and improved resolution planning.

Although the discussion around the largest entities is certainly important, we suggest that their emergence is part of a larger process that has transformed the financial intermediation industry more broadly. In this paper, we document and analyze how the industry evolved and pose questions about what might have been the forces that drove the industry and firm structures we see today.

Despite the intense debate on bank complexity, very little documentation or analysis exists on the dynamics leading to the current industry configuration. In fact, even the meaning and metrics of complexity are debatable; in both comparative and absolute terms, we lack a clear consensus on how to assess an entity's complexity. This problem is important not only from a positive angle, as we strive to understand the economics behind the phenomenon, but also from a normative angle, as we decide on policy measures exclusively for complex institutions. How do we establish how complex entities are? Where do we draw the line across institutions?

In this paper, we focus on *organizational* complexity.[1] We look at organizational structure as gauged by the number and types of subsidiaries organized under common ownership and control. A focus on organizational complexity has multiple implications for policy analysis. It seems, for instance, a natural way to look at issues of resolvability and systemic importance. An institution with more legally organized affiliates, perhaps engaged in diverse business activities or located across geographic borders, presents greater challenges for orchestrating an orderly resolution. Similarly, entities with complex organizational structures may experience systemic events of broader scope: shocks can spread to multiple industries within the financial sector as they propagate across the many affiliates of the organization, perhaps accelerated by "cross-default" clauses in debt and derivative contracts. Finally, a complex organizational structure is a direct gauge of how complex regulation itself might be, or need to be, and thus of the challenges to effective oversight of complex organizations.[2]

This paper is the first to offer a rich documentation of the evolution in organizational structure of U.S. financial intermediation firms. Using comprehensive data on the universe of U.S. financial mergers and acquisitions over the past thirty years, we track the process of consolidation and cross-industry acquisitions and show a significant expansion in the complexity of banking institutions. Our study indicates that banks have transformed into increasingly expanding holding companies, extending their organizational footprint into nontraditional bank business lines through acquisitions of already formed specialized subsidiaries. This process of organizational transformation is substantial and far-reaching and is not confined simply to the largest entities of today. The massive sequence of transactions was also surprisingly gradual and "hidden in plain sight": given the regulated nature of bank holding companies, this process occurred with the explicit authorization of the regulator.

Multiple factors likely drove the rise in organizational complexity of banking institutions in the early 1990s. The process of geographic deregulation that has taken place in the past thirty years or so, which allowed banks to consolidate and expand both within and across state lines, may be one such factor; it allowed banks to reach sufficient scale to expand into nonbank sectors. The passage of the Gramm-Leach-Bliley Act (GLB), also known as the Financial Modernization Act of 1999, sanctioned and reinforced this process, even though, as we show in the data, a great deal of nonbank acquisition activity had already taken place.[3]

Banks became complex bank holding companies with control over many subsidiaries and across multiple sectors of the financial sector. However, we posit that this intense transformation was the result of a natural process of adaptation to a changing financial intermediation "technology." The traditional bank-centered model, familiar from textbooks on banking, puts banks as the central brokers between funding supply and demand. With this

[1] Alternative metrics focus instead on what an entity does. For instance, the methodology for the designation of global systemically important banks proposes as metrics of complexity the notional value of over-the-counter derivatives, the balance-sheet presence of "Level 3" assets (assets for which prices cannot be inferred by either markets or models), and the size of the trading and available-for-sale books. This is a narrower definition of complexity, likely captured adequately by metrics of scope and diversity in business lines of the subsidiaries of an organization.

[2] This implication applies directly to the regulation of U.S. bank holding companies. The Federal Reserve is the regulator of BHCs. However, other agencies are the principal regulators of specific types of subsidiaries.

[3] There is ample literature on the dynamic evolution of the original Glass-Steagall Act restrictions on banks' activities. See, for example, Carpenter and Murphy (2010) and Omarova and Tahyar (2011). Also see Fein (2004): "Although the Gramm-Leach-Bliley Act was expected to trigger a cascade of new consolidation proposals, the onslaught had not materialized . . . perhaps because much of the consolidation had already occurred prior to the Act."

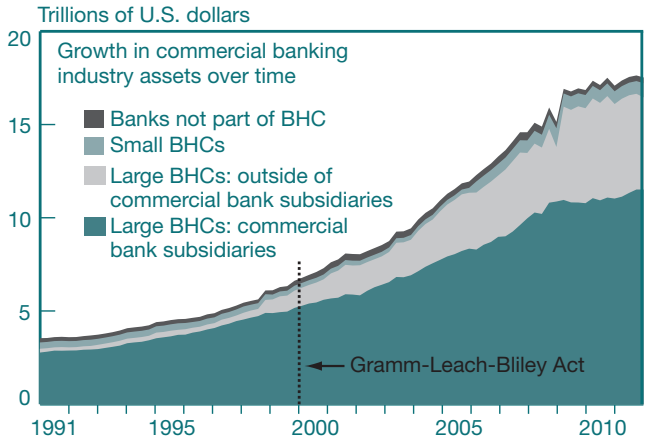
model, general-purpose deposit-taking and loan-making operations define an intermediary and its organizational boundaries. However, asset securitization changed the technology of intermediation. Loans no longer have to reside on the balance sheet of an intermediary. Alternatives to bank deposits can fulfill the liquidity needs of fund suppliers. Hence, general-purpose banks—in their traditional form—are less necessary for all intermediation services. Instead, highly specialized entities have emerged, each able to offer specific services that taken together fulfill the functions traditionally provided by banks. This is the model of intermediation that we are now accustomed to describing as *shadow banking* (see, for example, Pozsar et al. [2010], and Adrian, Ashcraft, and Cetorelli [2013]). This transformation in the technology of intermediation can also explain the observed evolution in bank organizational form: as modern intermediation increasingly relies on nonbank entities to provide specialized services, banking organizations can adapt and survive by incorporating these specialists as subsidiaries under common ownership and control. Hence, as shadow banking has grown and become a prevalent model of intermediation, we should expect banks to enlarge their organizational footprint. In other words, and in truly Coasian terms (Coase 1937), the *boundaries* of the banking firm have expanded progressively to include the activities of nonbank intermediaries, and this evolution should be reflected in the forms of increasingly complex bank holding companies.

The debate around the repeal of the Glass-Steagall Act, which brewed for decades before the passage of GLB, actually reflected the argument that the technology of intermediation was changing. For instance, already in 1988, Isaac and Fein wrote, "Congress [should not] ignore the technological, economic, and competitive forces shifting the financial markets away from traditional banking channels toward increased use of the securities markets for financial intermediation. . . .The securitization of assets has reduced the need for bank loans even further." (Isaac and Fein 1988). And two years earlier, the president of the Federal Reserve Bank of New York stated that "if securitization were to continue to spread rapidly to other types of credit, the historic role of the deposit-based credit intermediation process could be seriously jeopardized" (Federal Reserve Bank of New York 1986).[4]

In the next section, we develop this rationalization of the observed organizational evolution of banking firms in further detail. In our discussion, in line with the observation above, we purposefully use the terms *banks* and *bank holding companies* interchangeably, in recognition of the dynamic evolution in the organizational structure of entities involved in intermediation activities. We are, of course, aware of specific regulatory meanings attached to these terms and to the existence of other types of entities that are authorized to conduct banking activity without a BHC organizational form,[5] but in practice it turns out that the BHC "model" is the one that dominates over this time period. Chart 1, from Avraham, Selvaggi, and Vickery (2012), clearly shows that dominance. In terms of dollars of assets, BHCs have consistently represented almost the totality of all bank assets. Section 3 presents the data, a comprehensive panel of merger-and-acquisition transactions that have occurred in the U.S. financial sector over the past thirty years. Section 4 illustrates our method of using transaction data to construct metrics of complexity for bank "families," matched to regulated bank holding companies. Section 5 describes our findings and our interpretation of the observable evolution of the complexity of bank holding companies. Section 6 draws concluding remarks.

Chart 1

Trends in Number and Total Size of U.S. Bank Holding Companies (BHCs)




Source: Avraham, Selvaggi, and Vickery 2012.

Note: This chart presents financial data up to fourth-quarter 2011. A large bank holding company is defined as a top-tier firm that files a Federal Reserve Y-9C report. Commercial bank assets of large BHCs are measured as the sum of consolidated assets reported by each banking subsidiary in its Federal Financial Institutions Examination Council Call Report filing. Nonbank assets of large BHCs are the difference between total assets as reported in the Y-9C and commercial bank assets as defined above. Assets of small BHCs reflect only their commercial bank subsidiaries.

[4] Pavel (1986) documents the growing importance of asset securitization and its implication for traditional banking.

[5] Likewise, we are aware of the regulatory evolution even in the meaning of the word bank (see, again, Omarova and Tahyar [2011]).

## 2. A Rationale for Increasing Bank Complexity

Our approach places the evolution of financial intermediaries within the broader context of the evolution of the financial intermediation industry. In a recent special issue of the *Economic Policy Review*, Cetorelli, Mandel, and Mollineaux (2012) expounded the main thesis that, with the rising importance of asset securitization, banks adapted and remained central players in the process of financial intermediation.[6] They did so by embracing the new activities related to securitization (Cetorelli and Peristiani 2012) and expanding the footprint of their organizations, with bank holding companies increasingly adding a vast array of nonbank subsidiaries (Avraham, Selvaggi, and Vickery 2012; Copeland 2012).[7]

Intermediation services are no longer necessarily housed in a single, one-stop-shop, general-purpose entity. Instead, highly specialized entities work in parallel and in sequence to fulfill the functions of the traditional intermediary. For example, asset managers provide liquidity services and products that are close substitutes for demandable deposits; specialty lenders originate loans independent of deposit liabilities; issuers and underwriters guarantee packaging into securities and market placement; and brokers and dealers manage the funding and collateral pledging that are at the center of the securities markets (Kirk et al. 2014).

While this model of intermediation is usually said to allow for a more efficient allocation of risk and for a solution to some of the associated agency frictions (such as the asymmetric information between borrowers and lenders or banks and depositors), it also creates new frictions across the newly emerging specialized intermediaries (extensively documented, for instance, in Ashcraft and Schuermann [2008]). Hence, we argue that while the model allowed for the emergence of specialized intermediaries, their organization as separate subsidiaries within a common hierarchy internalized some of these frictions by sharing sources of intermediation information, coordinating deal flow, benefiting from cross-guarantees within different parts of the organization, and centralizing the credit standing of the organization in its entirety.[8] Adapting to this new industrial environment, the complex holding company structures offered key advantages by collecting specialists together under one corporate organization. Our hypothesis is that those economic advantages drove the emergence of complex bank holding companies. This conglomeration underpins the value-creation part of complexity.

[6] The volume *The Evolution of Banks and Financial Intermediation* is available at http://www.newyorkfed.org/research/epr/2012/EPRvol18n2.pdf.

[7] In 2011, for instance, bank holding companies controlled about 38 percent of the assets of the largest (top twenty) insurance companies, roughly 41 percent of total money market mutual fund assets, and approximately 93 percent of the assets of the largest (top thirty) brokers and dealers (Cetorelli 2012).

[8] This argument follows directly from Stein (2002) and Rajan and Zingales (2000).

## 3. Acquisitions in the Financial Sector

How does the structure of the intermediation industry evolve over time? Which entities (whether banks or nonbanks) undertake significant organizational transformation? How diffuse is this process in the cross-section? When does it take place? We address these questions using the SNL Financial Mergers and Acquisitions (SNL M&A) database.

SNL captures the universe of U.S. financial acquisition deals starting in 1983 and continuing to the present using many sources, including press releases, public filings, participant surveys, adviser surveys, and news searches. SNL's coverage tracks new financial players involved in M&A activity, allowing us to track sector-wide growth in size and complexity.

We start by compiling a panel data set of acquisitions. For each deal, SNL provides information on the buyer name,[9] the target name, the buyer industry, the target industry, the value, and the completion date. Because the database lacks a unique entity identifier, we work with entity names.[10] We use SNL's general industry-type variable to bin entities by industry. SNL classifies entities by the Standard Industrial Classification code sourced from the Securities and Exchange Commission or the Federal Deposit Insurance Corporation. When such information is missing or ambiguous, SNL internally assigns an industry code based on major sources of revenue or underwriting operations. It reports the nominal value of the deal, defined as the total consideration paid to the seller, when that information is available.

The SNL M&A raw database has over 37,000 deals. We restrict our analysis to whole-entity acquisitions completed before 2013. We drop a few observations that we found to have uninformative participant names, such as "private investor," "management group," or "mortgage banking." We also filter out acquisitions in which a participant is not in the financial sector. Ten industry types remain: bank, asset manager, broker-dealer, financial technology, insurance broker, insurance underwriter, investment company, real estate,

[9] SNL lists the ultimate parent of the actual acquirer as the buyer.

[10] To make sure that names are unique within an entity and to reduce potential coding errors, we clean all names by removing all special characters and capitalizing all letters.

savings bank/thrift/mutual,[11] and specialty lender. Finally, taking advantage of the fact that some entities appear multiple times, we fill in the missing fields of an entity if those fields are unique and available elsewhere in the data set.

In total, 19,532 deals meet these criteria. The data span 23,451 unique U.S. entities (7,893 unique banks), with a total of 6,507 unique buyers, 18,402 unique targets, and 19,486 unique buyer-target pairs.

Deal value is available when disclosed, as happens with all public acquisitions. These make up 58 percent of the acquisitions in our data set. For calculation purposes, we set the value to zero if it is missing. We rely on SNL to convert all non-dollar-denominated values to U.S. dollars using exchange rates at the completion date, although this conversion is infrequent because of the U.S.-only nature of the SNL M&A database. We also normalize all deal values to 2012 dollars using the consumer price index (CPI) for all urban consumers, all items, not seasonally adjusted. Since the CPI is available only monthly but our acquisition data are daily, we linearly interpolate to get an estimate of the CPI at the deal completion date.

To measure the total acquisition activity of entities, we construct two aggregates across all acquisitions in which the entity acts as the buyer. The first consists of the raw number of deals, while the second consists of the total sum of deal values.

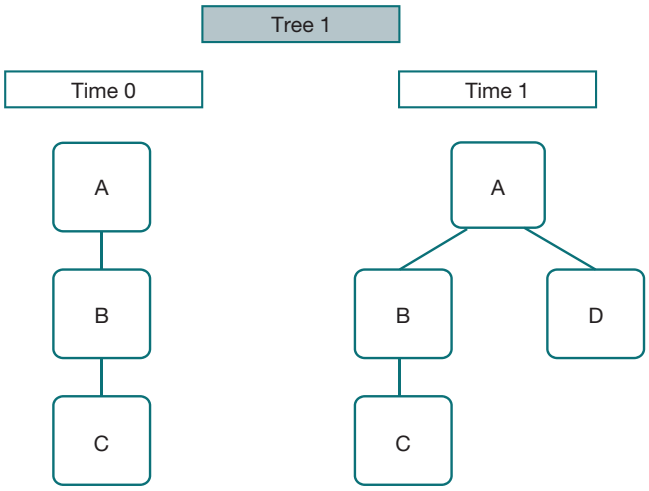
## 4. Data Construction

Up until now, we have focused on acquisitions. However, this limits our ability to answer questions on the cumulative effects of acquisition activity. We therefore extend our analysis to studying entire organizations, or families, themselves. We consider a family to be the complete picture of a self-owned entity and all of its subsidiaries.

The term family lends itself to a host of other relevant terms for the structure of organizations. The exhibit on this page illustrates an example of a "family tree." An entity within a family may have an "immediate parent," the direct owner, and an "ultimate parent," the highest owner in the family tree. For example, in Tree 1 at Time 0, A is the immediate parent of B and the ultimate parent of both B and C.

We use our information on acquisitions to assemble a family-level panel data set. In our earlier data set, an observation is an acquisition, such as "A buys D." Our family-level data set looks at an entire tree as an observation, such as "Tree 1 at Time 0."

[11] Note the separation of banks and thrifts.




We start with market data using the Center for Research in Security Prices (CRSP) U.S. Stock Database, provided by Wharton Research Data Services. A key variable from this data set is the PERMCO, a unique entity identifier that is consistent through time. To bring our earlier discussion to the data, we define a family as any group of entities that share a PERMCO, thus restricting our sample to public families. We add in regulatory accounting data from the Board of Governors of the Federal Reserve System, *Consolidated Financial Statements for Bank Holding Companies* (FR Y-9C), a quarterly regulatory report filed by BHCs. To match to these databases, we add in four more linking identifiers available from the SNL M&A data set: the ticker symbol of the entity's primary exchange stock, the Committee on Uniform Security Identification Procedures code (CUSIP) of the entity's primary exchange security, the Federal Reserve Research, Statistics, Supervision and Regulation, and Discount and Credit Database identifying number (RSSD ID) of the entity,[12] and the RSSD ID of any BHC parent.

A fundamental insight that informed our data construction is that a family tree requires knowledge only of the immediate parent of each entity in the family. For instance, in the above exhibit, we need only "A owns B" and "B owns C" to identify "Tree 1 at Time 0." To construct our panel data set, we exploit this principle by creating a separate "dictionary" data set that lists the universe of unique entities in the cleaned SNL M&A data set. We then create two new variables that track each entity's ownership—one for the immediate parent and one for the ultimate parent. This new data set allows us to "look up" entities at different points in time, using the immediate and ultimate parent variables to build a snapshot of the family tree.

[12] A unique identifier assigned by the Federal Reserve System to all financial institutions, main offices, and branches. RSSD IDs are the primary identifier for the FR Y-9C.

Because we lack information on family structure before SNL's acquisition coverage, we set the baseline owner of each entity to itself at the beginning of our data process. Further, in defining our family structures, we include only entities that are involved in an acquisition at some point in our sample period. In other words, our data limitations anchor our results to changes in complexity relative to our baseline and through the acquisition channel exclusively; we capture neither the structure before the start of the SNL M&A data set nor changes through de novo entity creation.

Our primary algorithm updates the dictionary data set by sequentially reading from the acquisition-level data set described in section 3. As acquisitions occur, we replace the target's parent variables in the dictionary data set. We first replace the immediate parent with the name of the buyer, reflecting the change in ownership.[13] We assume that whole acquisitions carry all previously acquired entities, and thus we replace the immediate parent of all subsidiaries of the target.[14] Finally, we update the ultimate parent variable by tracing the path of immediate parents.

To illustrate our approach, consider again the family tree above. In the dictionary data set at Time 0, "A owns B," "B owns C," and some entity (perhaps itself) owns D. When we read the deal "A buys D," we change D's immediate parent to A. At Time 1, we have "A owns B," "B owns C," and "A owns D." To identify the ultimate parent, we simply trace all entities back to A.

At each quarter-end, we sum the dictionary data set from entity level to ultimate parent level, constructing a profile of variables that count the number of subsidiaries in each industry for each ultimate parent. We append all quarter-specific cross-sections to form the basis of our panel data set.

Since we capture changes in organizational structure only through the acquisition channel, we may be concerned with important missing links across ultimate parents that do not appear in our data. To resolve this potential issue, we match all owners to their CRSP PERMCO and FR Y-9C RSSD ID at each quarter. This match restricts our sample to public FR Y-9C filers but ensures a time-consistent and regulatory-based definition of a banking family. As noted above, our data from SNL include neither PERMCO identifiers nor RSSD ID identifiers of the top regulatory filer. However, the SNL and CRSP data sets share ticker and CUSIP variables, allowing a direct match to the PERMCO. Similarly, we use the other SNL-provided RSSD ID variables to match to the top regulatory filer of the FR Y-9C. As a last layer of robustness, we rely on the PERMCO-RSSD ID link data set provided by the Federal Reserve Bank of New York to ensure proper identification of families.[15] We then sum any families with the same PERMCO as before, creating our final panel data set.

To make sure our algorithm works as intended and correctly captures important acquisitions, we do a variety of hand inspections using the raw SNL M&A database and the National Information Center (NIC) website.[16] For instance, because of its size and acquisition history, Bank of America offers a rich case study. We look at its history in detail, from NationsBank's buy of C&S/Sovran, Fleet's buy of Shawmut, BankAmerica's buy of Security Pacific, and NationsBank and BankAmerica's consolidation to the name we know today. Our database accurately covers all of these important acquisitions. Among other firms checked are Allco, BNY Mellon, Countrywide, Key, Regions, and Washington Mutual.

Although NIC is the natural choice as the information center of BHCs, two problems prevent NIC data from helping our understanding of this evolution when we compare SNL with NIC, particularly with respect to de novo entity creation. First, NIC focuses on the regulated banking industry, covering nonbank financial firms only insofar as they link to regulated entities. Therefore, unlike SNL, NIC lacks information on deal-level analysis at the broadest levels of the financial sector. We cannot see changes in the structure of nonbank financial firms unless they are already underneath the umbrella of a BHC. Further, we cannot find out how nonbank financial firms come under the control of a BHC, such as M&A as opposed to de novo creation. Second, NIC is extremely different from SNL in its scope of coverage; it is very detailed within the banking dimension but classifies many other financial subsidiaries as "domestic entity other," a catch-all type that includes some things we care about (asset management subsidiaries) and some things we do not (collateralized debt obligations, special-purpose vehicles, and the like). This group is extremely difficult to disentangle. Conversely, SNL focuses on specific entity types that are relevant to the asset securitization chain and is thus more useful for our purposes.

Note that the mapping from SNL's bank-type industry variable to FR Y-9C filers is not one to one. Of the 1,028 unique RSSD IDs in our family-level data set, about 85 percent are banks and 15 percent are thrifts. Wells Fargo achieves the highest bank consolidation in fourth-quarter 2008, totaling

[13] Note that in replacing the previous immediate parent, we also capture sales.

[14] In all subsidiaries, we include subsidiaries of subsidiaries, subsidiaries of subsidiaries of subsidiaries, and so on.

[15] If any of the identifier matches disagree, we use the link that appears most often. We have confirmed by hand that this reduces error more than throwing away data when links are ambiguous.

[16] For example, to check for possible conceptual errors in our primary algorithm, we go through a similar exercise as in our family-tree illustration with ABN AMRO.

361 banks. By the end of the sample, Regions Financial Corporation maintains the highest measure at 193.

Our final data set consists of 1,013 families spanning first-quarter 1988 to fourth-quarter 2012. This sample captures 22 percent of all FR Y-9C filers and 79 percent of all entities with a PERMCO-RSSD ID link. To give a picture of size, in fourth-quarter 2010, our sample totals 71 percent of the book value of equity from the FR Y-9C.

## 5. Analysis

As premised above, we operationalize bank complexity by measuring the extent to which a BHC expands its "horizontal" structure, acquiring entities operating in different industries of the financial sector. We must stress that our approach allows us to capture only *incremental* levels of complexity from acquisition dynamics. We cannot capture *organic* growth in complexity (de novo entity creations), nor entities acquired before the start of our sample period, nor the purpose of the acquisitions. That said, the quality checks on our constructed family-level data show that we capture a significant extent of the overall evolution in organizational structure of the largest BHCs.

### 5.1 Sector-Wide Dynamics

We begin by illustrating some of the characteristics of the original SNL Financial M&A database. As mentioned above, we partition the data into ten industry types within the financial sector.

Table 1 presents basic information about the acquisitions that take place over the sample period. The far-left column lists each of the ten industries within our data set. The "total unique" column presents the total number of unique entities across buyers and targets. The "unique buyers" ("unique targets") column presents the total number of unique buyers (targets).

The database allows us to identify 23,451 unique entities that appear at least once in acquisitions as buyers or targets over our sample period. Among industries, commercial banks account for about 34 percent of the unique entities, followed by insurance firms, thrifts, and specialty lenders. Of all these entity types, banks are by far the most involved in buying: 45 percent of unique buyers are banks, and 37 percent of banks act as buyers at least once in our sample. They are also the largest industry represented as unique targets, although to a smaller extent. Table 1 gives a flavor of the overall scope of the database and the related dynamics in acquisitions. However, it cannot offer direct insights into the process of horizontal organizational expansion; in referring to buyers and targets, the database does not indicate whether the underlying participants were from the same or from different industries.

Table 1
Unique Entities in Acquisitions Data Set

| Industry | Total Unique | Unique Buyers | Unique Targets |
|---|---|---|---|
| Bank | 7,893 | 2,904 | 5,843 |
| Asset manager | 1,648 | 374 | 1,306 |
| Broker-dealer | 1,387 | 361 | 1,070 |
| Financial technology | 1,989 | 426 | 1,621 |
| Insurance broker | 3,682 | 504 | 3,237 |
| Insurance underwriter | 2,193 | 793 | 1,514 |
| Investment company | 64 | 40 | 27 |
| Real estate | 229 | 87 | 150 |
| Savings bank/thrift/mutual | 2,352 | 676 | 1,927 |
| Specialty lender | 2,014 | 342 | 1,707 |
| Total | 23,451 | 6,507 | 18,402 |

Source: Authors' calculations, based on information in the SNL Financial Mergers and Acquisitions database.

Table 2 takes a different look at the same acquisition activity. It illustrates the extent to which each industry consolidates (same-type entity deals) or expands (different-type entity deals). Panel A displays the total number of acquisitions; panel B displays the total real value of acquisitions. We organize each panel as a two-way matrix. The rows show the industry of the buyer, while the columns show the industry of the target. Hence, the on-diagonal numbers represent same-industry consolidation, while the off-diagonal numbers represent cross-industry expansion.

We capture 19,532 acquisition events in our data set. As indicated by the total number of on-diagonal events (13,070), the financial sector overall experiences a substantial amount of same-industry consolidation. Banks account for almost half of these transactions. Likewise, banks also capture the lion's share of off-diagonal acquisition activity; their 3,742 acquisitions constitute about 60 percent of the 6,462 total off-diagonal acquisitions. For some industries, banks outperform same-industry entities in number of acquisitions. For example, banks acquire 519 asset managers, while asset-manager entities acquire only 459 other asset managers. Regardless of the target industry, the proportion of acquisitions by banks is high. For instance, banks are buyers in about 40 percent of all asset-manager acquisitions, 26 percent of all broker-dealer acquisitions, and 37 percent of all specialty-lender acquisitions.

This summary table suggests the significance of how much bank organizational structure has transformed over time. It also

Table 2

## Entity Industries in Consolidation and Expansion

Panel A: Types in Acquisitions, by Number

| | Target Industry | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buyer Industry | Bank | Savings Bank/Thrift/ Mutual | Asset Manager | Broker-Dealer | Financial Technology | Insurance Broker | Insurance Underwriter | Investment Company | Real Estate | Specialty Lender | Total |
| Bank | 6,076 | 1,305 | 519 | 292 | 164 | 759 | 38 | 3 | 1 | 653 | 9,810 |
| Savings bank/ thrift/mutual | 359 | 705 | 45 | 28 | 8 | 115 | 21 | — | 2 | 138 | 1,421 |
| Asset manager | 2 | 1 | 459 | 38 | 110 | 27 | 24 | 6 | 17 | 51 | 735 |
| Broker-dealer | 6 | 6 | 127 | 613 | 78 | 59 | 9 | 4 | 9 | 42 | 953 |
| Financial technology | 2 | — | 13 | 23 | 1,123 | 60 | 8 | — | — | 13 | 1,242 |
| Insurance broker | 4 | 1 | 31 | 12 | 35 | 1,762 | 18 | — | — | 6 | 1,869 |
| Insurance underwriter | 14 | 18 | 138 | 55 | 126 | 533 | 1,451 | — | 4 | 54 | 2,393 |
| Investment company | 2 | 1 | 19 | 4 | 4 | 4 | 2 | 11 | 4 | 42 | 93 |
| Real estate | 1 | 1 | 3 | 3 | — | — | 1 | — | 111 | 10 | 130 |
| Specialty lender | 19 | 21 | 10 | 26 | 20 | 11 | 5 | 3 | 2 | 769 | 886 |
| Total | 6,485 | 2,059 | 1,364 | 1,094 | 1,668 | 3,330 | 1,577 | 27 | 150 | 1,778 | 19,532 |

Panel B: Types in Acquisitions, by Value (Millions of U.S. Dollars)

| | Target Industry | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Buyer Industry | Bank | Savings Bank/Thrift/ Mutual | Asset Manager | Broker-Dealer | Financial Technology | Insurance Broker | Insurance Underwriter | Investment Company | Real Estate | Specialty Lender | Total |
| Bank | 1,405,983 | 203,243 | 43,512 | 173,952 | 18,083 | 3,297 | 16,783 | 1,127 | 333 | 276,048 | 2,142,361 |
| Savings bank/ thrift/mutual | 18,982 | 54,333 | 3,359 | 119 | 74 | 165 | 3,409 | — | 86 | 15,165 | 95,691 |
| Asset manager | 0 | 17 | 68,463 | 7,812 | 46,776 | 2,575 | 1,692 | 416 | 70,405 | 29,347 | 227,504 |
| Broker-dealer | 6,099 | 2,665 | 19,461 | 106,443 | 4,302 | 1,467 | 970 | 1,921 | 15,183 | 9,463 | 167,975 |
| Financial technology | 25 | — | 3,813 | 1,784 | 91,225 | 437 | 1,284 | — | — | 733 | 99,301 |
| Insurance broker | 10 | 11 | 41 | 41 | 5,346 | 21,359 | 244 | — | — | 1 | 27,054 |
| Insurance underwriter | 124,460 | 785 | 28,783 | 15,605 | 10,929 | 8,032 | 527,592 | — | 2,284 | 22,354 | 740,825 |
| Investment company | 0 | 19 | 654 | 18 | 6 | 129 | 5 | 2,657 | 4,669 | 4,120 | 12,276 |
| Real estate | 0 | 78 | 599 | 3 | —- | —- | 133 | — | 136,014 | 93 | 136,921 |
| Specialty lender | 110 | 848 | 1,904 | 2,006 | 1,884 | 62 | 1,824 | 393 | 416 | 73,561 | 83,008 |
| Total | 1,555,669 | 261,999 | 170,590 | 307,784 | 178,625 | 37,524 | 553,935 | 6,514 | 229,390 | 430,885 | 3,732,916 |

Source: Authors' calculations, based on data from SNL Financial.

hints at how the structure has changed with respect to entities in separate but related industries. Our conclusions are even more striking if we restrict our attention to the dollar value of these transactions (Table 2, panel B). Indeed, off-diagonal acquisitions performed by banks are more than 80 percent of the total value of all off-diagonal acquisitions.

Who are the top buyers over the period? How much are they buying? Tables 3 and 4 show the top fifty buyers by number and value of acquisitions, r espectively. The top entities by number of acquisitions are three of the now largest insurance brokers: Arthur J. Gallagher, Brown & Brown, and Hub International. As Table 3 shows, they acquired hundreds of entities, although almost exclusively consolidating within their own industry. Banks follow in the ranking, also displaying very large numbers of acquisitions but with a more balanced distribution between bank and nonbank targets. Many of the banks at the lower end of the list fell in the mass of acquisition activity after geographic deregulation. This consolidation may have set the stage for future expansion, as banks developed the scale and size necessary for later expansions in complexity.

Interestingly, banks dominate the ranking by value. Table 4 captures the most active firms over time, irrespective of when the activity took place and whether the entities are still in operation. This time-independence is the reason NationsBank is second on the list, despite its current incarnation as Bank of America. The artifacts of bank acquisition activity show a compounding and progressive industry buildup. For instance, although Bank of America is highly diverse today, it inherited the results of the earlier evolution of NationsBank and Merrill Lynch. Likewise, Citigroup inherited part of its diversity from the previous activity of Travelers Group. The same holds for Wells Fargo from Wachovia (originally First Union) and Norwest, and JPMorgan Chase from Bank One, Chase Manhattan, and Washington Mutual.

It is important to note that the phenomenon of horizontal expansion is not confined to a small handful of entities. As the tables show, below the top-ranked acquirers, we see a significant number of cross-industry acquisitions.

Next, we offer documentation on the dynamics of acquisitions. Chart 2 shows the composition of industries in four-year periods within our sample. Although the database shows mainly banks (and thrifts) as buyers in the late 1980s, variation in buyer type steadily increases over time. By the second half of the 1990s, all industry types perform acquisitions. Likewise, the variety in target types increases gradually over time, with nonbank targets already representing the large majority in the second half of the 1990s.

Chart 3 illustrates that the share of the dollar value of acquisitions reflects the gradual process of expansion in industry types, although the relative prevalence of each industry by value differs somewhat from prevalence by number. For instance, there is a relatively large number of insurance broker entities that are either buyers or targets of acquisitions, but they account for a much smaller share of the overall value. Conversely, there are relatively fewer insurance underwriters involved in acquisitions, but they account for a larger share.

Charts 4 and 5 combine the number of acquisitions within and across industries. While the process of same-industry consolidation is important in itself, for our purposes, we want to keep our focus on organizations expanding into other industries within the financial sector. To this end, it is useful to report the breakdown of acquisition activity (for buyers and targets), separating same-industry and cross-industry deals. Chart 4 shows that same-industry consolidation is quite diffusive across the various industries. Although banks dominated the activity during the geographic deregulation of the mid-1990s, there is sizable consolidation across the other industries as well, continuing into the present.

Chart 5 confirms and reinforces the message of the previous ones, which is that during our sample period the entire financial sector was reorganizing. Banks were buying nonbanks, but not to the exclusion of substantial cross-industry acquisitions of other entity types. Moreover, targets were not concentrated in any particular industry, suggesting that no particular industry-specific factors drove the development. Rather, it indicates a diffused transformation of the intermediation industry, with a progressive expansion of the organizational boundaries of intermediation firms.

## 5.2 Bank-Specific Dynamics

We shift our focus to banks themselves and follow their evolution. We start with a specific examination using the same deal data as above. Later in the paper, we present details of bank evolution at the family (or BHC) level.

Chart 6 goes into the specifics of the cross-industry evolution in bank organizational structure. Besides the extensive acquisition of thrifts in the early part of the period, the data denote how banks gradually expanded their footprint. Banks proceeded first by acquiring entities that were arguably closer to their traditional mode of operations—specialty lenders and asset managers, both specialized intermediaries that increased their roles once securitization-based intermediation became more prevalent. The expansion progressed naturally, with banks incorporating brokers and dealers later in the sample period. These entities rose in importance with the trading of a progressively increasing stockpile of securities created through asset securitization (Cetorelli and Peristiani 2012). Moreover, the process continued with the incorporation of insurance and financial technology firms, which offer payment-related services.

Table 3

## Top Fifty Buyers, by Number

| | | | Value (Millions of U.S. Dollars) | | | Count | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Name | Industry | All | Consolidation | Expansion | All | Consolidation | Expansion |
| 1 | Arthur J. Gallagher & Co. | Insurance broker | 3,314 | 3,249 | 65 | 249 | 245 | 4 |
| 2 | Brown & Brown | Insurance broker | 2,029 | 2,011 | 18 | 236 | 234 | 2 |
| 3 | Hub International | Insurance broker | 834 | 832 | 2 | 159 | 156 | 3 |
| 4 | BB&T | Bank | 19,989 | 15,291 | 4,697 | 142 | 23 | 119 |
| 5 | Wells Fargo | Bank | 50,566 | 48,577 | 1,989 | 138 | 34 | 104 |
| 6 | Norwest | Bank | 64,191 | 55,112 | 9,079 | 123 | 86 | 37 |
| 7 | National Financial Partners Corporation | Insurance broker | 739 | 731 | 8 | 95 | 62 | 33 |
| 8 | Bank of New York | Bank | 29,062 | 22,661 | 6,401 | 76 | 4 | 72 |
| 9 | Regions Financial Corporation | Bank | 27,951 | 26,154 | 1,797 | 74 | 50 | 24 |
| 10 | Union Planters | Bank | 9,564 | 7,672 | 1,893 | 69 | 53 | 16 |
| 11 | First American Corporation | Insurance underwriter | 5,738 | 171 | 5,566 | 66 | 4 | 62 |
| 12 | U.S. Bancorp | Bank | 12,146 | 5,151 | 6,995 | 64 | 17 | 47 |
| 13 | First Union | Bank | 72,837 | 61,532 | 11,305 | 64 | 29 | 35 |
| 14 | Stewart Information Services | Insurance underwriter | 40 | 40 | 0 | 63 | 4 | 59 |
| 15 | Goldman Sachs | Broker-dealer | 13,725 | 10,020 | 3,705 | 60 | 10 | 50 |
| 16 | SouthTrust | Bank | 2,450 | 1,539 | 910 | 60 | 46 | 14 |
| 17 | Marsh & McLennan Companies | Insurance broker | 6,757 | 6,635 | 122 | 58 | 49 | 9 |
| 18 | Compass Bancshares | Bank | 2,524 | 2,375 | 149 | 55 | 41 | 14 |
| 19 | Bank One Corporation | Bank | 70,781 | 56,069 | 14,712 | 55 | 36 | 19 |
| 20 | Citigroup | Bank | 100,742 | 2,530 | 98,212 | 54 | 2 | 52 |
| 21 | Community First Bankshares | Bank | 1,004 | 983 | 21 | 53 | 26 | 27 |
| 22 | Hibernia Corporation | Bank | 2,006 | 1,678 | 327 | 51 | 40 | 11 |
| 23 | First American Corporation | Insurance underwriter | 178 | 175 | 3 | 50 | 3 | 47 |
| 24 | PNC Financial Services | Bank | 34,106 | 28,577 | 5,529 | 47 | 17 | 30 |
| 25 | KeyBank | Bank | 12,518 | 9,648 | 2,870 | 46 | 20 | 26 |

Table 3 (continued)
## Top Fifty Buyers, by Number

| | | | Value (Millions of U.S. Dollars) | | | Count | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Name | Industry | All | Consolidation | Expansion | All | Consolidation | Expansion |
| 26 | USI Holdings Corporation | Insurance broker | 546 | 527 | 19 | 45 | 43 | 2 |
| 27 | Wachovia | Bank | 67,562 | 23,837 | 43,726 | 45 | 11 | 34 |
| 28 | Zions Bancorporation | Bank | 5,591 | 5,463 | 129 | 45 | 35 | 10 |
| 29 | First Banks | Bank | 1,141 | 801 | 340 | 43 | 31 | 12 |
| 30 | American International Group | Insurance underwriter | 59,147 | 58,330 | 817 | 42 | 22 | 20 |
| 31 | Colonial Bancgroup | Bank | 2,970 | 2,348 | 622 | 42 | 31 | 11 |
| 32 | SunGard | Financial technology | 1,942 | 1,795 | 148 | 42 | 38 | 4 |
| 33 | Fifth Third Bank | Bank | 18,416 | 14,189 | 4,227 | 41 | 18 | 23 |
| 34 | Synovus | Bank | 2,503 | 1,994 | 509 | 41 | 29 | 12 |
| 35 | Old National Bank | Bank | 1,641 | 1,319 | 322 | 39 | 24 | 15 |
| 36 | Aon plc | Insurance broker | 8,359 | 3,297 | 5,063 | 39 | 31 | 8 |
| 37 | JPMorgan Chase | Bank | 85,253 | 75,001 | 10,251 | 38 | 2 | 36 |
| 38 | Marshall & Ilsley | Bank | 8,380 | 4,661 | 3,720 | 38 | 17 | 21 |
| 39 | HCC Insurance Holdings | Insurance underwriter | 1,339 | 811 | 528 | 37 | 10 | 27 |
| 40 | Comerica | Bank | 6,033 | 5,947 | 87 | 36 | 27 | 9 |
| 41 | Fidelity National Financial | Insurance underwriter | 6,857 | 2,145 | 4,712 | 36 | 8 | 28 |
| 42 | FNB Corporation | Bank | 2,135 | 1,883 | 252 | 36 | 17 | 19 |
| 43 | Fiserv | Financial technology | 6,533 | 5,992 | 541 | 35 | 28 | 7 |
| 44 | Mercantile Bancorporation | Bank | 7,078 | 4,910 | 2,169 | 35 | 23 | 12 |
| 45 | National City Corporation | Bank | 26,288 | 20,778 | 5,509 | 34 | 11 | 23 |
| 46 | Hilb, Rogal & Hobbs Company | Insurance broker | 380 | 380 | 0 | 34 | 33 | 1 |
| 47 | LandAmerica Financial Group | Insurance underwriter | 1,172 | 971 | 201 | 33 | 2 | 31 |
| 48 | Commerce Bancshares | Bank | 990 | 924 | 67 | 33 | 30 | 3 |
| 49 | Willis Group | Insurance broker | 1,920 | 1,888 | 32 | 33 | 32 | 1 |
| 50 | Royal Bank of Canada | Bank | 12,409 | 5,530 | 6,879 | 33 | 4 | 29 |

Source: Authors' calculations, based on data from SNL Financial.

Notes: Consolidation captures acquisitions in which the buyer and target have the same type. Expansion captures acquisitions in which the buyer and target have different types.

Table 4

## Top Fifty Buyers, by Value

| | | | Value (Millions of U.S. Dollars) | | | Count | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Name | Industry | All | Consolidation | Expansion | All | Consolidation | Expansion |
| 1 | Bank of America | Bank | 187,572 | 87,208 | 100,364 | 16 | 3 | 13 |
| 2 | NationsBank | Bank | 138,702 | 135,166 | 3,535 | 23 | 12 | 11 |
| 3 | Travelers Group | Insurance underwriter | 137,466 | 5,892 | 131,573 | 8 | 1 | 7 |
| 4 | Citigroup | Bank | 100,742 | 2,530 | 98,212 | 54 | 2 | 52 |
| 5 | JPMorgan Chase | Bank | 85,253 | 75,001 | 10,251 | 38 | 2 | 36 |
| 6 | First Union | Bank | 72,837 | 61,532 | 11,305 | 64 | 29 | 35 |
| 7 | Bank One Corporation | Bank | 70,781 | 56,069 | 14,712 | 55 | 36 | 19 |
| 8 | Wachovia | Bank | 67,562 | 23,837 | 43,726 | 45 | 11 | 34 |
| 9 | Capital One | Bank | 66,804 | 22,434 | 44,370 | 12 | 2 | 10 |
| 10 | Norwest | Bank | 64,191 | 55,112 | 9,079 | 123 | 86 | 37 |
| 11 | Blackstone Group | Asset manager | 61,048 | 1,271 | 59,776 | 19 | 4 | 15 |
| 12 | American International Group | Insurance underwriter | 59,147 | 58,330 | 817 | 42 | 22 | 20 |
| 13 | Chase Manhattan | Bank | 58,120 | 45,275 | 12,845 | 26 | 4 | 22 |
| 14 | Wells Fargo | Bank | 50,566 | 48,577 | 1,989 | 138 | 34 | 104 |
| 15 | Washington Mutual | Bank | 50,347 | 320 | 50,027 | 27 | 4 | 23 |
| 16 | Firstar Corporation | Bank | 44,430 | 43,827 | 602 | 21 | 15 | 6 |
| 17 | Fleet Financial Group | Bank | 43,867 | 37,165 | 6,702 | 26 | 15 | 11 |
| 18 | Berkshire Hathaway | Insurance underwriter | 35,792 | 35,029 | 763 | 24 | 19 | 5 |
| 19 | PNC Financial Services | Bank | 34,106 | 28,577 | 5,529 | 47 | 17 | 30 |
| 20 | HSBC | Bank | 32,703 | 11,053 | 21,650 | 10 | 2 | 8 |
| 21 | MetLife | Insurance underwriter | 32,523 | 31,912 | 612 | 17 | 8 | 9 |
| 22 | Toronto-Dominion Bank | Bank | 29,866 | 14,567 | 15,299 | 21 | 5 | 16 |
| 23 | Bank of New York | Bank | 29,062 | 22,661 | 6,401 | 76 | 4 | 72 |
| 24 | Kohlberg Kravis Roberts | Asset manager | 29,002 | 0 | 29,002 | 6 | 0 | 6 |
| 25 | Regions Financial Corporation | Bank | 27,951 | 26,154 | 1,797 | 74 | 50 | 24 |

Table 4 (continued)
## Top Fifty Buyers, by Value

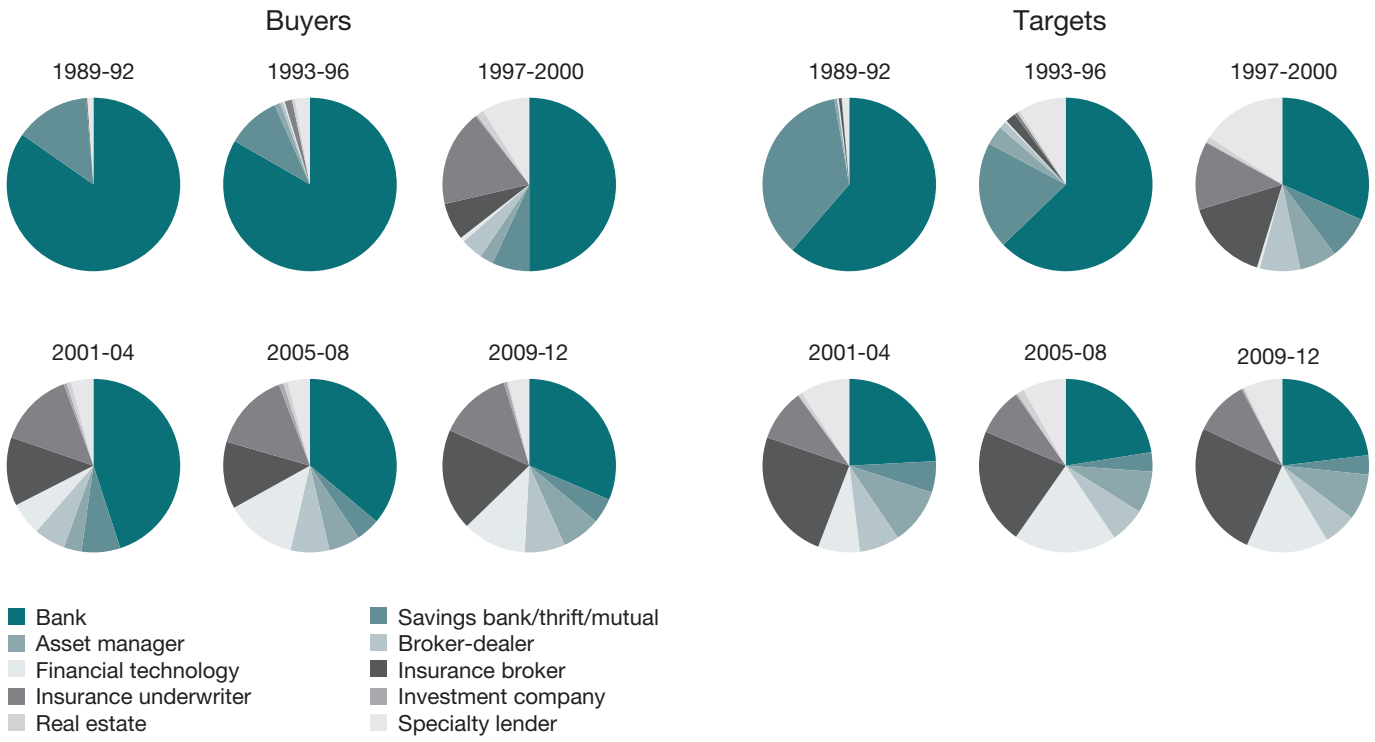
| | | | Value (Millions of U.S. Dollars) | | | Count | | |
|---|---|---|---|---|---|---|---|---|
| Rank | Name | Industry | All | Consolidation | Expansion | All | Consolidation | Expansion |
| 26 | BlackRock | Asset manager | 26,847 | 26,847 | 0 | 9 | 7 | 2 |
| 27 | Anthem Incorporated | Insurance underwriter | 26,360 | 26,360 | 0 | 2 | 2 | 0 |
| 28 | National City Corporation | Bank | 26,288 | 20,778 | 5,509 | 34 | 11 | 23 |
| 29 | St. Paul Companies | Insurance underwriter | 25,074 | 24,063 | 1,012 | 12 | 7 | 5 |
| 30 | SunTrust Banks | Bank | 24,070 | 23,019 | 1,051 | 32 | 13 | 19 |
| 31 | Chemical Bank | Bank | 23,610 | 23,610 | 0 | 13 | 11 | 2 |
| 32 | ING Group | Insurance underwriter | 23,270 | 16,628 | 6,642 | 20 | 4 | 16 |
| 33 | UBS | Bank | 22,775 | 0 | 22,775 | 17 | 0 | 17 |
| 34 | Morgan Stanley | Broker-dealer | 21,216 | 0 | 21,216 | 21 | 1 | 20 |
| 35 | Credit Suisse | Bank | 20,110 | 0 | 20,110 | 13 | 0 | 13 |
| 36 | BB&T | Bank | 19,989 | 15,291 | 4,697 | 142 | 23 | 119 |
| 37 | UnitedHealth Group | Insurance underwriter | 18,476 | 17,897 | 579 | 23 | 16 | 7 |
| 38 | Fifth Third Bank | Bank | 18,416 | 14,189 | 4,227 | 41 | 18 | 23 |
| 39 | Deutsche Bank | Bank | 18,398 | 13,055 | 5,342 | 13 | 1 | 12 |
| 40 | Aegon | Insurance underwriter | 18,274 | 17,923 | 352 | 10 | 7 | 3 |
| 41 | First Bank System | Bank | 17,646 | 16,123 | 1,523 | 22 | 14 | 8 |
| 42 | Swiss Re | Insurance underwriter | 17,108 | 16,967 | 140 | 16 | 14 | 2 |
| 43 | Merrill Lynch | Broker-dealer | 16,182 | 4,761 | 11,422 | 25 | 17 | 8 |
| 44 | Conseco | Insurance underwriter | 15,583 | 4,253 | 11,331 | 16 | 7 | 9 |
| 45 | Banco Bilbao Vizcaya Argentaria | Bank | 15,499 | 15,499 | 0 | 9 | 7 | 2 |
| 46 | Dean Witter Discover | Broker-dealer | 15,390 | 15,390 | 0 | 2 | 2 | 0 |
| 47 | Household International | Specialty lender | 14,610 | 14,421 | 189 | 13 | 6 | 7 |
| 48 | Monte dei Paschi di Siena | Bank | 13,898 | 13,898 | 0 | 1 | 1 | 0 |
| 49 | Equity Office | Real estate | 13,813 | 13,813 | 0 | 3 | 3 | 0 |
| 50 | Goldman Sachs | Broker-dealer | 13,725 | 10,020 | 3,705 | 60 | 10 | 50 |

Source: Authors' calculations, based on data from SNL Financial.

Notes: Consolidation captures acquisitions in which the buyer and target have the same type. Expansion captures acquisitions in which the buyer and target have different types.

Chart 2

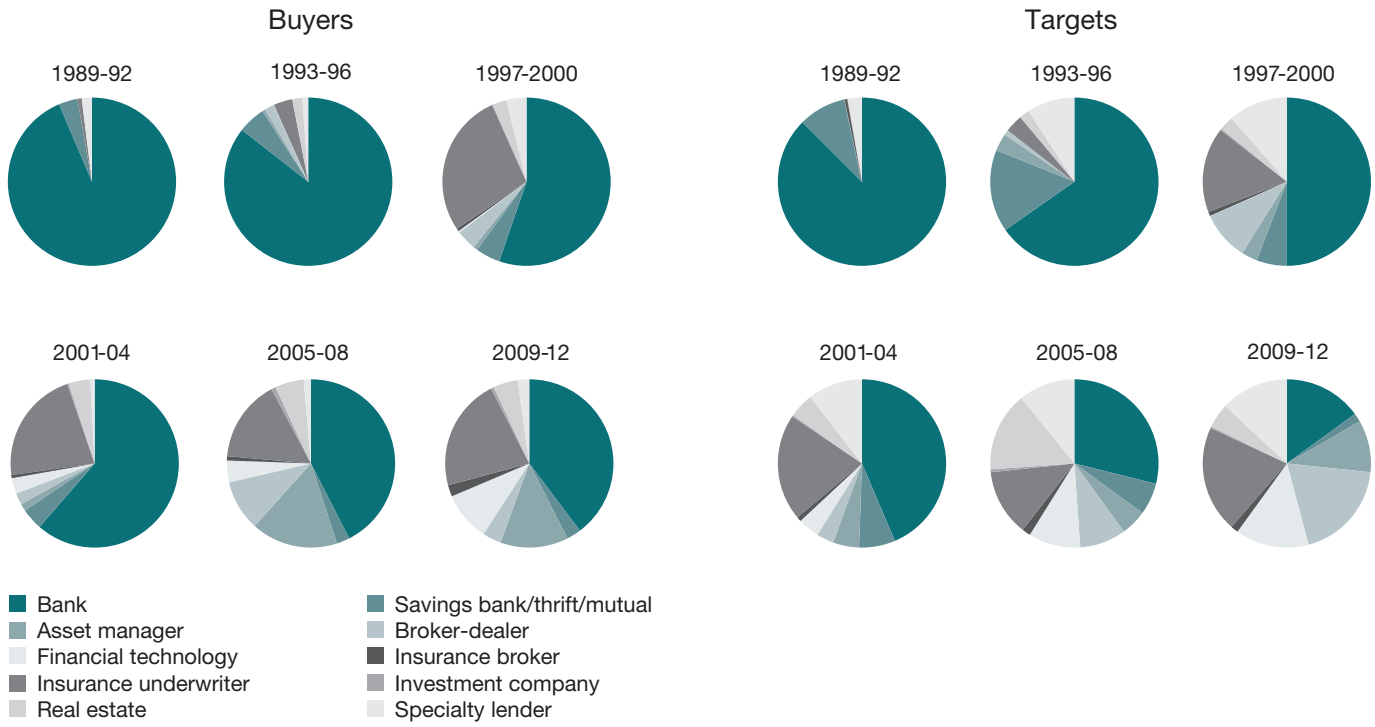
## Types in All Acquisitions, by Number




Source: Authors' calculations, based on data from SNL Financial.

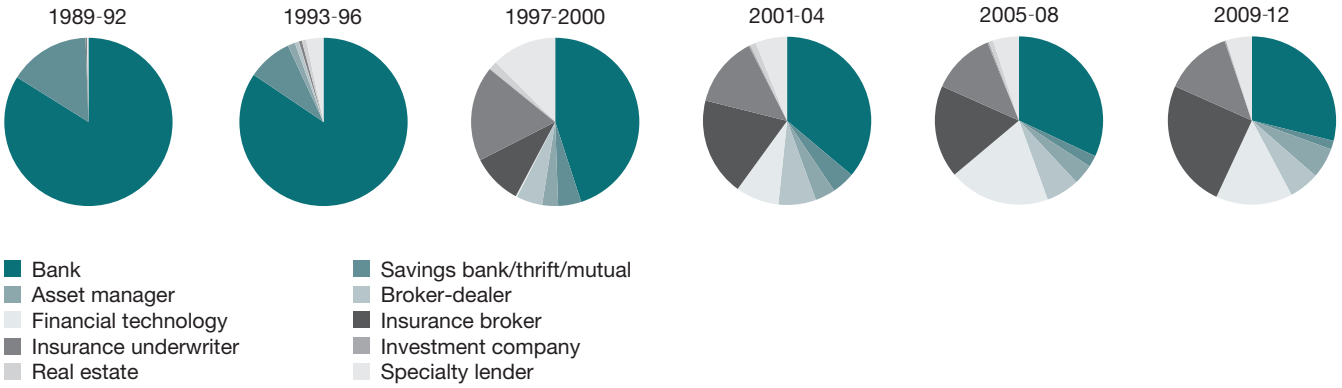
Chart 3

## Types in All Acquisitions, by Value




Source: Authors' calculations, based on data from SNL Financial.

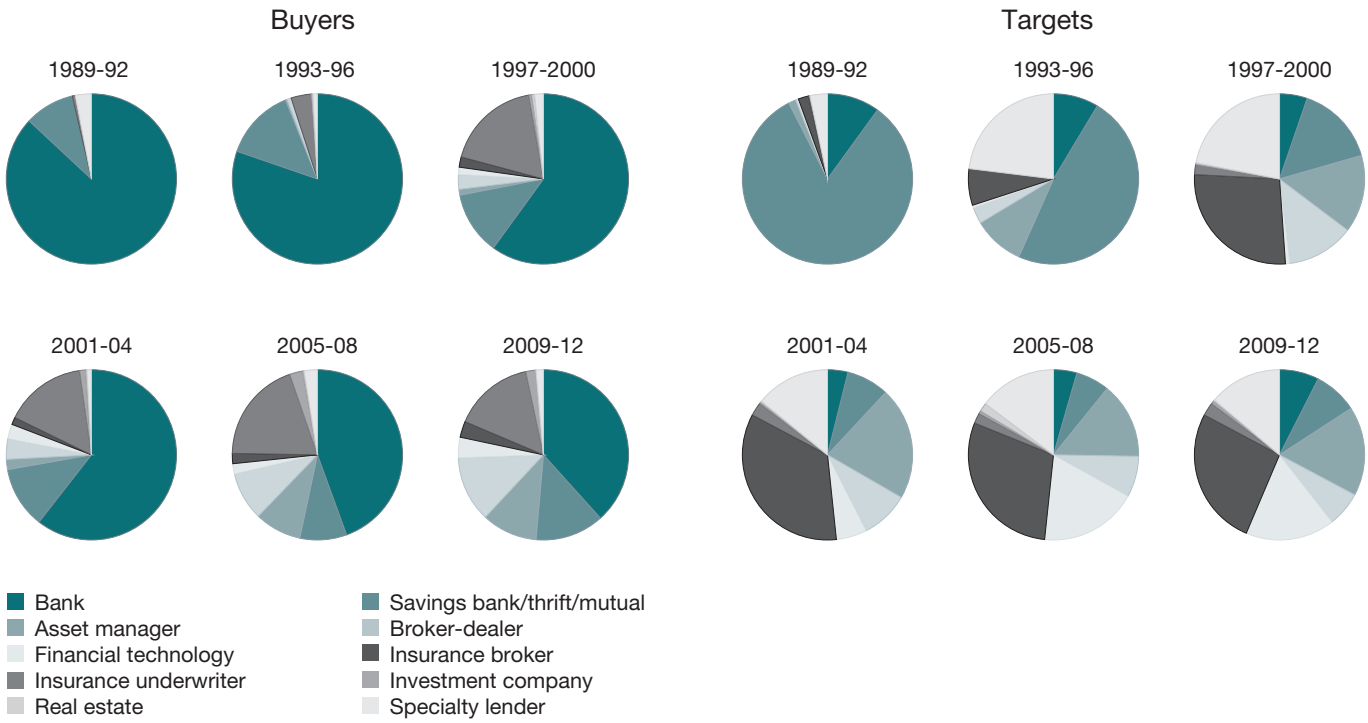
Chart 4
## Types in Same-Industry Acquisitions, by Number




Source: Authors' calculations, based on data from SNL Financial.

Note: Same-industry acquisitions represent deals in which the buyer and target have the same type.

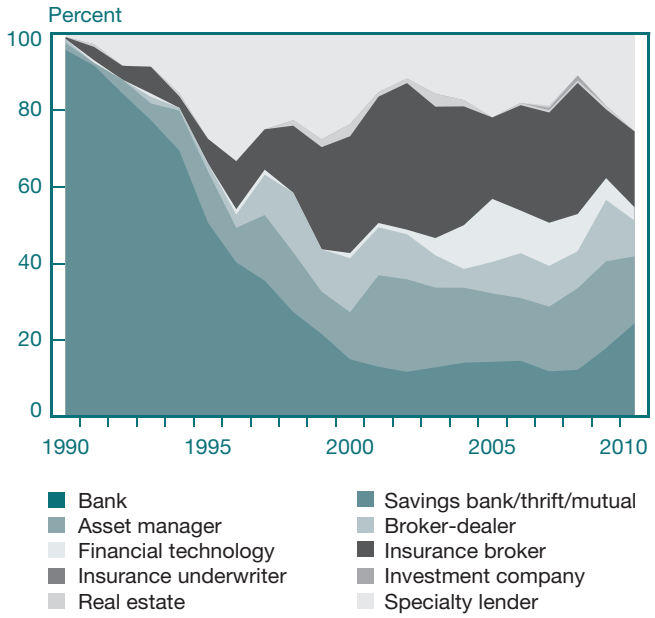
Chart 5
## Types in Cross-Industry Acquisitions, by Number




Source: Authors' calculations, based on data from SNL Financial.

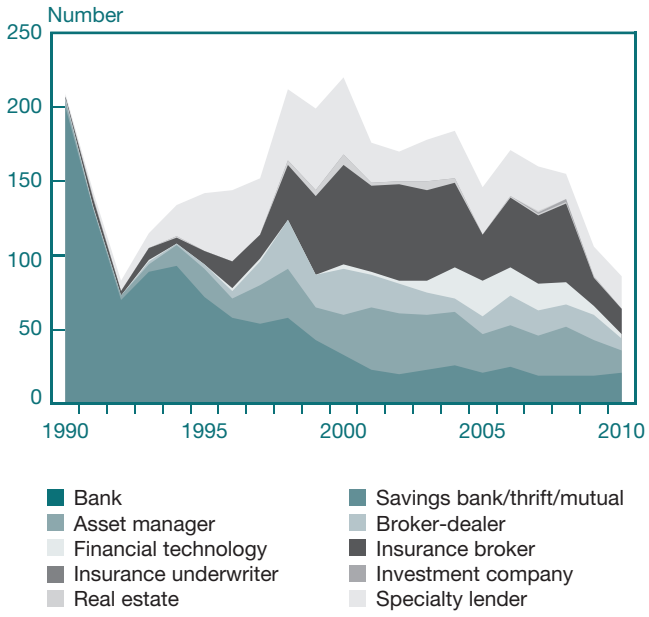
Note: Cross-industry acquisitions represent deals in which the buyer and target have different types.

Chart 6
Nonbank Targets of Bank Buyers (Share)




Source: Authors' calculations, based on data from SNL Financial.
Note: Vertical cross-sections illustrate the average share of targets by type in a given quarter.

Chart 7
Nonbank Targets of Bank Buyers (Number)




Source: Authors' calculations, based on data from SNL Financial.
Note: Vertical cross-sections illustrate the average number of targets by type in a given quarter.

Chart 7 instead displays the number, not the share, of acquisition types through time. It shows that the process of expansion remained active throughout the period, perhaps slowing down only in the post-crisis years.

## 5.3 Evolution in Bank Families, or Organizational Changes in BHCs

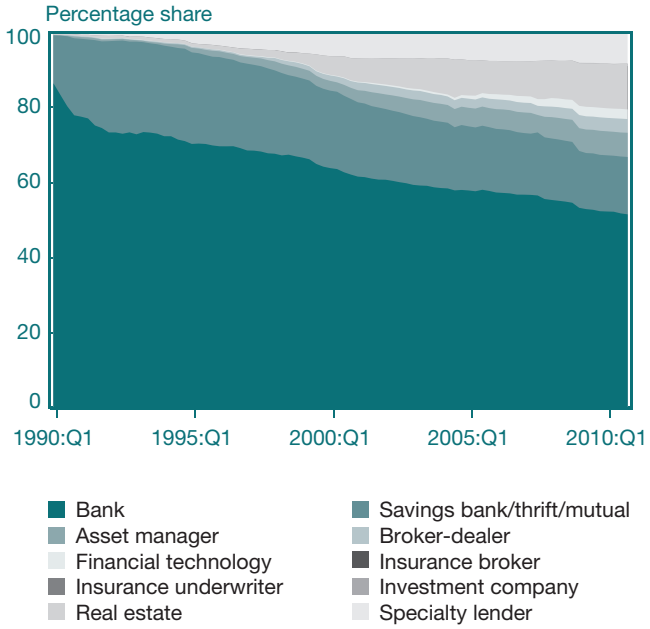
The entity-level analysis in the previous subsection already hints at the evolution in complexity of U.S. banking firms. However, maintaining the focus on individual entities actually understates the extent to which bank organizational boundaries really expanded. Entity-level analysis misses the process of merging, changes in names, and branching into multiple levels of affiliation. As a result, entity, rather than family, analysis leaves us blind to the actual size and composition of entity families. For example, in Table 4, Bank of America and NationsBank are the first- and second-highest ranked entities by acquisition value. However, these entities are truly the same; most of NationsBank's history folded into Bank of America upon creation. Within this new entity are many entities acquired along the way, perhaps representing a diversified portfolio or a focused industry giant. To track complexity accurately through time, we need a picture of the same entity's organization before and after the deal.

As explained in section 4, our methodology allows us to combine and track overall complexity, as captured by the amount and type of performed acquisitions (and sales). This buildup takes place within the walls of a banking family, defined by aggregating the information of individual entities under a common highest-holder identifier.

What does the typical BHC family look like? How does its structure evolve over time? Chart 8 addresses these questions by depicting the evolution of organizational profiles in our sample. The typical BHC changed appreciably over time. A BHC family was identified by having mostly commercial bank and thrift subsidiaries in the early 1990s. However, the organizational boundaries expanded significantly starting in the mid-1990s, as BHCs began adding an increasing number of nonbank subsidiaries.

The process that we are able to pick up through the data on acquisition matches well the data on total assets of BHCs, depicted earlier in Chart 1, which shows the increasing

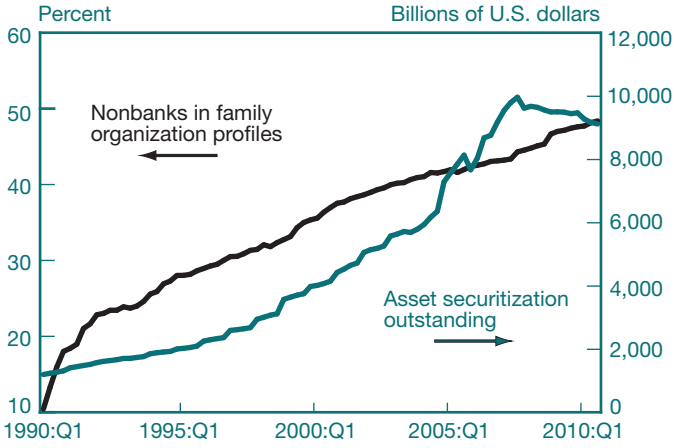
Chart 8
Organizational Evolution




Source: Authors' calculations, based on data from SNL Financial.

Note: Vertical cross-sections illustrate the average share of types within a bank family in a given quarter.

Chart 9
Nonbanks and Securitization




Sources: Authors' calculations, based on data from SNL Financial; Securities Industry and Financial Markets Association.

Notes: The black line illustrates the share (by count) of nonbanks in family organizational profiles. The green line illustrates asset securitization outstanding in billions of U.S. dollars.

contribution of nonbank subsidiaries to the total assets of their organizations. This evolution in BHCs' organizational footprint also coincides closely with the concurrent evolution in asset-securitization activity. Chart 9 shows the time series of the ratio of nonbank subsidiaries to total subsidiaries of all the BHCs in our sample, together with the time series of total asset securitization outstanding. As the chart suggests, the organizational expansion of BHCs tracks quite closely the rise in securitization activity observed from the mid-1990s up to the financial crisis.

Table 5 shows snapshots of family complexity taken in a given year, capturing the number of both bank and nonbank entities amassed through the acquisition channel by the top fifty BHC families (ranked by total assets) up to that year. BHCs in the early 1990s were relatively simple in organizational structure. Among the top ten in 1990, only BankAmerica Corporation, back then a holding company headquartered in San Francisco, California, had performed ten nonbank acquisitions, and Security Pacific Corporation had performed seven. Among the remaining top fifty, Bank One and Barnett had performed five nonbank acquisitions each. Five years later, the picture was already quite different. The number of acquisitions was much higher, both within and across industries. Some families from 1990 had disappeared from the subsequent list as surviving ones absorbed them (BankAmerica, for instance, acquired Security Pacific).

The BHC organizational profiles only increase in complexity as time goes by, with very large numbers of entities wrapped under common ownership and control. Moreover, the lists show that the process takes place across institutions, and it is not a phenomenon confined to just the largest entities.

Another way to capture the sector-wide transformation is to look at time-series metrics of BHC structures. Chart 10, for instance, displays the average number of commercial banks acquired and kept within a family in a given year. This number, not surprisingly, steadily increases, again reflecting the process of geographic deregulation and consequent consolidation.

The number of nonbank acquisitions in Chart 9 could still fail to show true expansion across industries. For instance, BHCs could have performed many acquisitions concentrated in just one nonbank industry. In order to capture the extent of broad horizontal expansion, we calculate a Herfindahl-Hirschman Index (HHI) of industrial concentration. This index is 1 if the BHC has only commercial banks and smaller than 1 if the BHC acquires nonbank subsidiaries. Furthermore, it progressively decreases as the acquisition profile among the ten industries becomes more "diverse." In the same chart, we report the average HHI of BHC families over time. The steady downward trend shows a push toward broad expansion in organizational boundaries.

Table 5

## Top Fifty Families by Size and Time, 1990-2000

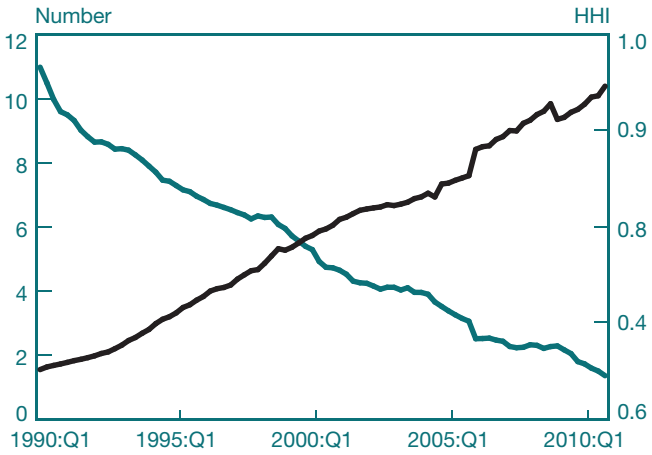
| | 1990 | | | 1995 | | | 2000 | | |
|---|---|---|---|---|---|---|---|---|---|
| Rank | Name | Banks | Nonbanks | Name | Banks | Nonbanks | Name | Banks | Nonbanks |
| 1 | Citi | 6 | 1 | Citi | 5 | 2 | Citigroup | 1 | 37 |
| 2 | BankAmerica | 3 | 10 | BankAmerica | 16 | 28 | JPMorgan Chase | 17 | 25 |
| 3 | Chase Manhattan | 1 | 0 | NationsBank | 17 | 3 | Bank of America | 104 | 77 |
| 4 | J. P. Morgan | 1 | 0 | J. P. Morgan | 1 | 1 | Wells Fargo | 194 | 80 |
| 5 | Security Pacific Corporation | 10 | 7 | Chemical Banking | 18 | 7 | Bank One | 74 | 20 |
| 6 | Chemical Banking | 18 | 2 | First Chicago NBD | 1 | 0 | First Union | 73 | 77 |
| 7 | NCNB | 5 | 0 | Bankers Trust New York | 1 | 0 | FleetBoston Financial | 45 | 47 |
| 8 | Bankers Trust New York | 1 | 0 | First Union | 22 | 25 | SunTrust Banks | 11 | 23 |
| 9 | Manufacturers Hanover | 1 | 0 | Banc One | 60 | 13 | U. S. Bancorp | 77 | 53 |
| 10 | C&S/Sovran | 1 | 0 | Fleet Financial Group | 25 | 21 | Key | 26 | 20 |
| 11 | First Interstate Bancorp | 7 | 0 | PNC Bancorp | 14 | 10 | Firstar | 0 | 1 |
| 12 | First Chicago | 3 | 0 | Norwest | 65 | 18 | Bank of New York Company | 5 | 32 |
| 13 | PNC Financial | 4 | 0 | Key | 26 | 12 | PNC Financial Services Group | 14 | 16 |
| 14 | Bank of New York Company | 3 | 0 | First Interstate Bancorp | 23 | 4 | State Street | 1 | 8 |
| 15 | Banc One | 16 | 5 | Bank of New York Company | 5 | 1 | BB&T | 55 | 89 |
| 16 | First Union | 15 | 1 | National City | 12 | 6 | Mellon Financial | 20 | 19 |
| 17 | SunTrust Banks | 1 | 0 | Bank of Boston | 11 | 9 | Fifth Third Bancorp | 27 | 39 |
| 18 | Bank of Boston | 2 | 1 | SunTrust Banks | 6 | 2 | SouthTrust | 47 | 12 |
| 19 | Fleet/Norstar Financial | 4 | 1 | Barnett Banks | 7 | 9 | Regions Financial Corporation | 83 | 28 |
| 20 | Barnett Banks | 4 | 5 | Mellon Bancorp | 5 | 8 | Comerica | 25 | 9 |
| 21 | Norwest | 10 | 2 | Comerica | 24 | 10 | Summit Bancorp | 6 | 7 |
| 22 | First Fidelity Bancorp | 2 | 1 | First Bank System | 27 | 10 | AmSouth Bancorp | 33 | 17 |
| 23 | Mellon Bancorp | 2 | 0 | Boatmen's Bancshares | 29 | 7 | MBNA | 0 | 3 |
| 24 | Continental Bank | 3 | 0 | CoreStates Financial | 6 | 5 | Charles Schwab | 3 | 14 |
| 25 | NBD Bancorp | 1 | 0 | State Street Boston | 1 | 2 | Northern Trust | 6 | 6 |
| 26 | Society | 2 | 0 | First of America Bank | 7 | 11 | Union Planters Corporation | 78 | 33 |
| 27 | National City | 2 | 1 | SouthTrust | 28 | 6 | Charter One Financial | 4 | 15 |
| 28 | Shawmut National | 3 | 3 | Southern National | 6 | 31 | M&T Bank | 14 | 18 |
| 29 | CoreStates Financial | 2 | 0 | Huntington Bancshares | 20 | 8 | Huntington Bancshares | 33 | 11 |
| 30 | Midlantic | 4 | 0 | Northern Trust | 4 | 3 | Popular | 14 | 5 |
| 31 | Bank of New England | 1 | 0 | Firstar | 1 | 1 | Old Kent Financial | 14 | 12 |
| 32 | Key | 8 | 1 | Crestar Financial Corporation | 4 | 16 | Zions Bancorp | 35 | 9 |
| 33 | First Bank System | 8 | 3 | AmSouth Bancorp | 10 | 8 | Compass Bancshares | 45 | 4 |
| 34 | Boatmen's Bancshares | 2 | 1 | Fifth Third Bancorp | 9 | 7 | First Tennessee National | 10 | 15 |
| 35 | First of America Bank | 5 | 3 | Mercantile Banc | 16 | 9 | Banknorth Group | 25 | 16 |
| 36 | Comerica | 13 | 4 | UJB Financial | 3 | 4 | Hibernia | 44 | 12 |
| 37 | UJB Financial | 2 | 0 | BanPonce | 4 | 2 | National Commerce | 18 | 25 |
| 38 | Manufacturers National | 5 | 1 | Meridian Bancorp | 9 | 4 | GreenPoint Financial | 0 | 6 |
| 39 | Meridian Bancorp | 2 | 1 | GreenPoint Financial | 0 | 3 | Provident Financial | 4 | 12 |
| 40 | Crestar Financial Corporation | 2 | 2 | Integra Financial | 2 | 3 | North Fork Bancorp | 5 | 15 |
| 41 | Huntington Bancshares | 4 | 1 | Regions Financial | 11 | 8 | Pacific Century Financial | 8 | 2 |
| 42 | Northern Trust | 1 | 1 | MBNA | 0 | 1 | Associated Banc-Corp | 14 | 1 |
| 43 | State Street Boston | 1 | 0 | Bancorp Hawaii | 3 | 2 | Colonial BancGroup | 26 | 11 |
| 44 | Signet Banking | 1 | 0 | First Security | 14 | 4 | People's Mutual Holdings | 2 | 5 |
| 45 | Ameritrust | 1 | 1 | First Tennessee National | 12 | 10 | Centura Banks | 18 | 17 |
| 46 | Michigan National | 4 | 1 | BayBanks | 5 | 2 | TCF Financial Corporation | 2 | 8 |
| 47 | Bancorp Hawaii | 3 | 1 | Old Kent Financial | 4 | 3 | Commerce Bancshares | 28 | 5 |
| 48 | Valley National | 1 | 0 | First Empire State | 3 | 4 | First Citizens Bancshares | 6 | 15 |
| 49 | Dominion Bancshares | 1 | 0 | Union Planters Corporation | 33 | 7 | FirstMerit | 3 | 9 |
| 50 | BayBanks | 2 | 0 | Signet Banking | 3 | 2 | BOK Financial Corporation | 13 | 2 |

Table 5 (continued)
## Top Fifty Families by Size and Time, 2005-10

| | 2005 | | | 2010 | | |
|---|---|---|---|---|---|---|
| Bank | Name | Banks | Nonbanks | Name | Banks | Nonbanks |
| 1 | Citigroup | 6 | 59 | Bank of America | 117 | 166 |
| 2 | Bank of America | 114 | 113 | JPMorgan Chase | 81 | 97 |
| 3 | JPMorgan Chase | 75 | 65 | Citigroup | 5 | 108 |
| 4 | Wachovia | 138 | 117 | Wells Fargo | 305 | 244 |
| 5 | Wells Fargo | 211 | 119 | Goldman Sachs | 0 | 89 |
| 6 | MetLife | 1 | 9 | Morgan Stanley | 0 | 25 |
| 7 | U.S. Bancorp | 116 | 83 | MetLife | 1 | 22 |
| 8 | SunTrust Banks | 12 | 34 | U. S. Bancorp | 126 | 96 |
| 9 | Countrywide Financial Corporation | 1 | 4 | PNC Financial Services Group | 69 | 117 |
| 10 | National City | 31 | 54 | Bank of New York Mellon | 6 | 98 |
| 11 | BB&T | 105 | 161 | Capital One Financial Corporation | 54 | 41 |
| 12 | Fifth Third Bancorp | 47 | 53 | SunTrust Banks | 25 | 41 |
| 13 | Bank of New York Company | 5 | 59 | State Street | 2 | 26 |
| 14 | State Street | 1 | 15 | BB&T | 112 | 190 |
| 15 | Key | 28 | 27 | American Express Company | 0 | 12 |
| 16 | PNC Financial Services Group | 21 | 26 | Regions Financial Corporation | 191 | 163 |
| 17 | Capital One Financial Corporation | 45 | 22 | Fifth Third Bancorp | 55 | 69 |
| 18 | Regions Financial Corporation | 158 | 70 | Key | 30 | 31 |
| 19 | MBNA | 0 | 6 | Northern Trust | 6 | 11 |
| 20 | North Fork Bancorp | 8 | 17 | M&T Bank | 27 | 34 |
| 21 | Comerica | 23 | 10 | Discover Financial | 0 | 3 |
| 22 | Northern Trust | 6 | 9 | Comerica | 23 | 10 |
| 23 | AmSouth Bancorp | 30 | 75 | Huntington Bancshares | 51 | 34 |
| 24 | Popular | 15 | 9 | CIT Group | 0 | 21 |
| 25 | Charles Schwab | 3 | 19 | Zions Bancorp | 55 | 17 |
| 26 | Zions Bancorp | 50 | 17 | Marshall & Ilsley | 32 | 34 |
| 27 | Mellon Financial | 23 | 36 | New York Community | 5 | 12 |
| 28 | Commerce Bancorp | 4 | 14 | Popular | 18 | 10 |
| 29 | First Horizon National | 9 | 28 | Synovus Financial Corporation | 29 | 15 |
| 30 | Huntington Bancshares | 34 | 13 | First Horizon National | 9 | 29 |
| 31 | Compass Bancshares | 45 | 14 | BOK Financial Corporation | 20 | 2 |
| 32 | Synovus Financial Corporation | 27 | 14 | Associated Banc-Corp | 25 | 7 |
| 33 | New York Community | 2 | 7 | First Niagara Financial | 8 | 34 |
| 34 | Associated Banc-Corp | 24 | 7 | First Citizens Bancshares | 14 | 16 |
| 35 | Colonial BancGroup | 31 | 13 | East West Bancorp | 10 | 3 |
| 36 | First Bancorp | 7 | 6 | TCF Financial Corporation | 2 | 11 |
| 37 | Webster Financial | 24 | 30 | Webster Financial | 21 | 32 |
| 38 | Doral Financial | 1 | 1 | Cullen/Frost Bankers | 19 | 12 |
| 39 | Mercantile Bancshares | 16 | 10 | SVB Financial Group | 2 | 4 |
| 40 | BOK Financial Corporation | 18 | 2 | Fulton Financial | 26 | 13 |
| 41 | W Holding Company | 2 | 1 | First Bancorp | 9 | 8 |
| 42 | Sky Financial Group | 12 | 17 | Valley National Bancorp | 16 | 14 |
| 43 | First Citizens | 9 | 16 | FirstMerit | 4 | 11 |
| 44 | South Financial Group | 25 | 15 | Wintrust Financial Corporation | 10 | 10 |
| 45 | Commerce Bancshares | 28 | 6 | Susquehanna Bancshares | 16 | 27 |
| 46 | TCF Financial Corporation | 2 | 10 | BankSouth | 29 | 18 |
| 47 | Valley NBC | 9 | 12 | Bank of Hawaii | 8 | 2 |
| 48 | Fulton Financial | 22 | 11 | PrivateBancorp | 5 | 2 |
| 49 | Investors Financial | 1 | 3 | UMB Financial Corporation | 19 | 14 |
| 50 | Cullen/Frost Bankers | 15 | 8 | Franklin Resources | 0 | 13 |

Source: Authors' calculations, based on data from SNL Financial; Federal Reserve System, Form FR Y-9C, Schedule HC.

Chart 10
Concentration and Diversification




Source: Authors' calculations, based on data from SNL Financial.

Notes: The black line illustrates the average number of banks acquired and kept within a family in a given year. The green line represents the average Herfindahl-Hirschman Index (HHI) calculated across the ten types of bank families. For each family, HHI is defined as $\sum_{(i=1)}^{10}\left(\frac{n_i}{N}\right)^2$ where $n_i$ represents the count of subsidiaries of type $i$ and $N$ represents the total count of subsidiaries.

## 6. Conclusion

Three key observations can summarize the evolution in the structure of financial firms. First, bank holding companies have become less bank-centric by expanding the types of their subsidiaries. Second, this phenomenon was very widespread, as financial firms other than bank holding companies also expanded their scope. Finally, bank holding companies expanded by adding more banks to their firms in the early- and mid-1990s. As we noted earlier, there are several hypotheses that might be consistent with those observations. First, it seems that the geographic deregulation of banking in the United States led to significant changes in the structure of banking markets (while not covered in our paper, this phenomenon has been studied extensively) and bank holding companies. This expansion and consolidation positioned bank holding companies to take advantage of later regulatory changes to increase their complexity. Second, and along these lines, GLB may have also allowed bank holding companies to expand into activities from which they were previously excluded, such as brokering and dealing.

While deregulation or firms' attempts to evade existing regulation may have allowed firms to evolve in the ways we describe, these rationales unlikely explain fully the evolution. The acquisitions we see in the data are among firms still in the regulated sector, and many of these firms organize themselves as bank holding companies, which the Federal Reserve supervises at the consolidated level.

Instead, some other changes in financial intermediation seem to be required to explain such widespread and profound shifts in the industry. Here again, there are several possible candidates. For instance, it may be that the more geographically expansive nature of business enterprises gave rise to an increased demand for cross-border banking, both within the United States and overseas. That could have provided an impetus for the early wave of bank acquisition we see in our sample. An alternative hypothesis is that specialized firms, whose contributions to finance are to add value along a chain of financial engineering that operates externally to any particular firm, are now more efficient than generalist firms, which build an integrated value chain internally.

This hypothesis could be supplemented to account for the acquisitions of specialist firms by increasingly large BHC conglomerates. For example, information and credit frictions may be more difficult to overcome for isolated specialist firms but more manageable with help from internal capital markets in larger firms. Our results are consistent with this move toward a model of finance more oriented toward securitization. The hypothesis itself may be dependent on the long-term and ongoing revolutions in information technology and communications that have allowed more quantification of financial information and have improved the ability to communicate and manage that information. In that sense, for banking firms to stay viable in a changing industry, complexity is a necessary adaptation.

The changes documented in this paper refine our understanding of bank complexity across a number of dimensions. First, they highlight the expanded scope and complexity of individual firms. Second, they suggest that the industrial organization of finance is changing profoundly: Market interactions among more numerous and more specialized firms have displaced the earlier organization of generalized firms, which engaged in most stages of finance by using internal resources. Third, bank holding companies have become increasingly less bank-centric, increasing the importance of consolidated supervision by the cooperative effort of a larger set of functional regulators. Given these findings, design of informed regulation of complex banking organizations presents a key challenge going forward.

The financial crisis of 2007-09 raises concerns about the very existence of supersized institutions. Why does society need incredibly large and complex banking institutions when they are a potential cause of systemic disruption? Possible "subsidies" from explicit or perceived government guarantees may distort incentives in failure resolution. Size and complexity

may also lead to complicated and ineffective monitoring, such as duplication of rules or regulation that is too strict (or too weak).

Our documentation of the evolving structure of banks offers potential insights for the evaluation of policy solutions to these bank complexity problems. For instance, blunt fixes such as reinstating GLB might artificially impose breakups, fragmenting the intermediation industry and trading large and complex holding companies for shadow entities outside the scope of oversight. If complex conglomerate structures are the result of an adaptation to technological and financial advances, then tractable policies such as enhanced capital requirements, effective resolution plans, and stress tests may reduce systemic risk while retaining intermediation synergies, such as reducing informational frictions across links in the intermediation chain.[17]

[17] For a discussion of this policy trade-off, see Federal Reserve Bank of New York President Bill Dudley's speech: "Global Financial Stability—The Road Ahead," February 26, 2014. Available at http://www.bis.org/review/r140226b.htm.

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Nicola Cetorelli and Linda S. Goldberg

# Measures of Global Bank Complexity


- Although the complexity of global banking institutions is generally thought to contribute to the risk of systemic disruptions, no single accepted metric for complexity exists.
- To address this gap, this study introduces two broad measures: *Organizational complexity* captures the number and geographic spread of an institution's affiliates, as well as the levels of ownership linking affiliates; *business complexity* captures the range of activities conducted within an institution's walls.
- Using these measures, the authors assess the complexity of a sample of 170 global banking organizations. They find that complexity cannot be equated with institution size; although affiliate counts *are* correlated with size, no close relationship exists with other complexity measures.
- In addition, the authors conclude that the institutions differ greatly in the number of their affiliates, the complexity of their ownership trees, and the degree of diversification in their business activities.


## 1. Introduction

The increasing size and complexity of financial institutions has received renewed attention in recent years—prompted in part by the debate over the issue of too-big-to-fail entities. How the size of failing institutions might contribute to systemic disruption is well understood. Complexity, however, is a thornier, less easily defined concept, although it is a natural subject of policy concern given the systemic implications of resolving failing institutions. Resolvability requires successfully executing an orderly liquidation in the event of an organization's distress and default; in the case of complex institutions—many with global reach—such liquidations may be more difficult because a large number of legal entities or legal systems are involved.

Concerns over the potential systemic repercussions of disruptions to complex organizations have inspired a number of ideas for preemptive "fixes," including capping of size, breakup and separation of the institution along business lines, organizational restructuring to limit the cross-border dimension of complexity (this last remedy captured in a proposed Federal Reserve rule to strengthen the oversight of U.S. operations of foreign banks),[1] and efforts to make organizations more robust, including the already-implemented enhanced capital and liquidity requirements for systemically important financial

[1] For details, see http://www.federalreserve.gov/newsevents/press/bcreg/20121214a.htm.

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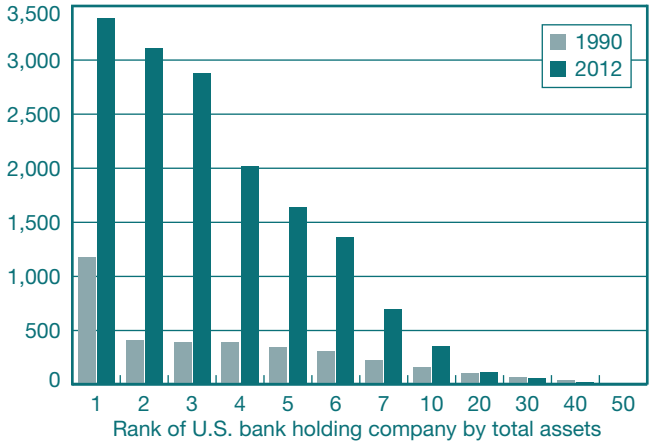
The authors gratefully acknowledge the excellent data work of Arun Gupta, Meru Bhanot, Samuel Stern, and Rose Wang, as well as input from Philip Strahan and from colleagues at the Federal Reserve Bank of New York who participated in a broader initiative on understanding size and complexity in financial institutions. The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

institutions. Other approaches to resolution include the FDIC's Title II Orderly Liquidation Authority approach under the Dodd-Frank Act, whereby financial organizations operating in the United States would do so with a "single entry" strategy intended to reduce system spillovers from resolution as well as the fiscal consequences of such events.[2]

In the context of these initiatives, we note that there is no single accepted metric for complexity and that analysis of this issue across broad groups of financial firms is relatively scarce. It is well known that banks have developed broader networks of affiliated banking and nonbanking entities at home and abroad. Herring and Santomero (1990) were among the first to predict such an expansion of financial conglomerates, arguing that it would arise from synergies in the production of financial services and in the consumption of financial services.[3] Twenty years later, Herring and Carmassi (2010) documented how far this trend toward consolidation and conglomeration in financial services had progressed, observing that, by the middle of this century's first decade, large complex financial institutions had hundreds or thousands of subsidiaries.[4] At least half a dozen top U.S. bank holding companies (BHCs) had more than a thousand subsidiaries in 2012, in contrast to a single firm with such numbers in 1990, as shown in Chart 1 (Avraham, Selvaggi, and Vickery 2012). The organizational evolution of U.S. BHCs followed an intense process of industry consolidation and substantial acquisitions of nonbank subsidiaries (Cetorelli, McAndrews, and Traina 2014). On the international side, the extent of banking's globalization through the establishment of affiliates in other parts of the world has been documented in numerous studies, including a recent broad overview by Claessens and van Horen (2013). These studies have been revealing, but the complexity of these organizations has not been documented comprehensively.

Despite the centrality of the bank complexity issue, no shared consensus has emerged just yet on what complexity might mean in the context of banking, or at least what might be the agreed-upon dimensions of our analysis of complexity. Concentrating on global banks adds many layers to considerations of complexity, so a focus on global banking organizations is bound to yield a more exhaustive take on the issue than an examination of purely domestic banking entities.

Chart 1
Number of Subsidiaries in U.S. Top Fifty Bank Holding Companies




Source: Avraham, Selvaggi, and Vickery (2012).

Accordingly, we turn our attention to financial institutions from around the world that have operations within the United States and financial institutions from the United States that have branches or subsidiaries abroad.

We adopt two broad measurement concepts. We introduce "organizational" complexity metrics to indicate the degree to which the organization is structured through separate affiliated entities. Organizational complexity also encompasses a related dimension specific to global entities—namely, geographic complexity, as captured by the span of the organization's affiliates across different regions or countries. In addition, we introduce "business" complexity, a concept referring to the type and variety of activities that may be conducted within the walls of a given institution. Organizational measures have a more direct fit with the main concerns typically associated with complexity, such as resolution, fragmentation, cross-border systemic risk, internal liquidity dynamics, managerial agency frictions, and "too big to fail." Business complexity concepts may speak more to the diversification and fragmentation of the type of production undertaken by organizations. Neither metric adequately captures the systemic nature of the distress resulting from potential failures; for this, the metric would need to incorporate insights on the criticality of the functions performed in the organization.

Since our focus is on global banking organizations, we pay careful attention to the fact that these are structured to encompass affiliates worldwide. The number of affiliates can be

[2] See http://www.fdic.gov/about/srac/2012/2012-12-10_title-ii_orderly-liquidation-authority.pdf.

[3] Herring and Santomero (1990) were also prescient in anticipating some of the policy concerns that would arise from the growth of institutional size and complexity.

[4] Herring and Carmassi (2010) discuss some potential consequences, but primarily argue that complexity increases systemic risk, worsens information and incentive problems within organizations, and impedes timely regulatory intervention and disposition of financial firms.

relatively few or in the thousands. This pattern of complexity reflects the broader growth in global banking over recent decades, as international financial markets in general have grown more interconnected. Foreign banks now represent over a third of the banks in most countries, often accounting for more than half of banking assets (Claessens and van Horen 2013). In the case of the United States, these shares are slightly smaller but still quite significant. For instance, foreign banks account for about 25 percent of total banking assets, and five of the ten largest broker-dealers are foreign owned.

We selected our sample of global banking organizations by considering the universe of financial institutions with operations in the United States.[5] For non-U.S. entities, our sample includes small financial organizations and most of the financial organizations designated as G-SIFIs (global systemically important financial institutions).[6] These institutions support a broad range of real activities in the United States and around the world, including traditional lending, securities underwriting, loan syndicate participation, and funds collection for local or parent operations. We provide comparative analysis by also considering U.S. institutions with a global footprint. We measure complexity for each financial institution (U.S. or non-U.S.) by using detailed data on the counts of affiliates organized under common ownership and control, and we use this information to document a substantial heterogeneity across global institutions along all of the alternative dimensions of complexity. Finally, we show the relationship between different measures of complexity and the size of banking organizations.

The analysis yields a number of interesting observations. First, global banking organizations are highly diverse in terms of size and the correlated metric of absolute counts of affiliates around the world. These affiliates span multiple levels of ownership through an organizational tree. Second, within these organizations, the counts of nonfinancial affiliated entities are generally many times the counts of affiliated banks. Third, business-type complexity within these organizations—measured with Herfindahl index constructs—shows different tendencies according to the economic geography of the financial institutions' parent organizations, with large compositional distinctions across firms by parent nationality.

Details on the location of affiliates of each parent organization add another important dimension of complexity. We observe very large differences in the patterns of geographic complexity among institutions across countries and regions and even within country of origin. For example, global banking organizations with Japanese parentage are the least geographically diverse in terms of affiliate locations (that is, they are more likely to be located within Japan), while these same organizations tend to have lower overall numbers of affiliated entities. By contrast, financial organizations with parents in the euro area tend to be larger in number, have more affiliates on average, and are more differentiated in terms of the geographic diversity of affiliate locations. The U.K. financial organizations are fewer in number, but have large numbers of affiliates and high geographic diversity.

Finally, we consider whether organizations' complexity and size are comparable concepts that can be used interchangeably in discussions of size premia and too-big-to-fail debates. We find a strong correlation between the complexity of large financial organizations—as measured by affiliate counts—and the organizations' size . However, this tight link disappears with the other measures of complexity we have described.

## 2. The Sample of Global Banks and Available Data for Measuring Complexity

Perspectives on the complexity of an organization start with access to detailed data describing that organization's structure. All U.S. banks, as well as all branches and subsidiaries of foreign banks within the United States, file regulatory reports in the United States. These reports provide information on the structure of the organization that the reporting entities belong to, but primarily report data on the components within the United States. For a more complete picture of the entire parent or bank holding company, we supplement the information from regulatory reports with metrics of foreign bank organizational structure and size that are drawn from reporting available through the Bureau van Dijk's Bankscope database. We focus our attention on the subset of foreign-owned global institutions that are the ultimate parents of the U.S. branches of the foreign organizations.[7]

Since our focus is on global banks, we also look at those banks of U.S. parentage that have affiliates outside of the United States. This information on U.S. global banks is drawn

[5] In particular, we consider which foreign banking organizations operate branches in the United States.

[6] The Financial Stability Board's November 2012 update of G-SIFIs is discussed at http://www.financialstabilityboard.org/publications/r_121031ac.pdf.

[7] Foreign banking organizations are present in the United States also through ownership of U.S.-chartered bank subsidiaries. We could include these entities in our analysis of global complexity. However, branches are a direct emanation of a foreign-located parent, while subsidiaries (and, if existing, their U.S. holding company parents) are locally capitalized and under direct control of the U.S. regulator. In that sense, the implications associated with complexity of the parent organizations are quite distinct. For our purposes, we choose to focus our attention on the organizations that operate in the United States through bank branches, recognizing that some of these organizations may also have other U.S. subsidiaries, which can be banks and/or nonbanks.

Table 1

## Foreign Banking Organizations with U.S. Branches, by Highholder Region
As of Fourth-Quarter 2012

| | Highholder Data | | | | U.S. Branch Data | |
|---|---|---|---|---|---|---|
| Highholder Region | Number of Highholders | Highholder Total Assets (Billions of Dollars) | Number of G-SIFIs | G-SIFI Asset Share (Percent) | Number of U.S. Branches | Branch Total Assets (Billions of Dollars) |
| Euro area | 29 | 21,379 | 8 | 64 | 46 | 596 |
| United Kingdom | 4 | 6,855 | 3 | 78 | 11 | 143 |
| Japan | 8 | 6,163 | 3 | 78 | 18 | 440 |
| China | 6 | 9,312 | 1 | 20 | 11 | 53 |
| Switzerland | 2 | 2,621 | 2 | 100 | 8 | 134 |
| Canada | 7 | 3,375 | 0 | 0 | 20 | 396 |
| Other Americas | 19 | 1,477 | 0 | 0 | 22 | 47 |
| Other Asia | 37 | 4,114 | 0 | 0 | 59 | 61 |
| Other | 23 | 5,644 | 1 | 16 | 27 | 217 |
| All foreign | 135 | 60,940 | 18 | 48 | 222 | 2,089 |
| United States | 35 | 12,568 | 8 | 81 | — | — |

Sources: Federal Financial Institutions Examination Council (FFIEC), Report of Assets and Liabilities of U.S. Branches and Agencies of Foreign Banks, 002 regulatory filing; Bureau van Dijk, Bankscope database.

Notes: Highholder region information for the U.S. branches of foreign banking organizations filing with the FFIEC was matched from Bankscope's Ownership Module. We initially matched 140 highholders—that is, ultimate owners—in Bankscope. Of the 140, 3 were dropped because we could not find an ownership tree; 2 were dropped because they did not meet our criteria for complexity (that is, they did not have an ownership share exceeding 50 percent in their affiliates). "Other Asia" comprises Hong Kong, India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore, South Korea, Taiwan, and Thailand. "Other Americas" comprises Argentina, Bermuda, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guam, Panama, Puerto Rico, Uruguay, and Venezuela. "Other" comprises Australia, Bahrain, Egypt, Israel, Jordan, Kuwait, Nigeria, Norway, Saudi Arabia, Sweden, Turkey, and the United Arab Emirates. G-SIFI asset share is defined as the percentage of the region's total assets that are associated with a global systemically important financial institution.

from regulatory reporting in the United States and serves as a reference point for comparisons with the complexity of foreign financial organizations operating in the United States. For all global banks, we provide metrics of organizational structure as well as various descriptive statistics obtained using these metrics. Our analysis primarily examines data on organizational structure in place at the end of 2012.

## 2.1 Foreign Organizations with U.S. Branches

As part of our criteria for defining a sample of global banks, we begin with information pertaining to the 222 branches of foreign banking organizations that filed regulatory reports in the United States at the end of 2012.[8] As shown in Table 1, overall these branches belong to a total of 135 foreign banking organizations (FBOs). Asia as a whole (Japan, China, and "other Asia") accounts for the largest number of parent organizations from a single region, but euro-area organizations dominate from the perspective of total assets. The total worldwide assets of these euro-area FBOs exceed $21 trillion.

A number of the foreign banking organizations in the United States have G-SIFI status—a sign of their significant global footprint. In terms of geographical distribution, most G-SIFIs are originally from Europe. While European FBOs are the largest worldwide, their U.S.-specific presence, measured by the asset size of their bank branches, is not dissimilar to that of FBOs originating in other regions. Branches

[8] In the fourth quarter of 2012, 230 U.S. branches of foreign banks filed regulatory reports. Of these, we were able to match only 222 to complete highholder data from Bankscope.

themselves follow heterogeneous business models (this information is not reported in the table). For example, many smaller branches often lend to nonresident borrowers and support trade finance. Most of the larger branches instead conduct trade finance and also provide short- and long-term lending to support customers from their home country as well as U.S. business clients. Many of the foreign organizations use their branches to help manage the liquidity of the larger entity. Finally, the largest FBOs have many activities that extend beyond lending, including sales and trading, corporate finance, and asset management. Some of these activities are conducted outside the branches and through affiliated U.S. subsidiaries.

The final row of Table 1 provides some comparable statistics on U.S. global financial institutions that engage in banking activity. A total of 35 U.S. financial institutions have branches or subsidiaries outside of the United States and are considered global banks by these criteria. Eight of these institutions are classified as G-SIFIs, representing 81 percent of the $12.6 trillion in total assets across all U.S. global banking organizations.

## 2.2 Parents and Their Affiliates

Measurement of the complexity of global banking organizations requires multiple steps. Typically, the immediate owner of the U.S. branch is a commercial bank, but that entity can have a different ultimate owner. Indeed, there can be many intermediate ownership links, with ownership shares that vary all along the levels of ownership in an organizational tree. Determining the ultimate owner, or "highholder," of an organization requires climbing up the ladder of an organization's ownership.

A number of issues concerning ownership of the organization must be resolved before we can generate useful metrics of complexity. First, within financial firms, legal and regulatory distinctions are made between related institutions, those with majority ownership, and those that are controlled. For our purposes, we seek to capture a level of ownership that is sufficient to constitute affiliation from an economic perspective—that is, where control can be presumed. Second, we confront the question of how to deal with multiple levels of ownership trees under an ultimate parent, since most parents own entities that have stakes in other entities. Third, we recognize the difficulty in constructing metrics that aggregate over affiliates of different sizes and types. While some methods of aggregation best demonstrate the dimensionality of the organization, and perhaps are most useful for indicating potential frictions in a firm-resolution scenario, other methods might be more useful for systemic risk discussions. The latter point raises the issue of whether ideal complexity constructs would show which entities serve some "critical function" from the vantage point of the organization's production function, in the sense of having the potential to significantly disrupt some part of the organization's business in the event of their absence.[9] Moreover, while recognizing these important conceptual issues, we confront the practical issue of whether all this relevant information is available. Below we outline the approach followed based on these considerations and data availability, addressing only some of these issues.

Our parent concept is the ultimate parent organization that presides over the U.S. branch, its commercial bank owner, and the structures above these entities. The full vertical ownership and vertical affiliate structure are available in regulatory reports filed in the United States for the banks and bank holding companies with a U.S. parent. We use these data to measure the complexity of U.S. organizations, as also examined in Avraham, Selvaggi, and Vickery (2012). However, the ownership structure reported above the particular banking entity in the United States generally does not capture the full structure for the whole foreign parent organization, particularly for larger and more complex organizations.

For foreign parents, we follow Herring and Carmassi (2010) and use Bankscope's Ownership Module to extract relevant organizational structure.[10] For each organization, the data sources contain information on affiliate names, percentage of ownership by the immediate parent or a related control categorization, geographic location, and type. Information on the size or balance sheet data of affiliates is less consistently available. The data are available in levels of direct ownership from the parent—meaning, for example, that a level 1 affiliate is directly owned by the ultimate parent entity. Level 2 entities are owned by level 1 entities, and so on down through level 10 of an ownership tree. Each affiliated entity is tied to its direct parent with information provided on the quantitative level or a percentage grouping of ownership, as well as with information on the entity type, industry, and size.[11] The structural

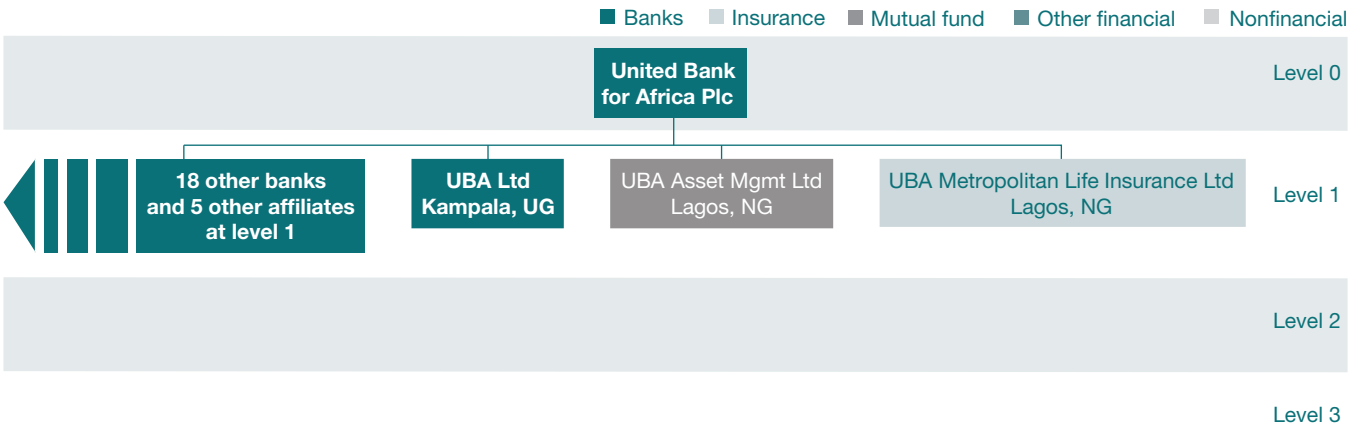
[9] For a discussion of critical functions, see Annex 3 of the Financial Stability Board's work on recovery and resolution, available at https://www.financialstabilityboard.org/publications/r_121102.pdf. In practice, such determinations are made at the level of specific products and services.

[10] In terms of procedure, we begin with the regulatory reports filed in the United States. These provide information on "entity" names and identification codes that are then hand-matched with names of organizations reported in Bankscope. We then cull information on the organizational structure of the foreign parent. We were able to match approximately 97 percent of all reporting U.S. branches of foreign banking organizations to a foreign parent, which represented 98 percent of all FBO branch assets in the United States in the fourth quarter of 2012. The missing entities are typically smaller branches that have been in the overall sample for shorter periods of time; they are less likely to be in organizations with multiple branches in the United States.

[11] Not all fields of data are equally well populated. We include the foreign parent itself as an affiliate in the organizational structure and assign it to level 0. Suppose a bank headquartered in Germany had one affiliate in France. This organization is intuitively more complex than a bank headquartered in France

Exhibit 1

## Sample Organizational Structure of a Simple Foreign Banking Organization




Source: Bureau van Dijk, Bankscope database.

Notes: Highholder structure information is drawn from Bankscope's Ownership Module from 2012:Q4. Highholder and affiliates shown are selected to illustrate a foreign banking organization with subsidiaries only at the first level. "Other financial" includes the following Bankscope entity types: financial company, private equity firm, venture capital firm, and hedge fund. "Nonfinancial" includes the following Bankscope entity types: industrial company, foundation/research institute, and self-owned firm.

information available from Bankscope is typically the most recently reported. For the details reported below, we use information contained in Bankscope as of the end of 2012. We follow Herring and Carmassi (2010) and sort these affiliates into broad buckets: banks, insurance companies, mutual and pension funds, other financial subsidiaries, and nonfinancial subsidiaries. Bankscope defines "other financial" as consisting of four Bankscope categories: "financial companies," "private equity" firms, "venture capital" firms, and "hedge funds," with "financial company" not separately defined. We restrict our analysis to include only those entities in which a parent has 50 percent or more ownership. Thus, to be included in our affiliate counts, an ultimate parent organization has an affiliate below it (at level 1) if the ownership threshold is at least 50 percent, and if the level 1 organization has an ownership stake of at least 50 percent in the level 2 organization, and so on all the way to level 10, which is the furthest distance from the ultimate parent that we found recorded within Bankscope. Given these conditions, all statistics provided present a conservative view of the ownership and complexity of the organizations. We have performed the analysis using ownership shares of both 25 percent and 50 percent and have generated quite similar results for both cutoff levels.

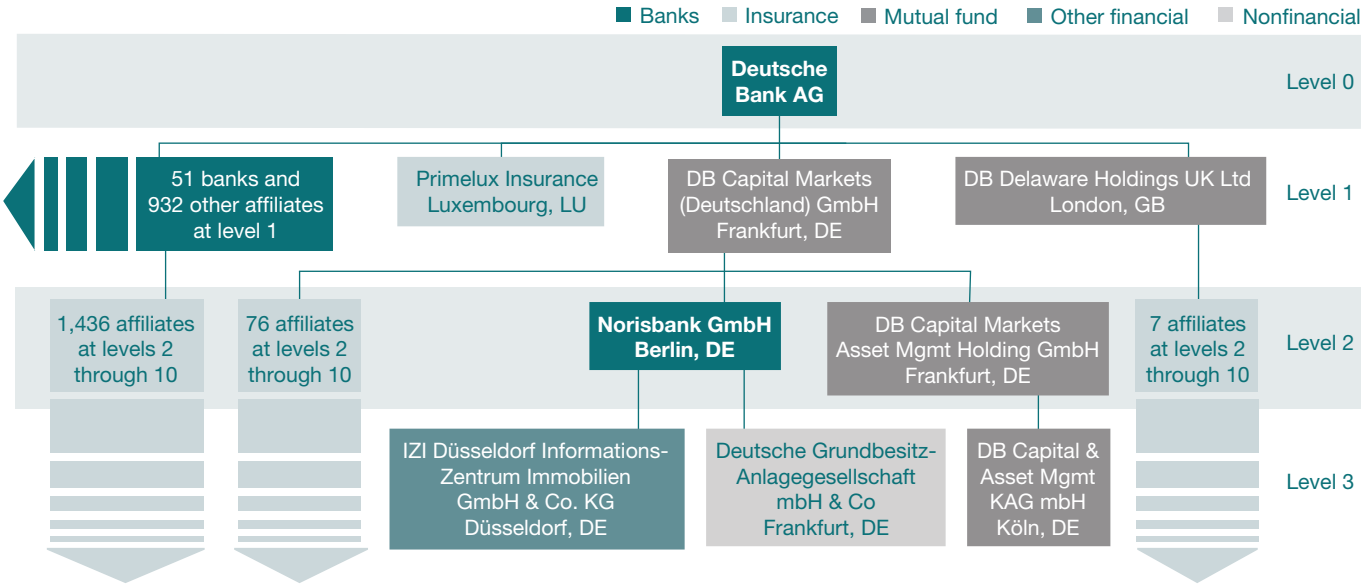
*Footnote 11 (continued)*
with one affiliate in France. Adding the foreign parent as an affiliate noticeably alters the complexity measures only in cases where the parent has few affiliates.

To understand these structures, consider Exhibits 1 and 2, which show the types of organizational trees that emerge from the data. The entity depicted in Exhibit 1 has a relatively simple organizational structure. In this case, United Bank for Africa Plc is a parent organization with only level 1 affiliates in the hierarchy, and most of the affiliates are classified as commercial banks. This structure contrasts sharply with that provided in Exhibit 2, which shows a small part of the organization under parent Deutsche Bank AG. This organization is highly complex, encompassing a broad range of affiliates of different types cascading down the various levels of the tree. For example, the highholder has numerous direct ownership positions shown in level 1, spread across types of entities as the color coding indicates. These level 1 affiliates have their own ownership positions in entities captured as level 2 affiliates, also across a range of bank and nonbank types.

Some caveats apply to the results. All affiliate counts should be considered illustrative as opposed to definitive, because our approach has potential shortcomings. First, we match a U.S. branch to its ultimate highholder and then match that highholder to a Bankscope entity, thus introducing a risk of mismatch. Second, we examine the most recent organizational tree under a highholder as reported in the Bankscope Ownership Module, but we do not view the longer history of organizational trees. While we expect considerable inertia in the organizational structure and counts, structures potentially

Exhibit 2

Sample Organizational Structure of a Complex Foreign Banking Organization




Source: Bureau van Dijk, Bankscope database.

Notes: Highholder structure information is drawn from Bankscope's Ownership Module from 2012:Q4. Highholder and affiliates shown are selected to illustrate a multilevel foreign banking organization. "Other financial" comprises the following Bankscope entity types: financial company, private equity firm, venture capital firm, and hedge fund. "Nonfinancial" comprises the following Bankscope entity types: industrial company, foundation/research institute, and self-owned firm.

could change dramatically over time. Third, we make specific assumptions about the ownership share that warrants inclusion in our counts. Since lower ownership shares could also be associated with valid affiliates, our counts likely understate the total number of affiliates under control of an ultimate parent.

## 3. Evidence on Complexity

### 3.1 Measures of Complexity

We construct a number of complexity metrics, each with a different value depending on the economic issues to be addressed, including activities during the life of the organization or during periods of extreme stress and resolution. While finer measures could potentially be constructed using more detailed supervisory or regulatory data, the measures we present have the advantage of being available for a wide cross section of entities and therefore are useful for cross-country and broad conceptual discussions. For example, we can consider the complexity of a firm's organizational structure, which maps into the issues normally raised when the terminology of complexity is used in policy circles. For instance, a firm organized with multiple separate legal entities is likely to pose greater challenges for those executing an orderly liquidation, thus potentially increasing the risk of systemic repercussions. Likewise, we can consider the fragmentation of business activities across different entity types, which is relevant for policy in that it may increase the challenges in conducting effective monitoring and regulation if, for instance, the separate subsidiaries are under the oversight of separate regulatory agencies.[12] For global firms,

[12] U.S. bank holding companies are a good example of this. These organizations as a whole are subject to the supervision of the Federal Reserve, but the activities of certain subsidiaries are under the direct regulation of other agencies (for example, the SEC for broker-dealers and funds, and state and federal insurance bodies for insurance subsidiaries). This issue is amplified for global organizations with subsidiaries located in foreign countries that are subject to local regulatory jurisdictions.

Table 2
## Complexity Metrics

| Type | Name | Construction | Comments |
|---|---|---|---|
| Organizational | *Count* | Number of 50+% owned affiliates under a parent organization | The affiliate count includes the parent itself as an affiliate. |
| Organizational | *CountNBtoB* | Number of 50+% owned nonbank affiliates/number of 50+% owned bank affiliates | |
| Business | *Business complexity* | $\frac{T}{T\text{-}1}\left(1-\sum_{i=1}^{T}\left(\frac{count^i}{totalcount^i}\right)^2\right)$ where $T$ is the number of types | The normalized Herfindahl index is based on affiliate types given in Bankscope, grouped into 1) banks, 2) insurance companies, 3) mutual and pension funds, 4) other financial subsidiaries, and 5) nonfinancial subsidiaries. Output values range from 0 to 1, where 0 is lowest complexity and 1 is highest complexity. |
| Geographic | *Geographic complexity* | $\frac{R}{R\text{-}1}\left(1-\sum_{r=1}^{R}\left(\frac{count^r}{totalcount^r}\right)^2\right)$ where $R$ is the number of regions | The normalized Herfindahl index is based on affiliate regions given in Bankscope, grouped into 1) euro area, 2) United Kingdom, 3) Japan, 4) South Korea, 5) China, 6) Canada, 7) United States, 8) Taiwan, 9) Middle East, 10) other Americas, 11) other Europe, 12) other Asia, 13) other. Output values range from 0 to 1, where 0 is lowest complexity and 1 is highest complexity. |

an organizational footprint that spans multiple countries also adds to the challenges of oversight and resolution.

Table 2 provides the set of measures—organizational, business, and geographic—that we construct for each of the global financial firms. The standard measure of organizational complexity, *count*, is the total number of affiliates—including the ultimate parent—that satisfy the percent ownership criteria we apply in constructing the metric. This measure is especially relevant for thinking about organizational fragmentation and resolution planning. A second organizational measure, *countNBtoB,* is computed as the ratio of counts of nonbank affiliates to bank affiliates. This indicator is more relevant for potential discussions about the relationship between bank and nonbank affiliates and for discussions about the pattern of liquidity flows between the commercial banks and the rest of the organizational structure.[13] The two other metrics, introduced to capture business and geographic complexity, are constructed as Herfindahl concentration indexes. The *business complexity* measure gauges the diversity of the affiliates in terms of the types of business they conduct, with types divided into five buckets; the *geographic complexity* measure assesses the diversity of the affiliates in terms of geographic location, with locations divided into thirteen regions.

[13] See Cetorelli and Goldberg (2013).

## 3.2 Organizational Complexity of Non-U.S. Global Banks

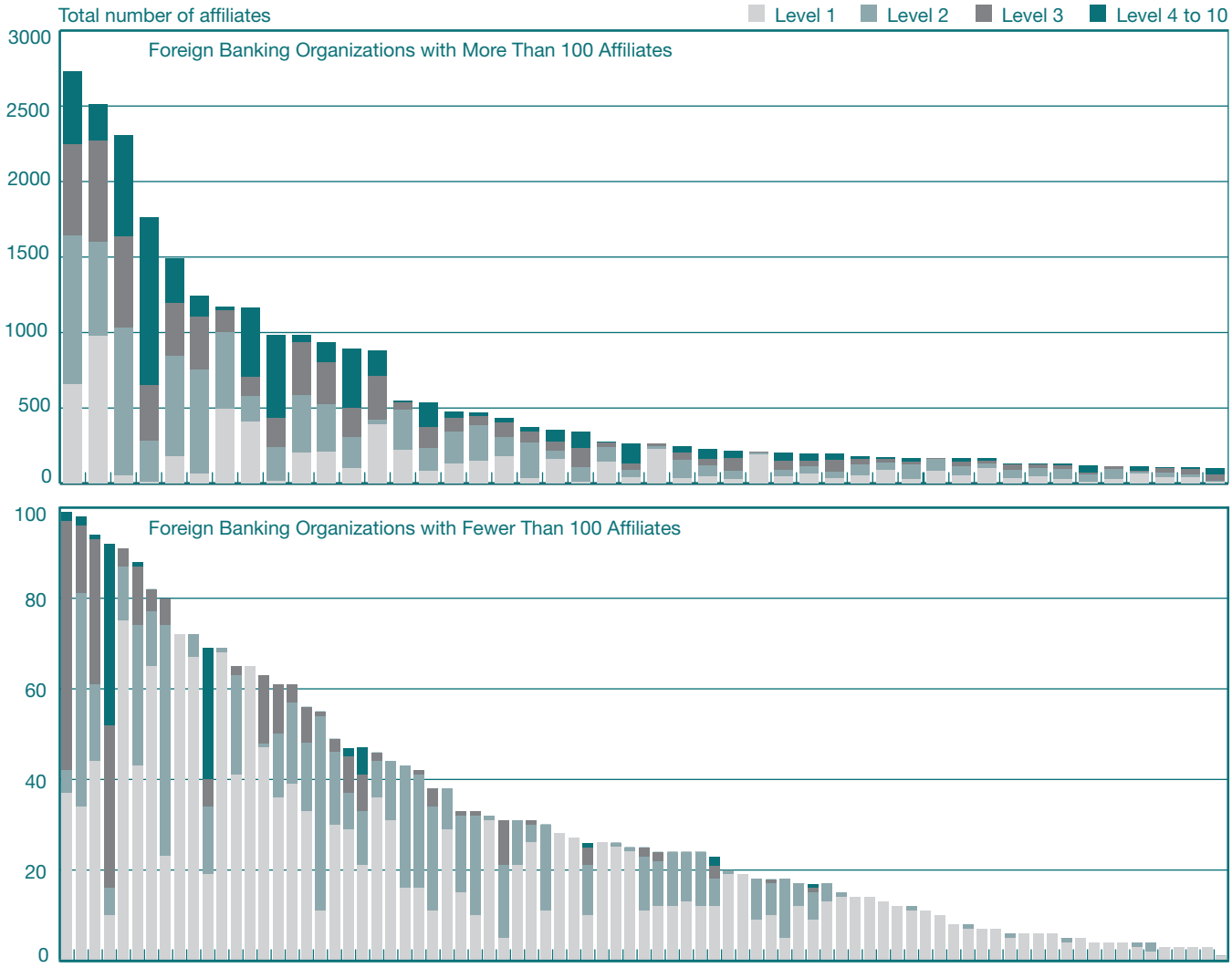
We begin by describing the findings for those organizations owned by parents outside the United States. The statistics for these institutions are constructed using the Bankscope database, as noted earlier. We later turn to the statistics that are computed for U.S. financial institutions and that are based on the U.S. regulatory reporting by those entities.

Consider first the patterns in our broadest metric of organizational complexity, which is the total count of affiliates under a highholder with U.S. branches and where at least 50 percent ownership of an affiliate is required at each level of the organization. Chart 2 provides total counts for highholders. Those organizations with more than 100 affiliates are shown in the top panel, and those organizations with fewer than 100 affiliates are presented in the bottom panel. Each vertical bar represents a separate highholder.[14] Among these highholders, twenty-four have more than 250 affiliates and fifteen have more than 500 affiliates; the highholder with the highest count has 2,729 affiliates (top panel). Most of the foreign organizations have fewer than 100 affiliates (bottom panel).

[14] We do not focus on the specific factors driving the establishment of a given legal entity. In some cases, tax or regulatory arbitrage may be factors explaining the existence of a subsidiary, more so than actual business activities. However, such entities still contribute to more difficult monitoring and regulation, more complex resolution, and perhaps a denser network of interconnections within the organization.

Chart 2

## Foreign Banking Organizations: Number of Affiliates, by Level




Source: Bureau van Dijk, Bankscope database.

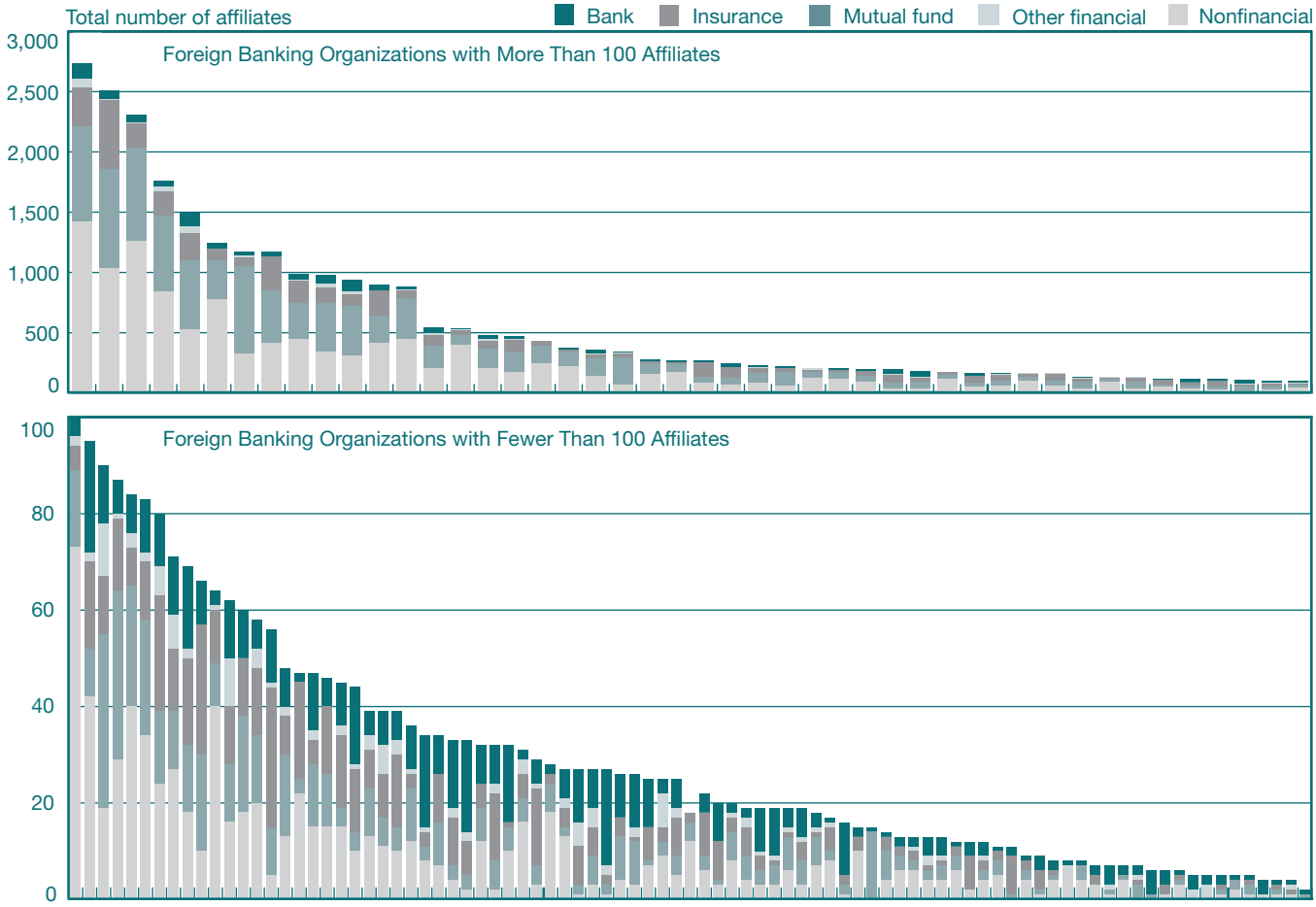
Notes: Each bar in the chart panels represents a separate foreign banking organization. Highholder structure information is drawn from Bankscope's Ownership Module. Level 1 is the first level down from the highholder. An affiliate is considered to be owned by the highholder if a series of 50-plus percent ownership links exists between it and the highholder. Highholders in the figures are sorted by number of affiliates. Data shown do not include level 0, which contains one affiliate that represents the highholder itself. Data capture organizational structures as of end-2012.

The color segments within each vertical bar of Chart 2 show how many affiliates are captured at each level of the organizational tree, from level 1 through level 10. We provide buckets of levels to keep this information visually accessible, showing counts for affiliates at level 1, level 2, level 3, and levels 4 and beyond. It is noteworthy that Herring and Carmassi (2010) use the pattern and counts of only level 1 affiliates to capture complexity.

Our decomposition shows that studies limiting the analysis to level 1 affiliates, while informative, will not present the full richness and diversity of affiliate structures. Level 1 affiliates dominate the structures for entities with fewer than 100 affiliates, but even these lower-complexity organizations appear quite different when levels 2 through 4 are added to the metrics of organizational structure. The role of the multiple levels of

Chart 3

## Foreign Banking Organizations: Breakdown of Affiliates by Type




Source: Bureau van Dijk, Bankscope database.

Notes: Each bar in the chart panels represents a separate foreign banking organization. "Other financial" includes the following Bankscope entity types: financial company, private equity firm, venture capital firm, and hedge fund. "Nonfinancial" includes the following Bankscope entity types: industrial company, foundation/research institute, and self-owned firm. Data capture organizational structures as of end-2012.

ownership is especially important in the organizations depicted in the top panel. The level 1 affiliates would capture only a small fraction of affiliates for many of these large players. While most of the counts of affiliate ownership are within three levels from the top of the organization, a sizable share of affiliates are further from the ultimate parent, at levels 4 through 10. Level 1 affiliates are the largest group of affiliates across these global banking organizations. There are more than 7,000 level 1 affiliates, 9,000 level 2 affiliates, and more than 6,000 level 3 affiliates, so the total number of affiliates down to and including level 10 is well in excess of 29,000 for the 100-plus foreign parents.

These non-U.S. global bank affiliates can also be sorted by types of activities. As previously noted, affiliates owned are classified as belonging to one of five types of primary activity: bank, insurance, mutual fund, other financial, and nonfinancial. Chart 3 recasts the organizations shown in Chart 2 using delineation by types of activity rather than level in the reporting structure. The counts of nonfinancial affiliates are generally many times the counts of banks. Insurance companies are least pervasive at each level, followed by banks and then mutual funds.

The second organizational complexity metric captures the extent to which the structure of the organization goes

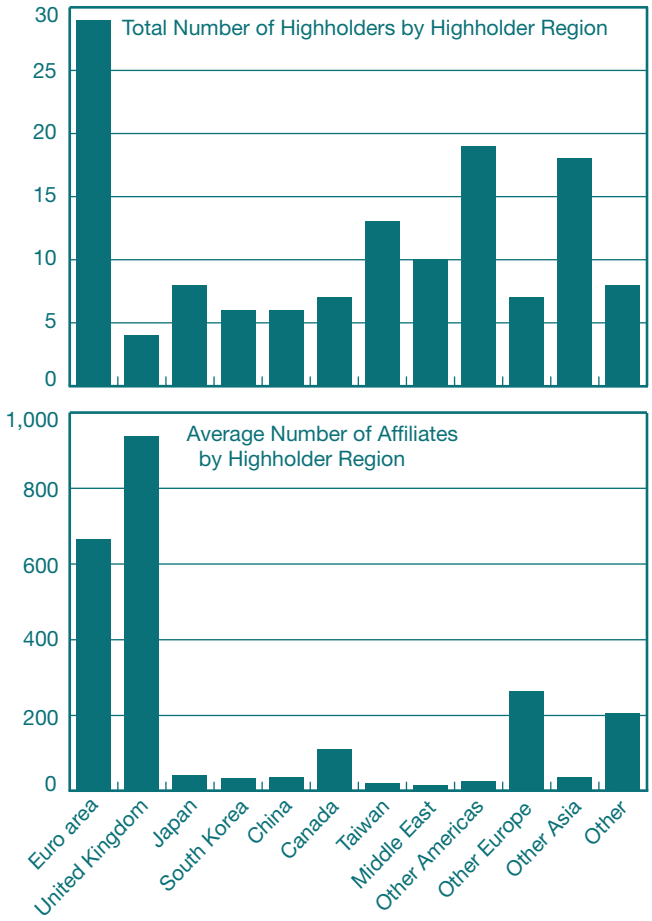
beyond banks. The median ratio of nonbank affiliate counts to bank affiliates across the smaller (fewer than 100 affiliates) organizations is 3.5, while the median ratio across the more complex (more than 100 affiliates) organizations is 19. If these ratios are taken as a metric of activity levels (as opposed to just fragmentation for other reasons), we would conclude that nonbank activity rises as organizations become more complex.

Business and geographic complexity metrics for the foreign organizations also provide interesting insights. To make this comparison most informative, we break down the parentage of the foreign organizations by country or region.[15] As reported in Table 1, Asia as a whole accounts for the largest number of foreign banking organizations with U.S. branches. The euro area ranks second in terms of counts.[16] However, euro area banks are significantly larger in terms of overall asset size. The average number of affiliates per parent also differs substantially across regions (Chart 4, bottom panel). Highholders in the United Kingdom have the largest number of affiliates by far, with euro-area highholders coming in second. Next, we supplement this information with descriptive statistics on the business complexity and geographic complexity of the organizations by parentage (that is, by the country or region of the ultimate owner).

The measure of business complexity is constructed as a Herfindahl-type index. The index is 0 for organizations with low complexity—which in practice means that the organization is exclusively composed of commercial banks—and 1 for organizations with the highest business complexity. In the latter case, the affiliate counts would be equal across the five categories of types: banks, insurance companies, mutual and pension funds, other financial subsidiaries, and nonfinancial subsidiaries. Chart 5 presents the business complexity measure in two ways: by composition into types (bottom panel) and by Herfindahl readings (top panel), shown as box-and-whiskers plots. The whiskers show the full range of Herfindahl readings constructed across the organizations from each country or region. The box shows the median degree of diversity and the lower and upper quartiles of diversity across all institutions from that country or region.

The box portions in the top panel differ in length, indicating that the scope of differences from the mean by parent geography is limited for the U.K., South Korean, and Canadian parents, but broader for parents from Taiwan, the Middle East, other Asia, and the euro area. The range of differences is particularly high for parents from other Asia. The type breakdowns in the lower panel show that South Korean organizations have the heaviest relative concentration of banks, followed by Chinese organizations. South Korean organizations also have the heaviest concentration of mutual fund affiliates. European organizations, whether from the euro area, the United Kingdom, or the rest of Europe, have the heaviest concentration of affiliates categorized as "other financial firms." The affiliates of Taiwanese parents are the most evenly distributed across types.

Chart 4
Foreign Banking Organizations:
Number of Highholders and Affiliates, by Region



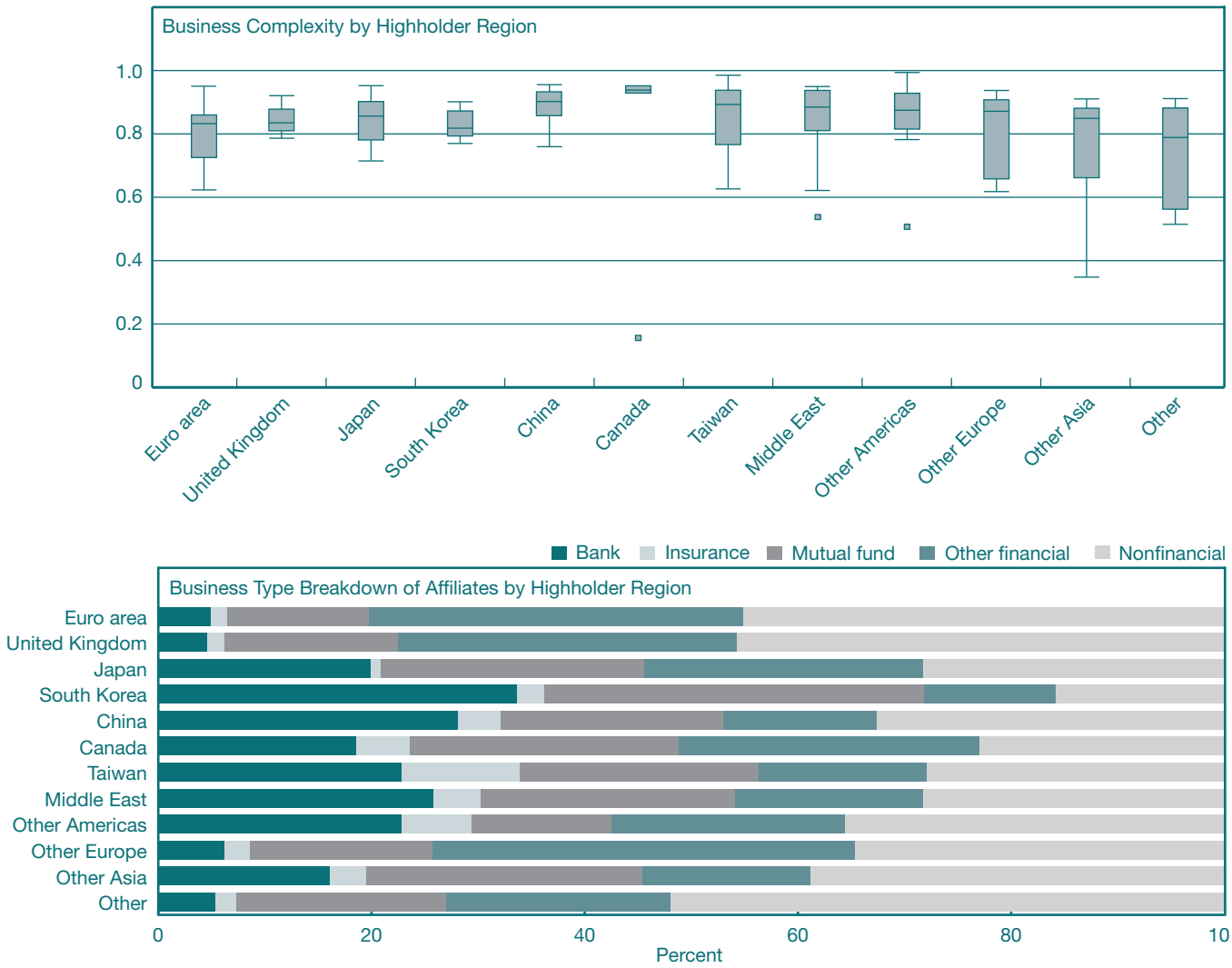

Source: Bureau van Dijk, Bankscope database.
Notes: "Middle East" comprises Bahrain, Egypt, Jordan, Kuwait, Saudi Arabia, Turkey, and the United Arab Emirates. "Other Americas" comprises Argentina, Bermuda, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guam, Panama, Puerto Rico, Uruguay, and Venezuela. "Other Europe" comprises Norway, Sweden, and Switzerland. "Other Asia" comprises Hong Kong, India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore, and Thailand. Data capture organizational structures as of end-2012.

[15] We use the International Monetary Fund's 2012 definitions to define the euro area and the Middle East. We then categorize the remaining countries using the geoscheme created by the United Nations Statistics Division, with African and Oceanian countries making up the "other" countries category.

[16] The list of countries in each region is reported in the footnote of Chart 4.

Chart 5

## Foreign Banking Organizations: Business Complexity of Affiliates



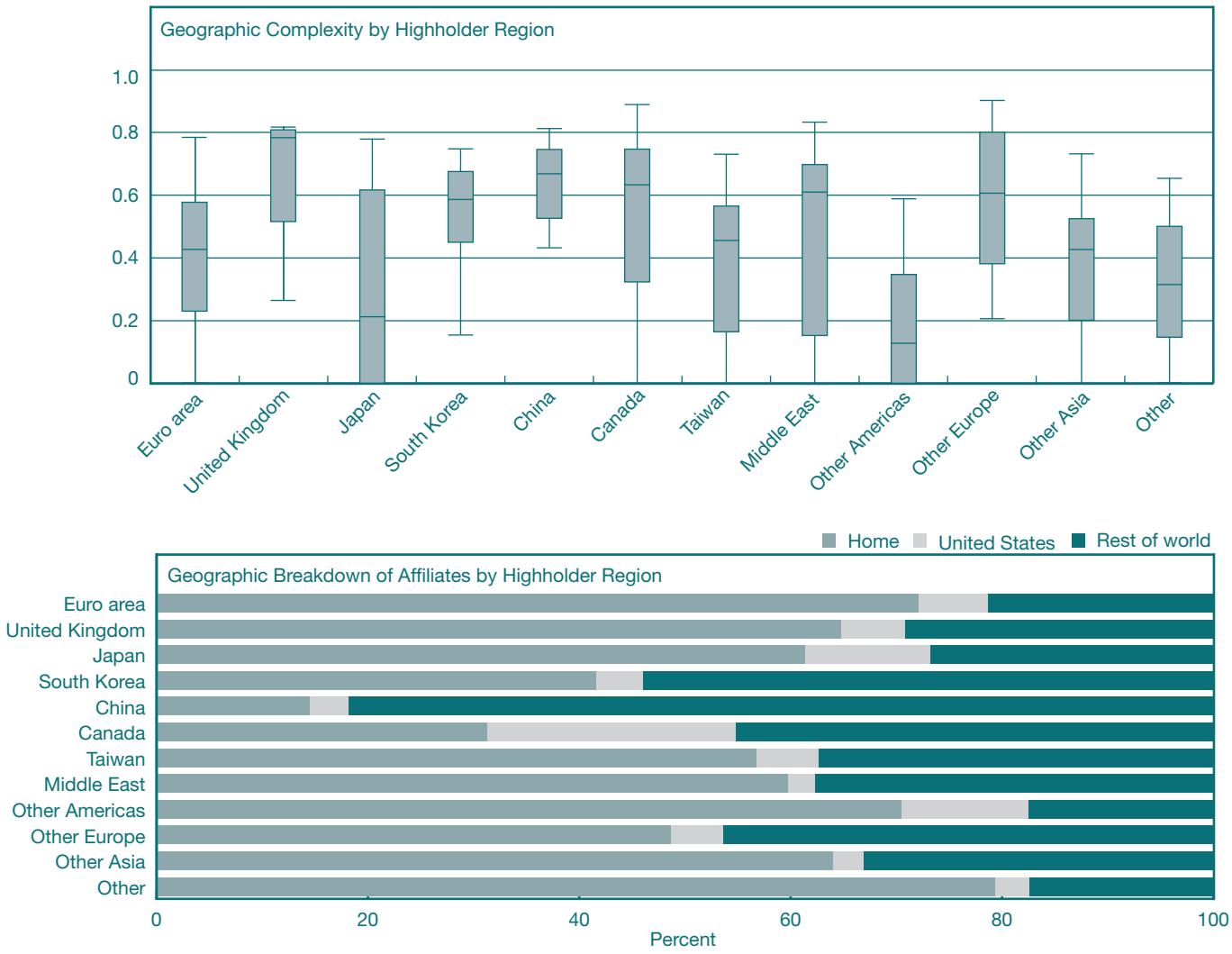

Source: Bureau van Dijk, Bankscope database.

Notes: The top panel summarizes business complexity, which is described in Table 2. The top whisker identifies a region's maximum business complexity, the top line of the box is the 75th percentile, the line inside the box is median complexity, the bottom line of the box is the 25th percentile, and the bottom whisker identifies the minimum business complexity (excluding outliers). Outliers are identified by points using the conventional formula 1.5 * interquartile range. For both panels, "Middle East" comprises Bahrain, Egypt, Jordan, Kuwait, Saudi Arabia, Turkey, and the United Arab Emirates. "Other Americas" comprises Argentina, Bermuda, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guam, Panama, Puerto Rico, Uruguay, and Venezuela. "Other Europe" comprises Norway, Sweden, and Switzerland. "Other Asia" comprises Hong Kong, India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore, and Thailand. Business type breakdown is consistent with reporting conventions in Bankscope's ownership module. Data capture organizational structures as of end-2012.

The geographic complexity measure incorporates information on the geographic location of each parent organization's affiliates. For this construction, affiliate locations are broken down into thirteen groups: euro area, United Kingdom, Japan, South Korea, China, Canada, United States, Taiwan, Middle East, other Americas, other Europe, other Asia, and "other" (Chart 6). The panels of the chart are constructed similarly to those already discussed for the business complexity measures. Very large differences exist across banks by country or region, and within country of origin, in the patterns of geographic

Chart 6

## Foreign Banking Organizations: Geographic Complexity of Affiliates




Source: Bureau van Dijk, Bankscope database.

Notes: The top panel summarizes geographic complexity, which is described in Table 2. The top whisker identifies a region's maximum geographic complexity, the top line of the box is the 75th percentile, the line inside the box is median complexity, the bottom line of the box is the 25th percentile, and the bottom whisker identifies the minimum geographic complexity (excluding outliers). Outliers are identified by points using the conventional formula 1.5 * interquartile range. For both panels, "Middle East" comprises Bahrain, Egypt, Jordan, Kuwait, Saudi Arabia, Turkey, and the United Arab Emirates. "Other Americas" comprises Argentina, Bermuda, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guam, Panama, Puerto Rico, Uruguay, and Venezuela. "Other Europe" comprises Norway, Sweden, and Switzerland. "Other Asia" comprises Hong Kong, India, Indonesia, Malaysia, Pakistan, the Philippines, Singapore, and Thailand. Data capture organizational structures as of end-2012.

diversity of their affiliates. The banks with Japanese parentage are in organizations that are among the least geographically diverse in terms of the average affiliate structure and that also have lower overall numbers of affiliates. The euro area organizations are large in number and large in their average number of affiliates. The U.K. organizations are fewer in number, but they also have large numbers of affiliates.

The lower panel of Chart 6 provides an additional perspective on geographic diversity by distinguishing affiliates that are located in the home country/region from those in

Table 3

## Pearson and Spearman Correlations of Complexity Measures

| | Pearson Correlations | | | |
|---|---|---|---|---|
| | Ln Count | Count-NBtoB | Business Complexity | Geographic Complexity |
| Ln count | 1 | | | |
| CountNBtoB | 0.67* | 1 | | |
| Business complexity | 0.03 | -0.33* | 1 | |
| Geographic complexity | 0.31* | -0.14 | 0.29* | 1 |
| | Spearman Rank Correlations | | | |
| | Ln Count | Count-NBtoB | Business Complexity | Geographic Complexity |
| Ln count | 1 | | | |
| CountNBtoB | 0.68* | 1 | | |
| Business complexity | -0.02 | -0.24* | 1 | |
| Geographic complexity | 0.32* | -0.07 | 0.28* | 1 |

Source: Bureau van Dijk, Bankscope database.

Note: Complexity measures are constructed using end-2012 data from Bankscope's Ownership Module.

*Significant at the 5 percent level.

the United States and from those in the rest of the world. It is interesting that most countries/regions have more than half of their affiliates in their home market. Having a U.S. presence in total affiliates is strongest for organizations from Canada, Japan, and other Americas (which includes Mexico). Organizations from other countries might have branches and a small number of affiliates in the United States, but about 95 percent of their legal entities are typically located elsewhere.

Overall, these metrics of complexity address different dimensions of the business make-up and geographical reach of global organizations with branches in the United States. Note that the metrics are not always significantly or positively correlated with each other. As reported in Table 3, counts are positively correlated with the ratios of nonbank to bank affiliates. The correlation between affiliate counts and the measures of geographic complexity is statistically significant. Business complexity and geographic complexity are positively correlated, but both are negatively correlated with the non-bank-to-bank-count ratios.

## 3.3 Organizational Complexity of U.S. Global Banks

U.S. banks and their organizations can also be highly complex, as evidenced by U.S. legislative actions addressing recovery and resolution planning in the aftermath of the Great Recession. To illustrate this complexity and provide an appropriate comparison with foreign organizations in the United States, we start with the top-fifty U.S. bank holding companies in 2013—similar in size to the larger FBOs—and limit our discussion to U.S.-owned organizations with global banking activities. To meet the global banking criterion, an organization must have some branch or subsidiary outside of the United States and must file a report indicating exposure to foreign countries.[17] In this way, we can compare U.S. organizations that have global banks with foreign organizations that have global banks.[18] As reported in Table 1, these criteria generate a sample of thirty-five organizations with U.S. owners.

For information related to organizational complexity, we start with a database that collects FR Y-10 reports, the "Report of Changes in Organizational Structure" filed by each institution.[19] The "structure data" use Regulation Y definitions of control and include affiliates that are controlled and regulated by the bank holding company. The database contains information on the geography of each affiliate, as well as information on the type of affiliate as captured by the U.S. NAICS (North American Industry Classification System) codes. We can clearly differentiate between banks (NAICS 5221), insurance companies, nonfinancial firms, and other financial firms. We do not have a readily available mapping that cleanly separates the mutual funds from other financial firms, a division that would allow for a direct correspondence with the categories drawn from the Bankscope data for foreign organizations. We use the most current structure as of the fourth quarter of 2012.

The counts of subsidiaries under the parent organization exceed 3,000 for three of the organizations, total more than 1,000 for another three, and are below 100 for many of the other U.S. banking organizations (Chart 7, top panel). The U.S. organizations are similar to their foreign global counterparts in that banking entities represent only a small share

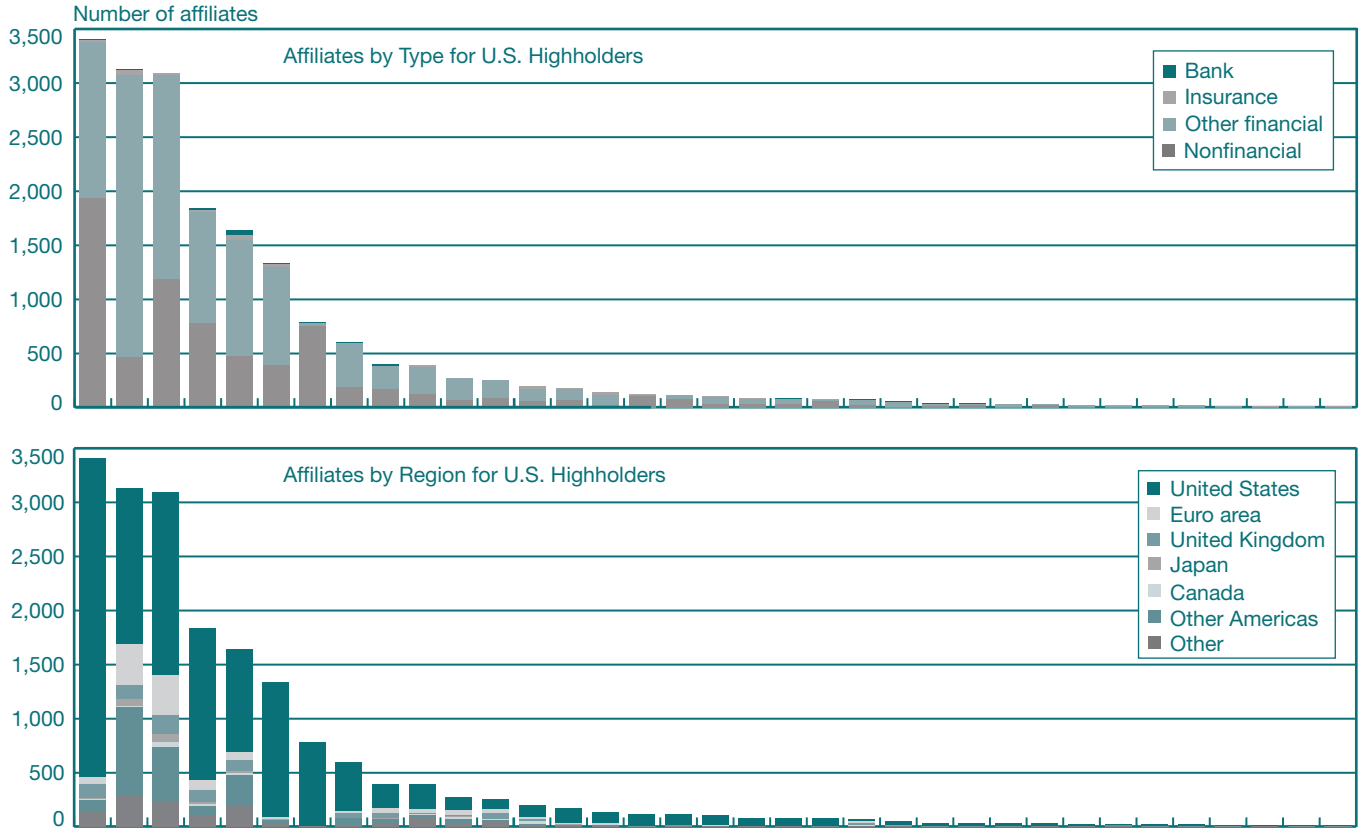
[17] Instructions for the preparation of the FFIEC 009 Country Exposure Report are provided at http://www.ffiec.gov/PDF/FFIEC_forms/FFIEC009_201103_i.pdf.

[18] Because our analysis is ultimately motivated by the potential implications for the United States of the existence of complex global banking organizations, it makes sense to identify U.S. global organizations by looking at entities that have either branches or subsidiaries abroad. This is not inconsistent with our approach to analyzing foreign global families, identified as those having only branch operations in the United States (see footnote 7).

[19] See http://www.federalreserve.gov/reportforms/forms/FR_Y-1020121201_i.pdf.

Chart 7

U.S. Global Banks: Breakdown of Affiliates by Type and Regional Composition




Source: Board of Governors of the Federal Reserve System, FR Y-10 and FR Y-6 reporting forms.

Notes: Each bar in the chart panels represents a separate U.S. global bank. Highholder structure information is provided by the Federal Reserve Bank of New York's Statistics Function, sourced from the Federal Reserve Board's reporting forms. Data capture organizational structures as of end-2012. We first define the euro area and Middle East using the IMF's 2012 definitions. We then categorize the remaining countries using the U.N. Statistics Geoscheme. "Other Americas" comprises the following countries: Argentina, Aruba, the Bahamas, Barbados, Bermuda, Brazil, the British Virgin Islands, the Cayman Islands, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guam, Guatemala, Haiti, Honduras, Jamaica, Mexico, the Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Trinidad and Tobago, the Turks and Caicos Islands, Uruguay, and Venezuela. "Other" includes the following regions: the Middle East (Bahrain, Egypt, Lebanon, Oman, Qatar, Saudi Arabia, Turkey, and the United Arab Emirates), other Europe (Channel Islands, Croatia, Czech Republic, Denmark, Gibraltar, Hungary, Iceland, Liechtenstein, Monaco, Norway, Poland, Russia, Sweden, Switzerland, Ukraine, and Yugoslavia), and other Asia (Bangladesh, Brunei, Hong Kong, India, Indonesia, Kazakhstan, Malaysia, Pakistan, the Philippines, Singapore, Thailand, and Vietnam). "Other" also includes the following countries: Australia, Botswana, Cameroon, Côte d'Ivoire, the Democratic Republic of the Congo, Gabon, Israel, Kenya, Mauritania, Mauritius, Morocco, Namibia, New Zealand, Nigeria, Senegal, Somalia, South Africa, Swaziland, Tanzania, Tunisia, Uganda, Zambia, Zimbabwe, and the Virgin Islands.

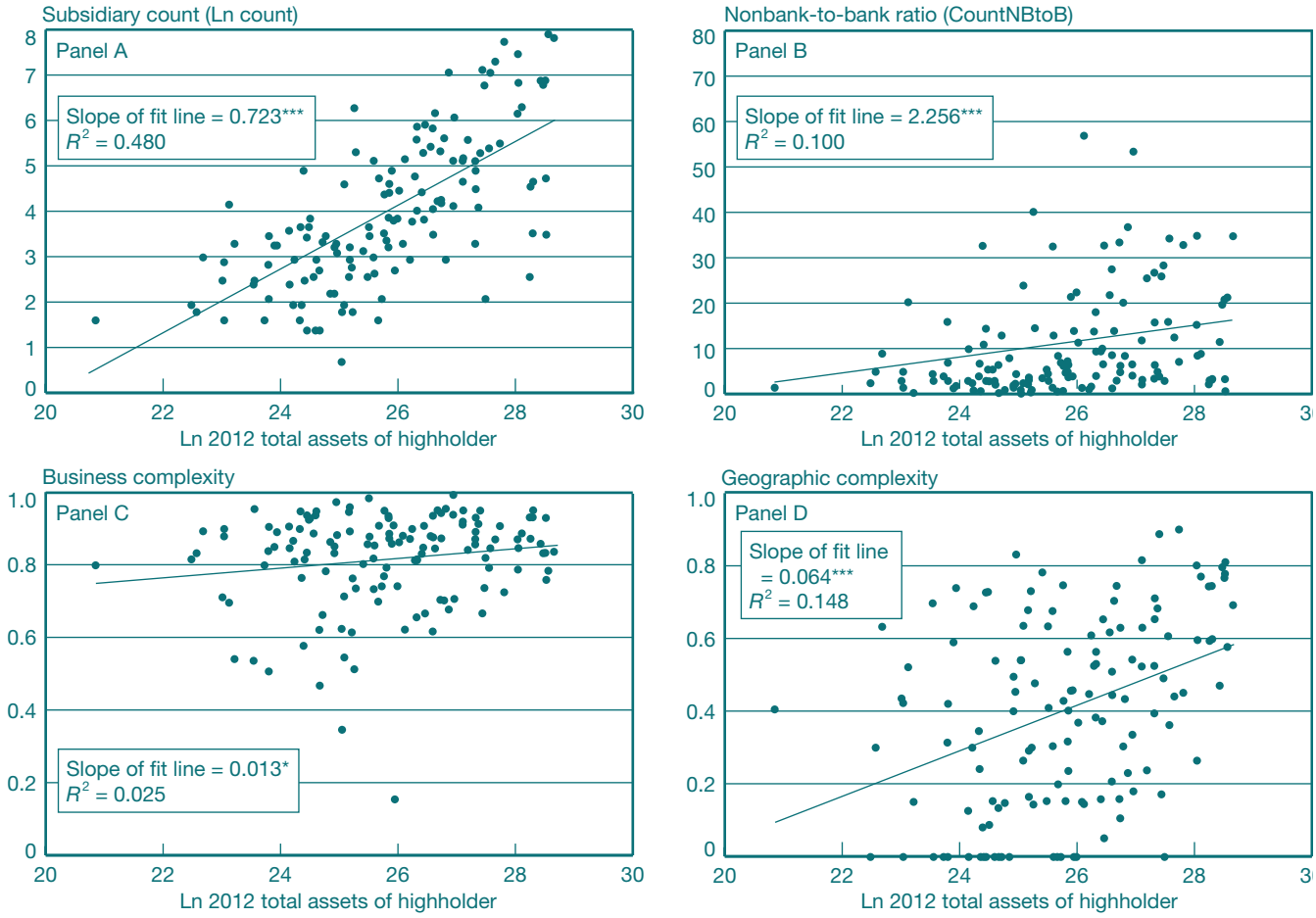
of the subsidiaries. Other financial entities and nonfinancial entities account for the vast majority of affiliates. As for the geographic location of the affiliates (Chart 7, bottom panel), U.S. global organizations exhibit considerable variation in the extent of home bias in their affiliates' locations. The mean share of affiliates within the United States is 83.2 percent, while the non-U.S. affiliates are concentrated in the euro area, the United Kingdom, and other Americas.

## 4. Is Organizational Size Analogous to Complexity?

Discussions of complexity often treat fragmentation of the organization—and the number of affiliates—as a concept analogous to the size of the organization. In this section, we consider the relationship between our alternative complexity metrics and the size of the highholder organization as

Chart 8

## Foreign Banking Organizations: Relationship between Size and Complexity




Sources: Bureau van Dijk, Bankscope database; Board of Governors of the Federal Reserve System, FR Y-7Q reporting form.

Notes: Complexity measures are constructed using end- 2012 data from Bankscope's Ownership Module. "Total assets" data are drawn from Bankscope and the Federal Reserve Board's FR Y-7Q reporting form.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

reflected in asset valuation. Overall, we find that the straight measures of affiliate counts are positively correlated with size of the highholder organization, such that the larger organizations have more affiliates. However, other measures of complexity that use information on type, organizational structure, and regional placement of affiliates are not as tightly correlated with the size of the overall institutions.

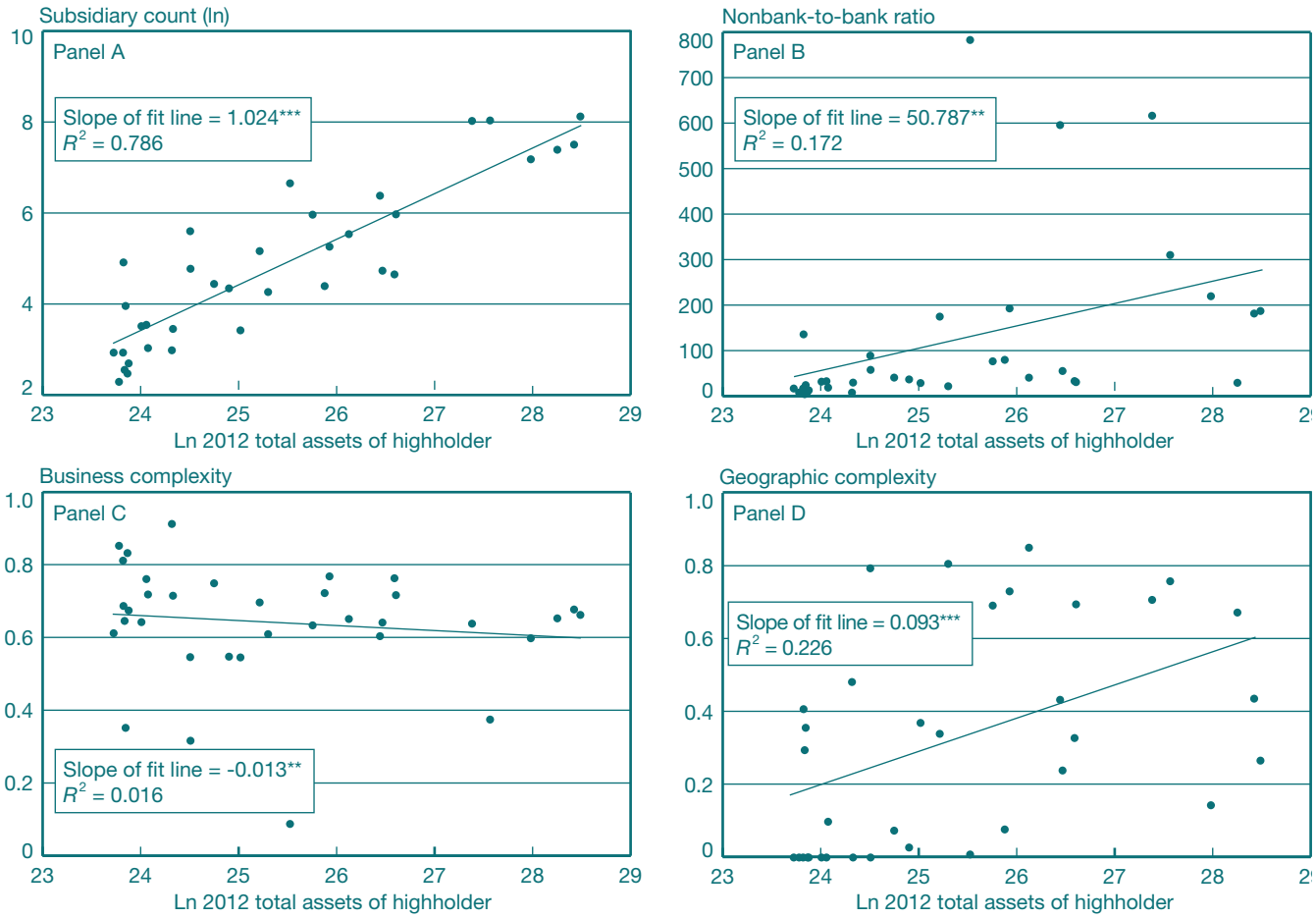
## 4.1 Complexity and Size for Foreign Global Organizations

Chart 8 provides plots and regression fits between measures of complexity and size. Panel A shows the relationship between the (logarithm of) counts of affiliates and the (logarithm of) asset size of the foreign global organizations.[20] The slope of the

[20] The size of the parent organization (in terms of assets) is, however, strongly correlated with the size of its branches within the United States.

Chart 9

U.S. Global Banks: Relationship between Size and Complexity




Source: Board of Governors of the Federal Reserve System, FR Y-10 and FR Y-9C reporting forms.

Notes: Complexity measures are constructed using end-2012 data from the FR Y-10 reporting form. "Total assets" data are drawn from the FR Y-9C reporting form.

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

regression line is significant, and about half the cross-sectional variation in *counts* is explained by size. An organization that is twice as large as another is likely to have 70 percent more affiliates. If resolution of failing institutions is a concern, this relationship shows that the larger—and often more systemically important—institutions may have more complex and numerous affiliate structures, suggesting that resolution costs increase with size.

Consider next the concepts that might be relevant for understanding the business models of the global banking organizations. The ratio of nonbank affiliate counts to bank affiliate counts is positively correlated with size (Panel B), but size explains less than 10 percent of cross-sectional variation. Additionally, the relationship between size and the diversity of affiliate types is close to zero as organizational size increases (Panel C), making size a poor predictor of affiliate-type diversity.

Similar observations pertain to the metrics of affiliates' geographic complexity (Panel D). Recall that we presented evidence of significant home bias in the affiliate locations

for these organizations. Some organizations, regardless of size, have all of their legal entities in their home markets. Other organizations, regardless of size, are broadly diversified geographically. Overall, the relationship between size and diversity by region is highly diffuse, even if positively sloped.

### 4.2 Complexity and Size of U.S. Global Financial Institutions

For U.S. global financial institutions, the tight relationship between size and complexity is a feature only of the *count* metric, which is the number of affiliated entities under the parent organization. As shown in Panel A of Chart 9, the (log) count of affiliates rises one-for-one with the (log) size of the overall organization, a tighter and more linear fit than that observed for organizations with foreign parents.[21]

For all other measures, the correlations with size—even when statistically significant—are decidedly weaker. The ratio of nonbank to bank counts, shown in Panel B, shows a weak relationship to organizational size in U.S. global organizations, as it did for the foreign organizations, with a regression fit of only 17 percent. There is little relationship between size and the diversity of affiliate types (here consisting of four types, instead of the five types identified for the measures relating to the non-U.S. entities), which have a slope of essentially zero and explain only 2 percent of the cross-sectional variation in these values (Panel C). The relationship between geographic diversity and size is positive but also weak (Panel D). Smaller U.S. entities in our sample are more likely to have affiliates located exclusively in the United States. Otherwise, geographic dispersion is not related to the size of the organization.

## 5. Conclusion

Our examination of the complexity of global banking organizations—both foreign institutions that have operations in the United States and U.S. institutions that have branches or subsidiaries abroad—has produced a number of significant findings. Above all, we have documented that there is more to complexity than just organizational size. Global entities can differ tremendously in their organizational complexity, business complexity, and global footprint.

It is not clear what might be driving the buildup in bank complexity. Complexity may result in part from firms growing larger as they attempt to achieve economies of scale and scope. Managerial motives (empire building, entrenchment) or rent seeking (monopoly power, acquisition of too-big-to-fail status) may also be contributing factors. Geographic diversification and the development of complex affiliate structures might reflect taxation regimes and efforts to avoid business transparency and achieve less restrictive regulation across markets (Baxter and Sommer 2005).[22] Moreover, some of the growth in complexity may be an endogenous response to an evolving intermediation technology that favors the growth of organizations incorporating, under common ownership and control, the many financial entities (specialty lenders, asset managers, finance companies, brokers and dealers, and others) that have increasingly become essential to the financial intermediation process (see, for example, Poszar, Adrian, Ashcraft, and Boesky [2010], Cetorelli, Mandel, and Mollineaux [2012], and Cetorelli and Peristiani [2012]).

Whatever the main causes of complexity may be, our analysis of global banking organizations—which are arguably the most complex among banking institutions in general—reveals a substantial degree of diversity in the forms that complexity takes. Banking organizations may display relatively few entities that are in their immediate control but, under that first layer of organizational complexity, many more affiliates may be connected indirectly to the same common highholder through multiple rounds of ownership. Alternatively, banking organizations may display a relatively narrow business scope, but still operate through a large number of entities broadly located across the globe. Or it could be that the organizations display a relatively narrow geographic focus but engage in a wide variety of business activities.

There is substantial room for further research to clarify the positive and negative consequences of business, organizational, and geographic complexity for individual financial organizations and the financial systems they inhabit. For instance, a bank that is part of a complex organization, spanning multiple sectors and countries, may benefit from larger and more diversified internal capital markets. Likewise, it may

[21] This finding is consistent with the evidence in Avraham, Selvaggi, and Vickery (2012), which showed that organizational size was the only significant determinant of this count measure of complexity, and that no role was played by an industry concentration index, geographical concentration indexes, or shares of domestic commercial bank assets.

[22] Desai, Foley, and Hines (2006) examine U.S. multinational firms and show that they establish operations in tax haven countries as part of their international tax-avoidance strategies. Rose and Spiegel (2007) argue that, while activities in offshore financial centers are likely to encourage bad behavior in some countries, they may also have positive effects, such as providing competition for the domestic banking sector.

gain access to external markets and benefit from the credit standing of the broader organization. In addition, there may be benefits from business synergies such as product complementarities, information flows, and cost savings on common resources. If these working hypotheses are correct, the mode of operation of a bank may differ in accordance with the complexity of its family.

Complexity may alter balance sheet management strategies, affecting decisions about funding models, liquidity policies, and investment and lending strategies. Hence, organizational complexity may have broad economic implications not just during episodes of financial distress but also in normal times. These observations suggest the importance of achieving a fuller understanding of the drivers and forms of complexity—and of using this knowledge to assess the positive and negative externalities that complexity generates.

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# Matching Collateral Supply and Financing Demands in Dealer Banks

- The 2008 failure and near-collapse of some of the largest dealer banks underscored the complexity and vulnerability of the industry.
- A study of dealer banks finds that their unique sources of financing are highly efficient in normal times, but may be subject to marked and abrupt reductions in stressful times.
- Dealer banks' sources of financing include matched-book repos, internalization, and collateral received in connection with over-the-counter derivatives trading.
- Under some conditions, U.S. accounting rules allow dealer banks to provide financing for more positions than are reflected on their balance sheets. Rules that permit netting of certain collateralized transactions may not yield a true economic netting of dealer banks' exposures.
- A prudent risk management framework should acknowledge the risks that inhere in collateralized finance.

## 1. Introduction

Banks are usually described as financial institutions that accept deposits of dispersed savers and use the deposited funds to make loans to businesses and households. This description is accurate but incomplete, as banks also engage in other types of intermediation that finance economic activity. Some banks act as dealers in markets, providing liquidity and supporting price discovery by buying and selling financial instruments, helping to facilitate trade in markets. Banks also perform prime brokerage services—a role that involves providing financing to investors along with many ancillary services, such as collateral management, accounting, and analytical services. The banks that engage in these activities, which we call dealer banks, facilitate the functioning of financial markets.

To conduct their business, dealer banks rely on varied and, in some cases, unique sources of funding. In most cases, dealer banks' lending is collateralized by securities or cash. As in a standard bank, funding for a loan made by the bank may come from the bank's own equity or from external sources, that is, from parties that are not borrowers from the bank. Unlike a standard bank, however, dealer banks can employ internal sources to fund a customer loan, either by taking a trading position that offsets that of the customer receiving the

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The authors thank Tobias Adrian, Darrell Duffie, Steven Spurry, and James Vickery for helpful comments. The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

loan or by utilizing an offsetting position taken by another customer. For example, the bank may make a "margin loan" to one customer, lending cash to finance the customer's security purchase, with the customer offering the purchased security as collateral for the bank loan. Another customer may request to borrow the same security to establish a short position, offering cash to the bank as collateral for the loan. The two customers' pledges of collateral provide the bank with the resources to fulfill both customers' demands for borrowing. That dealer banks can in some cases use the collateral pledged by one customer to lend to another, or to fund a trade made by the bank, confers a cost advantage since internal sources of funding are generally less expensive than external market sources. Dealer banks also maintain specialization in collateral valuation and management, which reinforces the aforementioned financing cost advantages. Consequently, such collateralized lending to investors is concentrated in dealer banks.

The interdependence of the financing for the borrowing of one customer and the collateral posted by another customer makes the sources of funding for dealer banks vulnerable in ways that are different from those of standard banks. Consider that in a standard bank, when a borrower repays a loan, the bank can often redeploy the repaid funds as a loan to another borrower or as payment to a deposit holder. In contrast, when a borrower repays the dealer bank, the borrower also reclaims the collateral it posted to the bank. If the dealer has repledged this collateral to finance another customer's position, it must find a substitute for the reclaimed collateral returned to the borrower. In other words, the dealer must scramble to find an alternative source of the collateral in order to meet its obligations. In times of financial market stress, external parties may be reluctant to lend to the dealer bank, even against collateral, so it can be costly and difficult for the bank to seek funding externally. This vulnerability of dealer banks, though similar to that faced by standard banks when depositors withdraw, differs in that it occurs instead when borrowers repay their loans, reflecting the profound interdependence between the bank's customers, their borrowing, and their pledges of collateral. Of course, not all of the dealer bank's funding is internally generated and so, like standard banks, dealer banks engage in maturity transformation and thus are also susceptible to rapid withdrawals of external sources of funding.

This article aims to provide a descriptive and analytical perspective on dealer banks and their sources of financing. In reviewing the methods by which dealer banks reuse collateral, we consider various concepts related to collateralized finance, many of which have been discussed in Duffie (2010, 2011), Stigum and Crescenzi (2007), and Committee on the Global Financial System (2013). We conclude that this type of financing yields high levels of efficiency in normal times, but may be subject to significant and abrupt reductions in stressful times, relative to the external financing sources upon which other banks rely. That conclusion raises many issues about how policy should address this type of financial sector vulnerability, which we briefly discuss. In addition, the limitations of existing sources of data on the extent of the use of collateral by dealer banks leads us to recommend more extensive reporting of dealer banking financing arrangements.

First, we create an analytical and stylized framework of dealer banks to outline their major collateralized finance activities. Under certain circumstances, U.S. accounting rules allow the dealer to provide financing for more positions than are reflected on its balance sheet. Dealer banks can take advantage of netting rules when calculating the size of their balance sheets. For example, under both U.S. and international accounting standards, the exposure of a dealer bank to a customer that has offsetting collateralized positions with the dealer bank can be reported as the net economic claim on the dealer bank by the customer. Consider the following (extreme) example. Suppose, as outlined above, Customer A borrows cash and provides a security as collateral to the dealer bank; suppose, furthermore, that Customer B borrows the security and provides cash collateral to the dealer bank. The dealer bank uses the collateral provided by one customer to satisfy the borrowing demands of the other. Now suppose that, later, Customer B borrows cash and proffers a different security to the dealer bank as collateral, and Customer A borrows that security and supplies cash to the dealer bank as collateral. Then because each customer's exposure may be eligible to be net on the balance sheet of the dealer, the dealer may be able to report assets and liabilities equal to $0, even though it had provided financing in substantial amounts to the two customers. Consequently, a dealer bank's balance sheet captures only a portion of its gross provision of financing to customers.

As a result of this fact, we present both a stylized balance sheet and a stylized collateral record that together allow for a better representation of how dealers provide collateralized financing. We then apply this stylized framework to explain how dealer banks perform key intermediation functions and discuss the various methods by which dealer banks can reuse collateral provided by customers. We review three of them in detail: matched-book financing, internalization of collateral financing, and pledging of collateral received in over-the-counter (OTC) derivatives trading. The nature of these activities allows dealer banks to derive efficiencies in their use of collateral and assist in the performance of financial markets.

We also use and apply data in firms' public disclosures to our stylized framework, to the extent that dealer banks' activities are reflected in such disclosures, and attempt to measure the degree to which firms economize and optimize on

their collateral resources. To determine how much financing a dealer bank provides to customers, one must examine the "collateral record" of a dealer bank, which can be found in its 10-K and 10-Q public disclosures. However, the nature of the reporting is not standardized across dealer banks; as a result, we are forced to restrict ourselves to a small number of banks. We choose to focus on Bank of America, Citigroup, Goldman Sachs, JP Morgan Chase, and Morgan Stanley—the bank holding companies with the largest broker-dealer subsidiaries.[1] As the largest dealer banks, their data capture the majority of such activity. We also include Lehman Brothers for its historical relevance to the crisis. These data allow us to provide a consistent aggregate view of the amount of collateral received, collateral pledged, and the size of the dealer banks' collateralized liabilities, for the very largest dealer banks. These data portray how these aggregate amounts have changed across time, especially during the period of the financial crisis and its aftermath.

In our review, we rely on two notions of efficiency employed by dealer banks. First, we define "collateral efficiency" as the percentage of a dealer bank's collateral received that is rehypothecated. This concept is one indicator that focuses on how extensively the dealer bank uses its customer-provided collateral resources. It is likely, and in our sample we verify, that this measure is increasing with the size of the dealer's collateral pool, as a larger portfolio of collateral will contain securities that match more customer demands than would a smaller portfolio. Other factors that we conjecture would increase collateral efficiency include the number and mix of customers, the operational capacity of the dealer, and other economic features of the dealer firm, such as its creditworthiness, that make it a good counterparty.

The second concept of efficiency captured by dealer banks, "collateralized financing efficiency," is a broad economy. Dealer banks seek to optimize their use of collateral to reduce their costs of serving customers' demand for borrowing. This concept differs from the previous one in that collateralized financing efficiency refers to all the economic benefits reaped by dealer banks in their allocation of firm and customer collateral. By rehypothecating the collateral that secures dealer banks' loans to customers, the dealer bank can provide to customers lower-cost financing, or increase its own profit margins. This lower cost is a reflection of two potential benefits captured in the collateralized financing arrangements in which dealer banks specialize. First, in a violation of the Miller-Modigliani theorem and framework, dealer banks can attract funding more cheaply by pledging collateral, rather than borrowing on an uncollateralized basis; *a fortiori*, the dealer bank can obtain funds for an even lower cost if those funds themselves are provided as collateral when a customer borrows a security held by the dealer bank.[2] Second, by using collateral of one customer to satisfy the borrowing demand of another customer, the dealer can in certain instances minimize the amount of economic and regulatory capital and liquidity needed to support its financing activities. In our review, we provide a measure of gross collateral received relative to assets recorded on the balance sheet, which can provide a gauge of the efficiency of collateralized finance provided by dealer banks. Those economies, which we will discuss in more detail below, also lead to a lower cost of provision of financing services by the dealer bank.

Additionally, like banks of all types, dealer banks engage in maturity and credit transformation; however, dealer banks also engage in the transformation of customer collateral. For example, a dealer bank can lend to a customer for a specific maturity, and then obtain funds by pledging the collateral provided by the customer but at a shorter maturity; that sort of maturity transformation is just one way by which dealer banks provide additional value to customers. Various types of credit transformations are also made by dealer banks as they seek to satisfy the demands of different customers. This includes collateral substitution, in which the dealer bank effectively lends one type of security while the customer provides the dealer bank collateral of a different type.

To the extent that dealer banks capture efficiencies from collateralized finance, we would expect that they would dominate this form of finance as they could provide these services at lower cost than alternative approaches. It is important to keep in mind that notwithstanding the presence of collateralized financing efficiencies, the dealer bank is subject to significant risks that may offset the lower costs provided by this form of finance in normal times, in a full consideration of social costs and benefits.

In particular, the dependency of the funding available to dealer banks sourced from collateral provided by customers was clearly evident in the financial crisis of 2007-09. As we will see, the amount of funding available to dealer banks shrank

[1] Broker-dealers are firms that participate in markets by buying and selling securities on behalf of themselves and their clients. They must register with the Securities and Exchange Commission (SEC), and are often a subsidiary of a larger bank holding company. Any securities purchased by the firm for its account can be sold to clients or other firms, or can become part of the firm's own holdings. Our definition of dealer banks includes activities performed by broker-dealers, but also includes OTC derivative dealing activities, which are often conducted in the affiliated depository institution subsidiary of the parent holding company (rather than the broker-dealer subsidiary).

[2] In the Miller-Modigliani framework, firms and households are risk-neutral and markets are complete, so borrowing on a collateralized or uncollateralized basis is essentially equivalent, and would yield the same interest rate. However, in a framework in which information about the extent of borrowing by the firm is not known by the lender, lenders are risk-averse and markets are incomplete; collateralized borrowing rates may be below uncollateralized borrowing rates.

precipitously in the wake of the bankruptcy of Lehman Brothers Holdings International. Further, the gross amount of collateral received by the other dealer banks in our sample, and the amount that these dealer banks in turn pledged as collateral, fell even more precipitously, indicating that the collateral provided by customers, when used as a secondary source of funding by the bank itself, is subject to greater withdrawal than the net claims or obligations as reported on-balance-sheet.

A limitation of our analysis lies in the way that dealer banks report their activities in providing collateralized finance. Because of the aforementioned interdependencies, dealer banks report their holdings and uses of collateral in ways that are open to alternative interpretations. As a result, it is not always clear how best to describe their balance sheet in a way that is consistent across firms. The reporting is heterogeneous and, consequently, not fully comparable across firms. This places severe limitations on the number of firms whose financing arrangements we review in this article.

Our study is organized as follows. Section 2 begins by defining the businesses of dealer banks, and follows by constructing some stylized balance sheets that clearly depict the sources and uses of funding for the major dealer banks. In section 3, we describe the main types of dealer financing arrangements, including those that allow the banks to utilize internal sources of funding for their lending, using our stylized frameworks so that comparisons can be made across institutions. In section 4, we use the public disclosures to provide measures of the stylized balance sheets and collateral record we introduce in section 2 for the firms, measuring the relative importance and evolution of the sources of financing over time. Section 5 concludes.

## 2. An Overview of Dealer Banks

Dealer banks are active in the intermediation of many markets, either in their role as dealers or in their role as prime brokers where they provide financing to investors. Dealer banks are financial intermediaries that make markets for many securities and derivatives by matching buyers and sellers, holding inventories, and buying and selling for their own account when buyers and sellers approach the dealer at different times, for different quantities, or are clustered on one side of the market. Many banks with securities dealer businesses also act in the primary market for securities as investment banks, underwriting issues to sell later to investors. Services typically provided by dealers include buying and selling the same security simultaneously, extending credit and lending securities in connection with transactions in securities, and offering account services associated with both cash and securities.

Many dealers carry out their activities in a broker-dealer subsidiary of a bank holding company. For most derivatives trades, dealers are one of the two counterparties, with many dealers recording their derivative exposures at their affiliated bank, the depository institution subsidiary of the parent company. Prime brokers are the financing arm of the broker-dealer, offering advisory, clearing, custody, and secured financing services to their clients, which are often large active investors, especially hedge funds. Prime brokers can conduct a variety of transactions for their customers, including derivatives trading, cash management, margin lending, and other types of financing transactions.

Dealer banks, like other for-profit businesses, strive to minimize the cost of providing financing to customers, which often need cash or particular securities. They can do this in part through a strategy of meeting their clients' needs without relying wholly on costlier sources of external funding. Sometimes this is accomplished if the dealer bank itself has an offsetting position, or at other times another customer's position. By fulfilling the collateral needs of one party (either in the form of cash or securities) with an already existing source of that collateral, the dealer bank can avoid additional financing transactions. This maximizes its income directly by eliminating a borrowing cost, as well as indirectly by minimizing costs associated with larger balance-sheet sizes.

### 2.1 Stylized Framework for Dealer Banks

Our stylized framework consists of two components: a balance sheet and a collateral record.[3] While a complete representation of a dealer bank's financial reporting is out of the scope of this article, we describe conceptually how certain financing activities appear on the balance sheet and the collateral record. By examining both the balance sheet and the collateral record, we can, to some extent, trace how much the firm is relying on internal sources of collateralized financing, that is, financing provided either by the dealer's own trading activity or by other customers' activities, and how much is sourced externally.

In Table 1, we present a simplified (and reduced) version of the official balance sheets reported by our sample of dealer banks, focusing on the parts most oriented toward their dealer banking business. We intend to use this simplification of the

[3] The collateral record can be thought of as analogous to a balance sheet, in that it records all sources and uses of collateral by the dealer bank. Like the balance sheet, it is an accounting concept, but it reflects underlying commitments made by the dealer bank. As such, it can also be thought of as a commitment schedule of the firm to receive/deliver collateral or cash from/to customers under specific conditions.

Table 1
Stylized Balance Sheet

| Assets | Liabilities and Equity |
|---|---|
| Cash | Equity |
| Instruments owned | Instruments sold but not yet owned |
| Reverse repo/securities borrowing | Repo/securities lending |
| Brokerage receivables | Brokerage payables |

balance sheet to illuminate those dealer-bank-specific and unique financing activities. Some categories are excluded because they are less relevant to the collateralized finance business unique to dealer banking, while others are grouped together because they are economically similar. This allows us to apply a single framework consistently across firms whose reporting disclosures are not always homogenous.

Assets are grouped into the categories outlined above and typically reflect a "use of" or "claim to" cash.

- *Cash* will generally include the dealer's own funds that are held in an account with a bank, such as a deposit with a bank within the same bank holding company, a Federal Reserve Bank, or a third-party bank. Cash will also include funds deposited with a bank that are fully segregated on behalf of a customer of the dealer.
- *Financial instruments* owned will reflect the fair value of risky positions owned by the bank, such as securities, physical commodities, principal investments, and derivative contracts. In concept, the fair value reflects the cash that could be obtained upon sale of the instrument.
- *Reverse repurchase agreements (reverse repo)/securities borrowing* generally reflects a cash outlay and a receipt of a financial instrument as collateral, such as a security.[4] The reverse repo is recorded on the balance sheet as the value of the cash outlay, not the collateral. These collateralized transactions are governed by specific SIFMA[5] forms. (For a more detailed discussion of these transactions, see Adrian et al. [2011].)
- *Brokerage receivables* are economically similar to reverse repos/securities borrowing, but are generally related to other forms of collateralized lending, such as brokerage customer margin loans and collateral posted in connection with derivatives.

Liabilities and equity are grouped into the categories outlined above and typically reflect a "source of" or "obligation to return" cash.

- *Equity* reflects all balance-sheet equity accounts, such as earnings and stock issuance.
- *Instruments sold but not yet owned* reflect the dealer's own short positions in a financial instrument, such as a security, physical commodity, or derivative contract.
- *Repurchase agreements (repos)/securities lending* generally reflects a cash receipt and a pledge of a financial instrument, such as a security. These are similar to the reverse repo/securities borrowing transactions described above, but in these the dealer bank takes the opposing side of the trade.
- *Brokerage payables* are economically similar to repos/securities lending, but are generally related to other collateralized borrowings, such as brokerage customer credit balances and collateral received in connection with derivative transactions.

While the balance sheet represents an accurate snapshot of the net economic claims on and obligations of the dealer relative to those counterparties from an idealized simultaneous settlement of all claims in default, it does not necessarily reveal an accurate view of the dealer bank's actual collateral sources and uses in real time, nor of the total amount of financing that the dealer bank is providing to customers. In this way, the balance sheet and the collateral record offer alternative insights into the financing and funding conditions of the firms. Combining the information from the balance sheet and the collateral record allows us to glimpse some of the collateral efficiencies and "collateralized financing" efficiencies experienced by the dealer bank.

The *collateral record* is divided into two categories, total collateral received that can be repledged, and total collateral pledged (Table 2). The collateral record reflects sources and

Table 2
Stylized Collateral Record

| Collateral Received | Collateral Repledged |
|---|---|
| — | — |
| — | — |

[4] A repurchase agreement, or repo, is an agreement to sell a security with a commitment to repurchase it at a specified date in the future, usually the next day, for a stated price. The economic function of these agreements is essentially equivalent to a short-term secured loan, and usually the value of the securities purchased is greater than the cash outlay, with the difference referred to as a haircut. For more details, see Copeland, Martin, and Walker (2010). For the party on the opposite side of the transaction, the agreement is called a reverse repo.

[5] Repurchase and reverse repurchase agreements are typically governed by a master repurchase agreement (MRA) or global master repurchase agreement (GMRA). Securities borrowing and securities lending are typically governed by a master securities lending agreement (MSLA).

uses of collateral broadly, including on a gross outstanding basis, and does not conform to specific guidance under U.S. generally accepted accounting principles (GAAP).

Dealer banks receive cash and securities as collateral in connection with reverse repos, securities borrowing, and brokerage receivables.

While these transactions may also be reflected on the stylized balance sheet, the reported numbers will differ from the collateral record for several reasons. First, the balance sheet does not fully reflect the use of collateral in the transaction. For example, a dealer may extend a $100 margin loan to a brokerage customer to purchase a security, which will be recorded as a $100 brokerage receivable on our stylized balance sheet. In this case, the dealer may have received (and was permitted to repledge) $140 of the brokerage customer's security. The collateral received can be delivered or repledged in connection with repos, securities lending, and brokerage payables. In this example, the dealer could repledge the $140 of the client's securities in a repurchase agreement; the movement of the client's securities would show up in the dealer's collateral record, but the stylized balance sheet would only reflect the margin loan and repurchase agreement.

Crucially, U.S. GAAP allows for the netting of receivables (for example, reverse repo, securities borrowing, and brokerage receivables) and payables (for example, repo, securities lending, and brokerage payables) when:

a. The repurchase and reverse repurchase agreements are executed with the same counterparty.

b. The repurchase and reverse repurchase agreements have the same explicit settlement date specified at the inception of the agreement.

c. The repurchase and reverse repurchase agreements are executed in accordance with a master netting agreement (MNA).[6]

d. The securities underlying the repurchase and reverse repurchase agreements exist in book-entry form and can be transferred only by means of entries in the records of the transfer system operator or securities custodian.

e. The repurchase and reverse repurchase agreements will be settled on a securities transfer system (for which specific operational conditions are described) and the enterprise must have associated banking arrangements in place (also described in detail). Cash settlements for securities transferred are made under established banking arrangements that provide that the enterprise will need available cash on deposit only for any net amounts that are due at the end of the business day. It must be probable that the associated banking arrangements will provide sufficient daylight overdraft or other intraday credit at the settlement date for each of the parties.

f. The enterprise intends to use the same account at the clearing bank or other financial institution at the settlement date in transacting both 1) the cash inflows resulting from the settlement of the reverse repurchase agreement and 2) the cash outflows in the settlement of the offsetting repurchase agreement.[7]

As a result, U.S. GAAP netting has the effect of reducing the size of the balance sheet relative to the collateral record.

## 3. Review of Select Activities at Dealer Banks

The following sections outline specific activities or transactions that dealer banks conduct in carrying out financial intermediation, focusing on three in particular: matched-book dealing, internalization, and derivatives collateral. While not exhaustive, these activities are representative of the activities inherent in the dealer's business model, which are accompanied by a unique set of risks that are not faced by standard banks.

### 3.1 Matched-Book Dealing

Dealer banks often refer to a balance sheet where repurchase agreements finance offsetting reverse repurchase agreements as a "matched book." The dealer bank's business model relies on optimizing its uses and sources of collateral. In essence, this means some clients demand cash and possess securities, while others demand securities and possess cash. In a typical matched-book transaction, a client provides a security as collateral in exchange for cash and grants the dealer the right to repledge this collateral. The dealer repledges this security to another client to source the cash. As a result, the dealer's balance sheet does not reflect any security owned. This can be an efficient method to finance securities for customers if the dealer has better access to repo markets generally, and the dealer can earn a slight interest rate spread in the difference in the interest paid to lenders and the rate it charges its borrowers. This incremental spread is one form of the "collateralized financing" efficiency exploited by dealers.

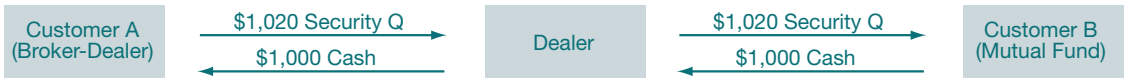
[6] A master netting agreement in effect allows all transactions covered by the MNA between the two parties to offset each other, aggregating all trades on both sides and then replacing them with a single net amount (International Swaps and Derivatives Association 2012).

[7] Financial Accounting Standards Board Interpretation no. 41, "Offsetting of Amounts Related to Certain Repurchase and Reverse Repurchase Agreements" (FIN 41).

Exhibit 1

## Matched-Book Dealing

Transaction 1: Customer A lends Dealer $1,020 in Security Q and receives $1,000 in cash.
Transaction 2: Dealer lends Customer B $1,020 in Security Q and receives $1,000 in cash.




### Stylized Dealer Balance Sheet

| Category | Beg. Balance | Transaction 1 | Transaction 2 | End. Balance |
|---|---|---|---|---|
| Cash | — | (1,000) | 1,000 | — |
| Instruments owned | — | — | — | — |
| Reverse repo/securities borrowed | — | 1,000 | — | 1,000 |
| Brokerage receivables | — | — | — | — |
| Total assets | — | | | 1,000 |
| Repo/securities loaned | — | — | 1,000 | 1,000 |
| Instruments sold, but not yet owned | — | — | — | — |
| Brokerage payables | — | — | — | — |
| Total liabilities | — | | | 1,000 |
| Total equity | — | | | — |

### Stylized Collateral Record

| Transaction | Collateral Received | Collateral Repledged |
|---|---|---|
| Transaction 1 | 1,020 | |
| Transaction 2 | | 1,020 |

Dealers can run a matched book using various types of transactions. For illustrative purposes, we focus on the simplest example, described above, of offsetting repos and reverse repos. Exhibit 1 presents a dealer that starts with no balance sheet, but is then approached by another broker-dealer, Customer A, which is looking for a $1,000 overnight cash loan and offers a $1,020 security as collateral. The dealer enters into a matched-book trade by simultaneously executing an overnight reverse repo with Customer A (Transaction 1) and an overnight repo with Customer B (Transaction 2), a mutual fund willing to invest its excess cash overnight.

The dealer's balance sheet reflects a symmetrical increase in both a claim to $1,000 cash and an obligation to return $1,000 cash. Although the dealer acted as principal, the balance sheet reflects no position in Security Q. However, the collateral record shows that the dealer received and acquired the right to repledge or sell $1,020 of Security Q, of which it actually repledged $1,020.

If the dealer had been unable to use Customer A's collateral to secure a loan from Customer B, it might have had to borrow on an unsecured basis to source the cash or, alternatively, encumber some of the bank's own collateral. As a result, the transaction might have become uneconomical from the dealer's perspective. In this example, the dealer passed the haircut required by Customer B (approximately 2 percent) entirely on to Customer A. As a result, in the example the dealer reaps efficiencies to the extent that it can borrow from Customer B at a lower cost than it can lend to Customer A.

Furthermore, there are cases where the dealer bank executes matched-book transactions in a way that can provide it a net funding source. Consider a modification to our example, in which the dealer is able to demand a higher degree of overcollateralization on the reverse repo. Suppose the dealer required Customer A to deliver $1,060 worth of securities as collateral for the cash borrowed, and Customer B still required only $1,020 of the securities from the dealer in exchange for its cash. Here, the dealer retains an additional $40 of securities that it could potentially pledge to additional financing transactions. The dealer, in charging a higher haircut than the one it pays, generates an additional financial capacity as a result of its intermediation activities. In turn, these extra efficiencies—we might call them a "collateral haircut margin"—allow the dealer to provide prime brokerage and lending services at lower costs. Whether the haircut margin reflects a transfer to

dealer banks, or whether competition among dealer banks for the profits provided by this haircut margin results in lower financing costs for customers—and therefore provides a benefit to society—depends on the level and nature of the competition between dealer banks.

### *Maturity, Credit, and Collateral Transformation*

In the original example, the final maturity of both transactions was the following day. However, a matched book does not always involve executing offsetting repurchase and reverse repurchase agreements that are "perfectly matched" in terms of the final maturity date or the credit quality of the involved counterparties. That is, dealer banks engage in maturity and credit transformation.

First, dealers can borrow cash through repo at shorter maturities than those at which they lend through reverse repo. Maturity mismatches expose the dealer to some interest rate risk, should short-term borrowing rates spike before maturity. In an extreme event, the dealer is exposed to "rollover risk," in which it could prove difficult for the dealer to roll over its borrowings, while still being required to fund the lending on longer-term reverse repos.

Second, dealers can borrow from more creditworthy investors and lend to less creditworthy borrowers, which introduces an element of credit risk, although this risk is mitigated by requiring collateral and charging haircuts accordingly. Generally, these risks are common to most financial intermediaries, including traditional banks.

### *U.S. GAAP Netting and Collateral Transformation*

The matched-book examples thus far have been presented as two transactions from the dealer's perspective, each with a different counterparty. In practice, dealers will often have multiple transactions executed with a single counterparty. Under U.S. GAAP, repos and reverse repos can be reported on a net basis with a single counterparty if executed in accordance with a master netting arrangement and if the agreements have the same explicit settlement date, as well as some additional operational requirements.[8]

Importantly, offsetting repurchase agreements are not required to be collateralized by the same securities to be eligible for U.S. GAAP netting. In essence, this means a dealer can deliver $100 cash in exchange for a U.S. Treasury security and, separately, borrow $100 cash and pledge a corporate bond, and offset these two transactions on its balance sheet as long as the other required conditions are met. This form of collateral transformation presents the dealer with more opportunities to optimize its sources and uses of collateral with clients without enlarging, or "grossing up," its balance sheet. However, this also introduces an additional layer of complexity in analyzing the dealer's collateral position, particularly in periods when market clearing conditions for different types of securities diverge.

[8] Refer to International Swaps and Derivatives Association (2012).

## 3.2 Internalization of Trading Activities

Dealers achieve yet another source of collateralized financing efficiency by "internalizing" their trading activities, that is, by using offsetting trading positions between two clients or between clients and the dealer bank to "finance" each other. Similar to the concept of matched book, opportunities to "internalize" can arise via the provision of funds by the dealer bank collateralized by client securities. Those securities are then reused and delivered into another transaction as a means of financing the client position. Its name refers to the concept that the bank, in some cases, can source financing for a customer internally, without the need to attract additional funding from the external marketplace for funds.

Though internalization exhibits certain similarities with matched book as a financing mechanism, it differs in the degree of cost advantage, in its ability to minimize the size of the balance sheet, and in its flexibility to generate financing for dealer bank trading positions. While these differences generally suggest that internalization is a low-cost and flexible form of financing for dealer banks, internalization is vulnerable to a unique set of risks, as it relies on the market positioning of customers. As conditions in markets change, owing to a significant price move, for example, either one side or the other might rapidly exit its financing position from the dealer, forcing the dealer to quickly replace securities or cash from external markets.

Exhibit 2 depicts one example of internalization, with the prime brokerage business of a dealer bank facilitating opposing transactions for two separate hedge fund clients. In this example, the dealer bank lends to a hedge fund client on margin and uses a portion of the securities purchased to fund the original margin loan (Transaction 1b). Internalization occurs when a separate client has sold short the same security, and therefore the collateral backing the margin loan is rehypothecated and delivered into the short position (Transaction 2b).

In this example, the dealer bank starts with a balance sheet of zero. Customer A deposits $500 of cash into its brokerage account (Transaction 1a) and then borrows $500 from the dealer

Exhibit 2

## Customer-to-Customer Internalization

Transaction 1a: Customer A deposits $500 in Cash into its brokerage account.
Transaction 1b: Dealer lends Customer A $500 in Cash to purchase $1,000 of security Q, receiving $700 of rehypothecatable collateral.
Transaction 2a: Customer B deposits $350 in Cash into its brokerage account.
Transaction 2b: Customer B sells short $700 of security Q, posting the cash proceeds to the Dealer as collateral.
End. Balances: Dealer holds the residual $550 of cash in a segregated lock-up account.


### Stylized Dealer Balance Sheet

| Category | Beg. Balance | Transaction 1a | Transaction 1b | Transaction 2a | Transaction 2b | End. Balance |
|---|---|---|---|---|---|---|
| Cash (including segregated lock-up) | — | 500 | (1,000) | 350 | 700 | 550 |
| Instruments owned | — | — | — | — | — | — |
| Reverse repo/ securities borrowed | — | — | — | — | — | — |
| Brokerage receivables | — | — | 500 | — | — | 500 |
| Total assets | — | 500 | (500) | 350 | 700 | 1,050 |
| Repo/securities loaned | — | — | — | — | — | — |
| Instruments sold, but not yet owned | — | — | — | — | — | — |
| Brokerage payables | — | 500 | (500) | 350 | 700 | 1,050 |
| Total liabilities | — | 500 | (500) | 350 | 700 | 1,050 |
| Total equity | — | | | | | — |

### Stylized Collateral Record

| Transaction | Collateral Received | Collateral Repledged |
|---|---|---|
| Transaction 1b | 700 | — |
| Transaction 2b | — | 700 |

bank to acquire a $1,000 long position in Security Q (Transaction 1b), using $500 of the funds deposited in Transaction 1a to make the purchase. Customer A pledges the acquired securities as collateral for the loan. As Customer A purchases the securities on margin, the dealer gains rehypothecation rights over the collateral posted in the amount of 140 percent of the margin loan, which is $700 of Security Q in this example. The remaining $300 of Security Q is segregated and placed off the dealer's books.

Separately, hedge fund Customer B, intending to open a short position in the same security, first deposits $350 of cash into its brokerage account (Transaction 2a) and then borrows $700 of Security Q from the dealer bank (Transaction 2b), pledging and depositing a total of $1,050 with the dealer bank ($700 in cash collateral and the $350 in its brokerage account). Here we assume both clients hold margin accounts governed by Regulation T,[9] which generally allows a client to borrow up to 50 percent of the value of a security pledged as collateral (in this case, $500 for Customer A) and requires clients to maintain

[9] The Federal Reserve Board's Regulation T relates to cash accounts held by customers and limits the amount of credit that dealers may extend to customers for the purchase of securities.

margin in the amount of 150 percent of the market value of open short positions (in this case, $1,050 for Customer B).

The dealer settles Customer B's short sale by using the securities pledged by Customer A for its margin loan, effectively internalizing the two positions. The dealer's ending balance sheet will reflect a segregated cash balance of $550, a brokerage receivable in the amount of the $500 margin loan to Customer A, and a brokerage payable to Customer B equivalent to $1,050.[10]

### *Differences between Internalization and Matched Book*

This example highlights a key difference with matched-book financing—as the name implies, internalization eliminates the need for external sources of financing, and represents a form of both "collateral" and "collateralized financing" efficiency.

Absent the ability to internalize these positions, the dealer would need to engage in two additional external transactions to satisfy both clients' positions. First, the margin loan would require financing, which the dealer bank would most likely obtain from the repo market. Second, the dealer bank would have to source the security to satisfy the client's short position, likely through a securities borrowing transaction. Both of these external transactions would resemble our example of matched book, in that the dealer bank would seek to earn a small spread based on its superior access to repo and securities borrowing markets. Instead, the dealer bank furnished its clients with a total of $1,200 in credit (the $500 margin loan and $700 short position), earning interest and fees on that level of credit, but has a balance sheet of only $1,050. Internalization allows the dealer to generate potential income from finding and matching, among its own customers, natural buyers and sellers of the same security. Importantly, internalization also presents regulatory advantages from a capital and leverage perspective; eliminating the need to engage in external repo and securities borrowing transactions minimizes the size of the balance sheet and enables the dealer bank to increase other client activity.

A second substantive difference from matched book lies in the dealer bank's ability to finance its own positions with client activity. A dealer bank may be naturally long a security as a part of its market-making inventory, as a hedge, or as an investment. Under circumstances where a client sells short that same security, the dealer bank can deliver its own inventory into the short sale, or in other words internalize the two positions. Again, the dealer benefits significantly from this form of internalization as it earns a fee on the client's short, and saves on the financing cost of its own inventory, although it does not achieve the same degree of balance-sheet reduction observed in the case of internalization between two clients.

### *Risks Associated with Internalization*

The internalization of client and firm trading activities affords the dealer bank distinctive cost and income advantages; however, it engenders a unique set of risks.

Unlike the traditional banking model, a dealer bank's client assets and liabilities tend to have an undefined set of maturities. The maturity of offsetting client positions is therefore difficult to predict precisely. Short-term imbalances in the duration of client or dealer positions that have been internalized against each other pose significant risks to the dealer. During a period of market or firm-specific stress in particular, a dealer may need to replace one side of an internalized transaction. For example, a client may liquidate its account by repaying its margin loan, resulting in a cash inflow to the dealer; however, the dealer may have already rehypothecated the underlying collateral for the margin loan to deliver into another client's short sale. In this event, the dealer bank may need to source a hard-to-borrow security in an illiquid market in order to settle the sale of the margined long position. Similarly, a client may "buy back" a short position that was previously financing another client's long position, which may force the dealer to resort to the external market to seek additional funds in a potentially illiquid repo market. While these imbalances between long and short positions might resolve themselves over a period of time, they can be temporarily destabilizing, requiring the dealer bank to increase its balance sheet to finance positions externally or, if that were to prove difficult, to sell assets or close client positions quickly.

In a similar vein, dealers can look to any unused capacity to internalize trading positions when wholesale funding markets experience temporary dislocations. This residual capacity in certain cases could function as a buffer, allowing dealer banks to shift from external sources of financing to internal ones during a short-lived period of market stress. Importantly, however, the ability to internalize is likely correlated with the relative liquidity of a given position. In other words, the least liquid positions—those with the greatest probability of

[10] This amount is a function of both clients' "net equity," as per SEC rule 15c3-3, and is not accessible to the dealer as a source of funding for other activities. The "locked-up" amount reflects the difference between the value of collateral rehypothecated from Customer A's margin account and the receivable from the margin loan ($700 - $500 = $200), plus the difference between Customer B's credit balance (that is, the original cash deposit plus the proceeds from the short position) and the market value of the short position ($1,050 - $700 = $350). Therefore, the total locked-up cash balance is $200 + $350 = $550.

becoming unfundable during a period of stress—would have the fewest opportunities for internalization. Alternatively, more common securities, such as exchange-listed asset classes, would likely present more opportunities for internalization as they would be present in greater abundance, offering more opportunity for matching with other client positions. This inventory of client positions, then, allows the dealer bank to use internalization, where possible, as a potential cushion against the cost of finding more expensive funding or tapping into liquidity reserves to replace existing wholesale sources.

### *Internalization and Financial Reporting*

Internalization is an important source of financing for dealer banks. However, under current standards for financial reporting, the degree to which dealer banks internalize trading activities or maintain available but untapped capacity to internalize positions is, at best, unclear. Since internalization results from the optimization of trading activities visible only through a dealer bank's collateral record, it is neither directly nor quickly observable given current standards of public financial disclosure. The "leveraging effect" of client-to-client internalization largely occurs off-balance-sheet, with only an imperfect record appearing in the footnotes to the firms' reported financial statements, where repledged collateral received from margin lending is aggregated with repledged collateral received through other secured transactions.

Moreover, U.S. GAAP accounting allows dealers to net long and short exposures within individual client margin accounts, which further augments the balance-sheet efficiency of internalized transactions, but by extension increases the disparity between the gross positions financed and the net exposures reported on-balance-sheet.

## 3.3 Derivatives Collateral Received

The final category of dealer bank financing examined in this article is collateral received or posted in relation to secured derivatives transactions. These transactions generate or use cash through receiving or posting initial margin (IM) and variation margin (VM), which serve to offset the risks associated with current and potential future exposure, respectively.[11] In principle, the collateral and collateralized financing efficiencies gained through derivatives transactions are similar to those arising from matched-book transactions or internalization. That is, a dealer bank that has sold a derivative to a client can purchase an equal and opposite exposure from another dealer bank, using the collateral received from one transaction to satisfy the collateral requirement on the second, while capturing a small income spread.

Unlike other secured transactions addressed in this article, however, the derivatives transactions as defined here do not entail the exchange of cash for securities, but rather the posting or receipt of collateral to secure an economic claim. Derivatives are collateralized according to contractual terms stipulated in the Credit Support Annex (CSA) of an International Swaps and Derivatives Association (ISDA) master agreement, which establishes the types of acceptable collateral, among other rules. Cash tends to be favored in this context because it is operationally easier to exchange and attains a greater degree of balance-sheet efficiency through the cash collateral netting provisions granted under U.S. GAAP and IFRS.

Firms can offset their derivative assets against derivative liabilities when:

a. Each of two parties owes the other determinable amounts.
b. The reporting party has the right to set off the amount owed with the amount owed by the other party.
c. The reporting party intends to set off.
d. The right of setoff is enforceable at law.

Additionally, cash collateral received or paid in connection with a derivatives contract can be net against the fair value of the contract if executed under a master netting arrangement.[12]

### *Net Financing and Efficiencies*

Asymmetries in contractual terms covering the extent of collateralization may give rise to situations in which dealer banks receive more collateral than they post, generating net financing possibilities to the extent that this excess can be repledged.

[11] See Basel Committee on Banking Supervision and International Organization of Securities Commissions (2013, p.10). Here, exposure refers generally to the replacement cost should the derivative counterparty default. Current exposure (CE) is a function of the current mark-to-market value of the transaction, whereas potential future exposure (PFE) reflects certain aspects of the contract itself (for example, revaluation/margining period) and the prospective volatility of the underlying instrument.

[12] "Without regard to the condition in paragraph 5(c), a reporting entity may offset fair value amounts recognized for derivative instruments and fair value amounts recognized for the right to reclaim cash collateral (a receivable) or the obligation to return cash collateral (a payable) arising from derivative instrument(s) recognized at fair value executed with the same counterparty under a master netting arrangement." Financial Accounting Standards Board Interpretation no. 39, "Offsetting of Amounts Related to Certain Contracts" (FIN 39).

Exhibit 3

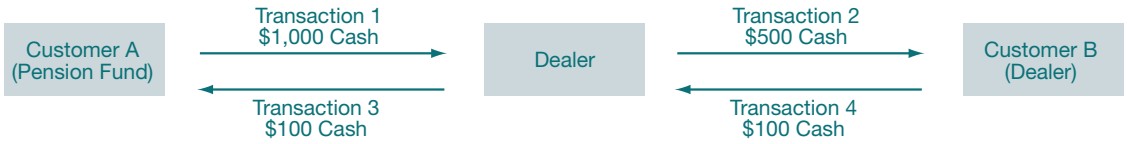
## Asymmetric Collateral Terms on Matched Derivatives

Transaction 1: Customer A purchases a Total Return Swap long position, for which Customer A pays $1,000 in initial margin (IM).

Transaction 2: Dealer sells the same exposure to Customer B, another dealer, but is required to post only $500 in IM.

Transaction 3: Customer A's contract value appreciates $100, requiring the Dealer to post $100 in collateral to Customer A.

Transaction 4: Dealer's contract with Customer B depreciates, requiring Customer B to post $100 in collateral to the Dealer.




### Stylized Dealer Balance Sheet

| Category | Transaction 1 | Transaction 2 | Transaction 3 | Transaction 4 | End. Balance |
|---|---|---|---|---|---|
| Cash | 1,000 | (500) | (100) | 100 | 500 |
| Instruments owned | — | — | — | — | — |
| Reverse repo/ securities borrowed | — | — | — | — | — |
| Brokerage receivables | — | 500 | — | — | 500 |
| Total assets | 1,000 | — | (100) | 100 | 1,000 |
| Repo/securities loaned | — | — | — | — | — |
| Instruments sold, but not yet owned | — | — | — | — | — |
| Brokerage payables | 1,000 | — | — | — | 1,000 |
| Total liabilities | 1,000 | — | — | — | 1,000 |
| Total equity | — | — | (100) | 100 | — |

### Stylized Collateral Record

| Transaction | Collateral Received | Collateral Repledged |
|---|---|---|
| Transaction 1 | 1,000 | — |
| Transaction 2 | — | 500 |
| Transaction 3 | — | 100 |
| Transaction 4 | 100 | — |

The size of this potential net financing pool is linked to a variety of factors specific to the dealer bank and the nature of the derivatives transactions. Much like other forms of secured financing, the dealer's relative credit quality and market access will influence its ability to negotiate preferential margining terms. In general, the tendency to margin on a portfolio basis suggests that large active dealers would benefit from economies of scale, minimizing their requirements to post collateral on interdealer transactions, while reinforcing their ability to command greater amounts from smaller or nondealer counterparts. Forthcoming rules governing the margining of OTC derivatives may limit this benefit by establishing minimum levels for the calculation of IM and VM; however, it is unlikely that the benefits of scale would be eliminated entirely.

Exhibit 3 uses our stylized framework to illustrate how matched collateralized derivatives transactions can both generate net financing for a dealer and minimize leverage through balance-sheet netting provisions. In this example, the dealer engages in matched derivatives transactions, remaining market-risk-neutral, but establishing preferential terms for IM. At inception, the offsetting transactions are reflected in the dealer bank's cash position, a brokerage receivable representing the IM paid on the hedging transaction, and a brokerage payable associated with the dealer's obligation to return IM received from Customer A. Notably, we assume that the fair values of each transaction will be fully collateralized by cash VM such that they qualify for netting treatment, and therefore the contract exposures will not be reported on-balance-sheet.

Irrespective of market movements in the underlying position, the dealer will retain the net funding gained through the receipt of IM. Furthermore, margin deposits tend to earn a short-duration money market yield, rendering this an inexpensive form of financing for dealer banks. Thus, because of the cash/collateral netting and portfolio margining imposed by the dealer bank, the dealer reaps collateralized financing efficiencies. The netting here is not bilateral customer-to-dealer netting, but netting by the dealer bank itself. "Rehypothecating" cash is effectively netting by the dealer of collateral received and collateral posted.

### *Potential Risks*

Balance-sheet and cost advantages aside, the stock of net collateral received by a dealer bank is exposed to certain vulnerabilities that call into question its overall durability as a means of financing, even under circumstances where the offsetting transactions are matched in terms of market risk and level of collateralization.

First, in a traditional sense, these transactions are subject to the same rollover risk considerations as other dealer financing arrangements. At the maturity of a swap transaction, unless the position is rolled over, the collateral received would need to be returned to the original client. If a dealer offsets a position with one of shorter duration, or if a dealer obtains some amount of net collateral received on transactions of matched duration, at maturity it faces a financing gap in the amount of the margin posted to the offsetting transaction.

Second, from the contractual perspective, transactions are often embedded with certain credit rating downgrade triggers requiring the posting of additional collateral or imposing more constraining restrictions on rights of rehypothecation. Other contractual risks exist as well, such as the potential for a client to replace existing collateral posted with a currency or security that cannot readily be reposted to a matched derivative position, however, this risk would only be present to the extent that the dealer bank takes a sort of contractual basis risk by accepting divergent collateral types on matched trades.

Finally, dealer banks may be beholden to reputational considerations in periods of stress. While they may have contractual rights over the use of client collateral, they may nevertheless honor client requests to segregate collateral or close out trades preemptively in the spirit of preserving their franchise. It is this element of uncertainty and contingent risk that undermines the durability of net collateral received in relation to derivatives as a source of dealer financing.

Table 3
Net Current Credit Exposure of OTC Derivatives
March 31, 2013

| Rank | Holding Company | Total OTC Derivatives (Billions of Dollars) |
|---|---|---|
| 1 | Goldman Sachs Group, Inc., The | 152,679 |
| 2 | JPMorgan Chase & Co. | 144,490 |
| 3 | Bank of America Corporation | 110,506 |
| 4 | Morgan Stanley | 103,813 |
| 5 | Citigroup Inc. | 93,816 |
| 6 | Wells Fargo & Company | 15,015 |
| 7 | HSBC North America Holdings Inc. | 12,238 |
| 8 | Bank of New York Mellon Corporation, The | 12,021 |
| 9 | State Street Corporation | 6,802 |
| 10 | PNC Financial Services Group, Inc., The | 3,547 |
| 11 | Suntrust Banks, Inc. | 2,521 |
| 12 | Fifth Third Bancorp | 1,663 |
| 13 | Capital One Financial Corporation | 1,417 |
| 14 | TD Bank US Holding Company | 1,385 |
| 15 | Northern Trust Corporation | 1,154 |
| 16 | KeyCorp | 1,067 |
| 17 | Unionbancal Corporation | 1,036 |
| 18 | RBS Citizens Financial Group, Inc. | 951 |
| 19 | Deutsche Bank Trust Corporation | 834 |
| 20 | Regions Financial Corporation | 732 |
| 21 | Ally Financial Inc. | 661 |
| 22 | BB&T Corporation | 579 |
| 23 | BancWest Corporation | 456 |
| 24 | M&T Bank Corporation | 450 |
| 25 | BBVA USA Bancshares, Inc. | 426 |
| Total for industry | | 673,018 |

Sources: OCC; FR Y-9C, Schedule HC-L.

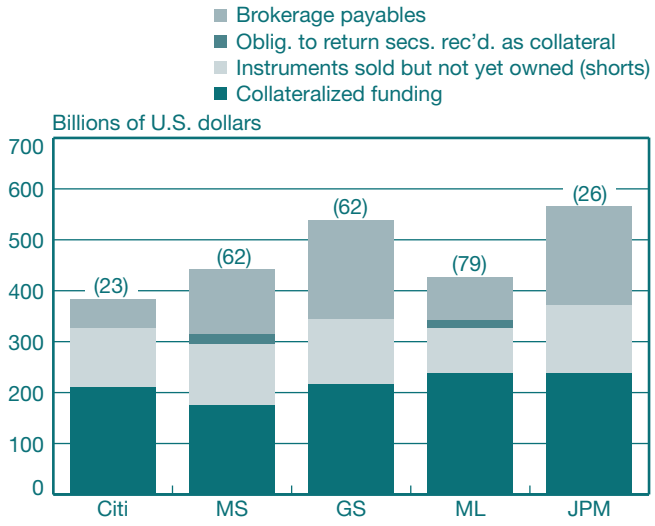
Note: Total OTC Derivatives is the sum of all net current credit exposures (Line 15(a)).

## 4. Data

Five bank holding companies—Bank of America, Citigroup, Goldman Sachs, J.P. Morgan Chase, and Morgan Stanley—represent more than 95 percent of the domestic banking industry's net current credit exposure for over-the-counter derivatives, which totaled $673 billion in 2013:Q1 (Table 3). These five banks are the major derivatives dealers, so we focus on these companies. We also include Lehman Brothers for its relevance to the crisis. By including these firms, we can

Chart 1

Select Funding Sources of Major Derivatives Dealers
December 31, 2012




Source: Company 10Q/10K filings.

Note: The figures in parentheses represent the sum of the select liabilities as a percentage of total liabilities.

examine the importance of the unique forms of financing we outline as well as how variable they were through the crisis.

To begin to gauge the size and importance of different funding sources for dealer banks, we show in Chart 1 the select liabilities of our candidate firms as of December 31, 2012, excluding unsecured borrowings and deposits in accordance with our stylized balance sheet.[13] Each of the five firms whose liabilities we display is a bank holding company (BHC) that performs the more standard banking activities of deposit taking and lending to households and commercial firms, as well as the activities we group and display under dealer banks.

With the exception of dealing in OTC derivatives, most of the dealer bank activities are concentrated in the broker-dealer subsidiaries of the BHCs. Goldman Sachs and Morgan Stanley were "stand-alone" investment banks in 2008 prior to their conversion to BHCs in September 2008, so their businesses remain more concentrated in dealer banking and prime brokerage than those of Bank of America, J.P. Morgan Chase, and Citigroup, reflected by the high portion of their total liabilities represented by select dealer banking funding sources. Merrill Lynch, a subsidiary of Bank of America, filed its 10-Q and 10-K reports separately from Bank of America up until 2013:Q1. Consequently, Citigroup and J.P. Morgan Chase have a much larger proportion of deposits as a share of their liabilities, and so the select liabilities we display in Chart 1 reflect a lower percentage of their total liabilities than for Goldman Sachs, Merrill Lynch, and Morgan Stanley. In many of our reported figures below, we concentrate our analysis on Goldman Sachs, Merrill Lynch, and Morgan Stanley, for two reasons. First, disclosures from these firms are primarily oriented toward dealer banking—more so than for the universal banks of Citigroup and J.P. Morgan Chase, which have large deposit franchises and corporate and household lending businesses, in addition to their dealer banking activities. Because our stylized balance sheet excludes the deposit-taking part of standard banking, we more closely approximate our stylized balance sheet by focusing on the three former investment banks. Second, the reporting of the collateral record is least consistent, among the five BHCs reported above, for Citigroup and J.P. Morgan Chase, with some elements only available at the annual frequency or not reported in an equivalent manner, as the other banks.

[13] Recall that Lehman Brothers Holdings International filed for bankruptcy on September 15, 2008, so that firm is not shown in the chart.

## 4.1 Data Sources

In the following sections, we use data from the firms' 10-Q/10-K filings to analyze their balance sheet and collateral records using our stylized framework. The components of our stylized balance sheet are calculated directly from the firms' consolidated balance sheets. We can estimate the firms' collateral record by exploiting self-reported data that appear either in parentheses on the balance sheet or in textual footnotes. We focus on the 10-Q/10-K data in this article because they offer the most consistent measures of the balance sheet and collateral record for dealer banks (see the data appendix).

Firms report collateral received from counterparties in connection with certain brokerage activities, such as reverse repurchase agreements, securities borrowing, and derivatives, as well as the amount of the collateral received that was subsequently repledged by the firm. The firms in our sample separately report the portion of their financial instruments owned that they have pledged as collateral that can be repledged, as well as financial instruments that have been pledged that cannot be repledged; taking the sum of these two numbers gives us the amount of financial instruments owned by the firm that it has pledged.

Firms also specifically state the amount of cash collateral posted and received in connection with derivatives activity that qualifies for U.S. GAAP netting.

## 4.2 Quantifying the Collateral Record

Reconstructing the collateral record as described above can shed light on the efficiencies captured by dealer banks through their secured activities. Although we are limited in our ability to fully quantify the sources of financing examined in our stylized framework—in particular, the internalization of trading activities—we assess two aspects of the collateral record that are indicative of the benefits dealer banks realize through the intermediation of secured transactions.

First, the level of collateral received that has been rehypothecated indicates firms' reliance on "customer collateral" generated through secured lending activities and derivatives to raise financing, from both internal and external sources; these data allow us to directly measure the banks' "collateral efficiency," as we have defined it. Second, the total stock of collateral held and the total stock of collateral pledged relative to the balance sheet can be used to indicate the degree of "collateralized financing efficiency" achieved by the dealer banks.

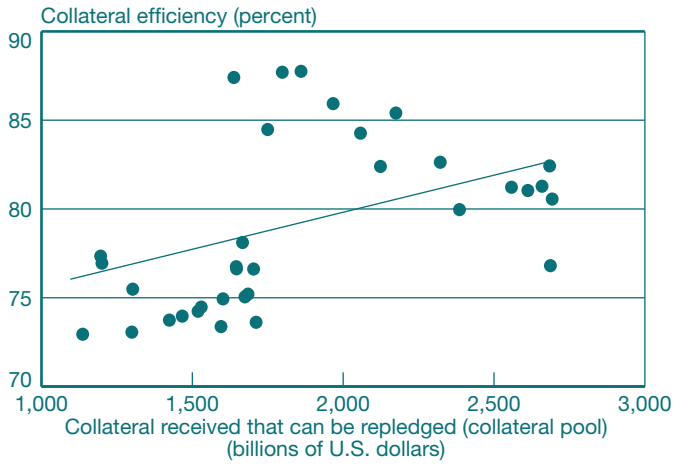
In both cases, we examine with particular attention the financial crisis period of 2008-09 characterized by significant balance-sheet deleveraging. With respect to levels of rehypothecation, we draw upon the example of Lehman Brothers to illustrate the magnitude of contraction in a case that ultimately ended in bankruptcy and liquidation.

Finally, we attempt to decompose the level of collateral efficiencies achieved into its transactional sources, that is, for the three types of activities described earlier—matched-book, internalization, and derivatives. Although this falls short of fully quantifying the amount of financing generated by the methods examined through our stylized framework, it provides some insight into the relative materiality of each source. Moreover, it allows us to observe a rough trend during the period of the crisis, raising important questions about the systemic risk effects of each activity.

### *Collateral Efficiency*

We first display a measure of "collateral efficiency," which we earlier defined as the percentage of a dealer bank's collateral received that is rehypothecated. Recall that it is likely that collateral efficiency is increasing with the size of the dealer's collateral pool, as a larger portfolio of collateral will contain securities that match more customer demands than would a smaller portfolio. Indeed, this correlation was positive and significant at the aggregate level for the sample of banks we examine in this article (Chart 2). Further, a simple regression using the panel data with entity-fixed effects confirms this positive and significant correlation between collateral efficiency and the collateral pool for these three firms. Other factors that we conjecture would increase collateral efficiency include the number and mix of customers, the operational capacity of the dealer, and other economic features of the dealer firm, such as its creditworthiness, that make it a good counterparty.

Chart 2
Collateral Efficiency and the Dealer's Collateral Pool




Source: Company 10Q/10K filings; includes GS, MS, and ML.

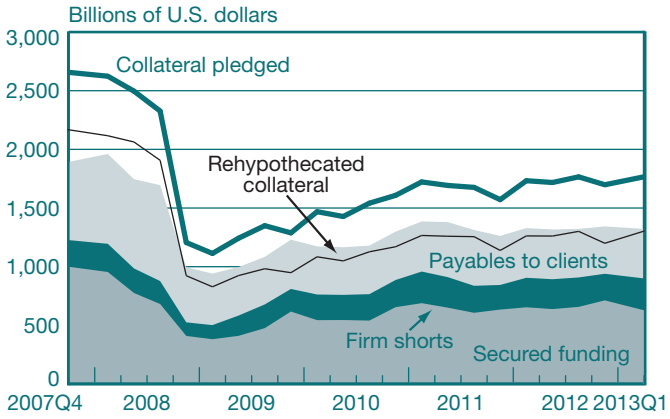
The collateral efficiency achieved by dealer banks underlies the more expansive collateralized financing efficiencies that pervade dealer banking. We examine this efficiency by comparing the size of the collateral pledged by dealer banks and the size of their on-balance-sheet assets and liabilities.

### *Collateralized Financing Efficiency: A Liability Perspective*

Recall that we defined collateralized financing efficiency as all the economic benefits reaped by dealer banks in their allocation of firm and customer collateral. To provide indicators of this efficiency, we first display the total stock of collateral pledged by the dealer banks relative to on-balance-sheet transactions that consume collateral, namely, their total secured liabilities. This is consistent with our stylized balance sheet for the dealer banks, where we focus on their secured financing activities.

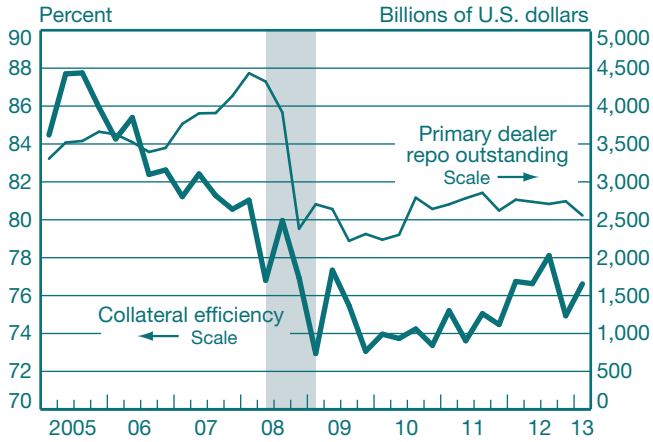
The difference between the amount of collateral pledged by the dealer bank and its level of secured on-balance-sheet liabilities highlights the netting and other balance sheet economies that enable dealer banks to gain collateralized financing efficiency. This provides a measure of collateral financing efficiency.

Chart 3
Secured Liabilities Relative to Collateral Pledged




Source: Company 10Q/10K filings; includes GS, MS, and ML.

Chart 4
Collateral Efficiency and Total Primary Dealer Repo




Source: Company 10K/10Q filings, Federal Reserve Bank of New York (FR 2004).

Notes: Collateral efficiency includes GS, MS, and ML; shaded area highlights rapidly declining collateral efficiency.

In Chart 3, we also measure the amount of rehypothecated collateral, recalling that this is the numerator in our measure for collateral efficiency. The chart illustrates the strong dependency on reuse of collateral received to finance dealer bank intermediation of cash and securities. Conceptually, in the event that all secured borrowers of the bank were to demand segregation of their collateral or fully restrict rehypothecation rights, the amount of rehypothecated collateral represents the total amount of financing that a dealer bank would need to raise from its own collateral or from the unsecured debt market to maintain its existing secured lending activities. The chart shows, therefore, just how important the amount of rehypothecation is to the dealer bank in achieving its efficiencies.

Chart 3 illustrates the trend between 2007:Q4 and 2013:Q1 of secured funding, including repo and securities lending transactions (blue area), firm shorts[14] (dark blue area), and payables to clients (light blue area), again restricting our purview to Goldman Sachs, Merrill Lynch, and Morgan Stanley for comparability. The thick blue line indicates the total amount of collateral pledged, with the thin black line representing the portion of collateral pledged that was sourced from other secured transactions and has been rehypothecated. The difference between the two lines represents the amount of the firms' own collateral pledged to secured transactions.

[14] Includes securities sold and not yet purchased. Excludes on-balance-sheet derivatives transactions, as the fair value of derivative liabilities reported on-balance-sheet generally refers to unsecured derivatives. This introduces a certain amount of error into our discussion of liabilities requiring collateral to be posted, as certain derivatives are collateralized by cash or securities that do not qualify for netting.

The importance of rehypothecation and the matching of sources and uses of collateral are emphasized by the level of rehypothecation relative to secured liabilities and total collateral pledged, and in normal times represents how efficient the dealer banks are in economizing on collateral. Total secured liabilities peaked in 2008:Q1 at just under $2 trillion, or 68 percent of the balance sheet, evidence of their materiality as a source of dealer funding. At that time, the level of collateral that had been rehypothecated and repledged exceeded the total secured liabilities reported on-balance-sheet by $156 billion, which indicates a very high level of collateralized financing efficiency.

The subsequent crisis-era period between 2007:Q4 and 2008:Q4 depicts a decline in total collateral pledged of nearly $1.5 trillion, or a 55 percent decrease. At the same time, on-balance-sheet secured liabilities declined by a much lower amount—$897 billion, or a 47 percent drop. In addition, the level of collateral rehypothecation fell by $1.2 trillion, or 57 percent, over the same period. The accelerated decline of the collateral stock pledged and the level of rehypothecation suggest a sort of collateral scarcity that particularly affects dealer banks. As the dealer banks' collateral efficiency plummeted, as shown directly in Chart 4, they had to supply more of their own collateral to secure funding as well as rely on uncollateralized funding or increases in equity.

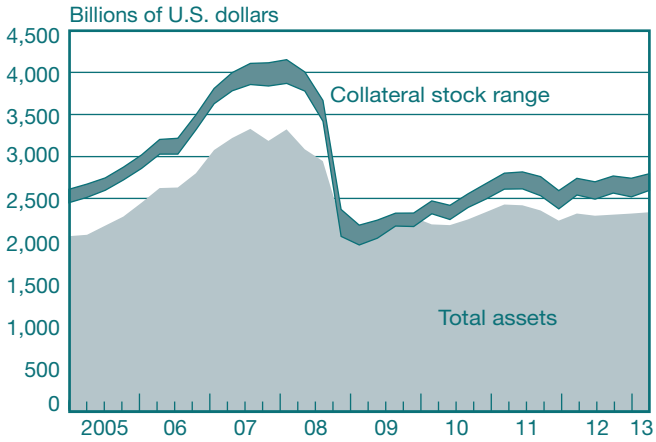
Why did such a precipitous drop in collateralized financing occur during the crisis? Duffie (2013) provides a case study of

some of the factors leading to the decline by examining features of Morgan Stanley's experience during the days following the bankruptcy of Lehman Brothers International Holding Co. In that case, Duffie reports that "[t]he dominant source of loss in liquidity was through an effective run by Morgan Stanley's prime-brokerage clients." As prime-brokerage clients exited their positions with Morgan Stanley, the firm lost access to securities those clients had posted as collateral which, because of overcollateralization of client positions, in turn reduced the amount of financing Morgan Stanley could raise using those securities as collateral for its own borrowing. At the same time, however, many clients continued to have high and immediate demand for funding, which Morgan Stanley worked to fulfill; denying client requests would send a very negative signal about the firm's ability to meet its other obligations, potentially crippling the firm. Consequently, Morgan Stanley had to rely on other and in general more costly external sources of financing to fulfill the demands it faced, which tended to expand its balance sheet, all else equal. These strains led to a significant drop in the levels of collateral received and pledged by the dealer banks and a decline in the efficiency of the activity, to which we turn next. It is likely that the drop reflected a combination of decreases in both demand and supply of this type of financing, as hedge funds and other clients reduced their risk profile and cut back on risky positions that required financing, and as dealer banks faced much higher costs of financing as they relied on more costly external sources of financing, including relying on higher levels of equity.

### *Collateralized Financing Efficiency: An Asset Perspective*

We turn next to the asset side of our stylized balance sheet and the total stock of collateral managed by a dealer bank, including the stock that has been pledged or encumbered as well as what remains unencumbered and available. Assets generally reflect a firm's earning potential; however, a simple balance sheet represents net economic claims and, as a result, can understate the earning potential discussed in our stylized framework, stemming from the reuse of collateral that appears in the collateral record. Collateralized financing efficiency can be measured as the difference between the total collateral stock as viewed from the collateral record relative to the reported balance sheet. This in turn signals how much gross financing the dealer bank has extended in its activities, relative to the amount of lending it reports on-balance-sheet. However, as discussed earlier, we cannot adequately capture the full extent of the dealer's collateralized financing efficiency using the data that we have because

Chart 5
Collateral Stock Relative to Total Assets




Source: Company 10K/10Q filings; includes GS, MS, and ML.

Note: Bottom line of range excludes cash (lower bound); top line includes cash balances (upper bound).

we do not know the "opportunity cost" the dealer avoided by not seeking funding from external markets. Thus, this estimate of collateralized financing efficiency will inherently be an underestimate, and will not reflect the full economy involved that would otherwise include the lower costs of internal sources of funds as well as the economization of capital and liquidity.

To arrive at this figure, we approximate the total stock of collateral held as the sum of the collateral received in relation to secured transactions reported in the footnotes of firms' SEC filings and the cash and financial instruments owned that appear on-balance-sheet. Notably, we do not include intangible assets, traditional loans, and certain investments (such as investments in subsidiaries) in the total stock of collateral, as these are not typically pledged as collateral for secured transactions.

Additionally, the linkage between the collateral record and the balance sheet is ambiguous, in particular, as it relates to cash. We expect that cash received in relation to derivatives or other secured transactions would appear both on the collateral record and the balance sheet; however, current disclosures do not provide enough detail to distinguish the overlap. Therefore, we approximate the potential range of total collateral received, using a lower bound that excludes on-balance-sheet cash (unsegregated and segregated) and an upper bound that includes all on-balance-sheet cash. Separately, and later in this article, we examine the net receipt of cash collateral in relation to OTC derivatives. Again, we restrict our view to Goldman Sachs, Merrill Lynch, and Morgan Stanley—the most comparable banks.

Chart 5 illustrates the trend of total assets (blue area) and our estimated range of the total collateral stock (blue band). Empirically, we can observe that dealer banks tend to generate stocks of collateral in excess of their total balance sheet during periods of stable market conditions, although this spread contracts acutely in response to market disruption. The stock of collateral for our sample firms peaked in 2008:Q1 at approximately $3.9 trillion–$4.2 trillion in notional terms (116–125 percent when measured relative to total on-balance-sheet assets). That is, the firms extended financing to customers in excess of their on-balance-sheet reported lending by approximately 16–25 percent.

In 2009:Q1, the stock of total collateral fell to $2.0 trillion–$2.2 trillion, or 92–103 percent of total on-balance-sheet assets. The drop in the total stock of collateral outpaced balance sheet deleveraging in both notional and percentage terms, falling $1.9 trillion–$2.0 trillion, or 47–50 percent, versus a $1.2 trillion, or 38 percent, decline in total on-balance-sheet assets—a fact that illustrates the outsized effect of deleveraging on the collateral record.

Balance-sheet declines understate the amount of contraction in secured financial activity for dealer banks, and the collateralized financing efficiencies exploited by dealer banks disappear rapidly during periods of stress. This disparity between the net economic claims or obligations on-balance-sheet and the gross collateral flows is an important concept, particularly when collateral sources and uses are allocated across different customers or a customer and the dealer bank. Dealer banks, in an effort to preserve their franchise, do not necessarily unwind positions on a net basis. Recall that deleveraging can occur asymmetrically, resulting in large funding gaps in the interim.

The average collateral stock as a percentage of total assets was between 118 and 125 percent between 2005 and 2010; this number fell in the 2010-12 period to 107–116 percent. Two reasons for this decrease in firms' collateral efficiency and collateralized financing efficiency likely relate to increased regulatory restrictions and increased risk aversion by dealer counterparties.

First, there have been several proposed regulatory changes that indirectly limit the levels of collateral rehypothecation. Recent liquidity regulations, such as the proposed Liquidity Coverage Ratio (LCR), could reduce these levels by requiring dealer banks to hold a buffer of unencumbered high-quality liquid assets as a reserve against short-term market and idiosyncratic liquidity risk in the future. Additionally, recent rules from the Commodity Futures Trading Commission would require that the execution and clearing of standardized swap contracts be shifted to central counterparties. These changes might decrease the stock of rehypothecatable collateral held by dealer banks for two reasons: 1) it may disintermediate dealer banks as market participants interact directly through the central counterparty or exchange and 2) it will likely concentrate a pool of collateral at the central counterparty, reducing the overall supply of collateral held by dealer banks. Proposals for an international supplemental leverage ratio would also indirectly limit the extent of rehypothecation, in particular, in terms of matched-book activity. Industry commentary suggests that the proposed rules discourage the use of matched-book repo, in particular reducing incentives for the use of repo backed by highly liquid securities. Additionally, the SEC has proposed placing new requirements on the segregation of collateral received in relation to centrally cleared "security-based" swaps, which could, on net, reduce levels of dealer rehypothecation. The Financial Stability Board and the European Commission have also countenanced the idea of outright constraints on rehypothecation, although these proposals are much further from tangible implementation.

Second, risk-averse dealer counterparties may be placing increased contractual limits on collateral rehypothecation to mitigate counterparty risk exposure.

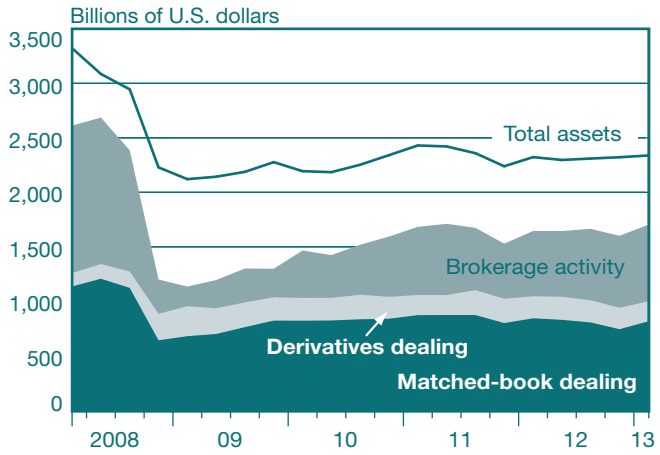
## 4.3 Composition Analysis

We now attempt to decompose the stock of collateral received in relation to secured activities into its component pieces, linking them where possible to our stylized framework. This view cannot fully explain the "collateralized financing efficiency" or the extent of matched financing that takes place between the sources and uses of collateral; however, it reflects a perspective of all sources of collateral received, including their relative materiality and durability. Chart 6 shows this decomposition of the stock of collateral received, which excludes financial instruments owned, into collateral received from reverse repo and securities borrowing (dark blue area), derivatives dealing (light blue area), and brokerage activities (blue area).

### *Estimates of Collateral Received by Activity*

For this chart, we attempt to estimate the amount of collateral received in connection with reverse repo and securities borrowing transactions using the total amount reported on the firms' balance sheets. However, because of the collateralized financing efficiencies discussed earlier, the balance-sheet number will severely underestimate the actual amount of collateral received in such transactions, as this proxy does not account for counterparty netting or haircuts, when lenders ask

Chart 6
Collateral Received from Specific Activities and Total Assets




Source: Company 10K/10Q filings; includes GS, MS, and ML.

Table 4
2013:Q1 Disclosures from Morgan Stanley, Goldman Sachs, and Merrill Lynch

| | | Amount | |
|---|---|---|---|
| | | Billions of Dollars | Percent |
| Total collateral received | | 1,702 | 100 |
| From: | Reverse repo/securities borrowing reported on balance sheet | 816 | 48 |
| | Reverse repo/securities borrowing counterparty netting under U.S. GAAP | 268 | 16 |
| | Derivatives cash collateral netting under U.S. GAAP | 184 | 11 |
| | Derivatives other collateral | 27 | 2 |
| | Remaining residual amount | 407 | 24 |

borrowers to pledge collateral in excess of the value of the secured transaction. This omission is sizable; as of August 2013, median haircuts in the U.S. tri-party repo market ranged from 2 percent for U.S. government and agency securities to 8 percent for some noninvestment-grade securities.

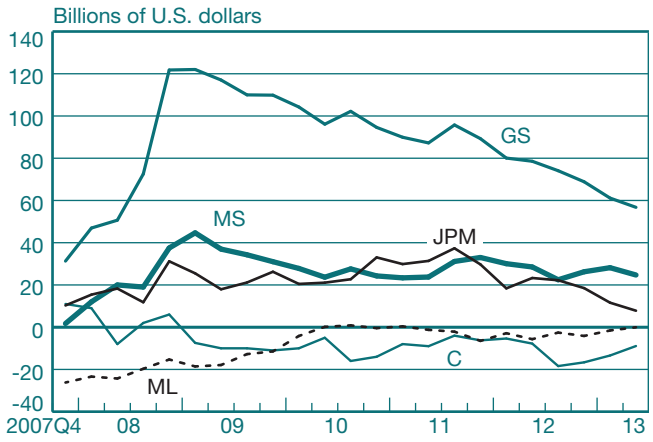
In addition, as described earlier, U.S. GAAP allows dealer banks to net down all secured funding transactions with a single counterparty. Recent disclosures by dealer banks provide us with insight into the magnitude of this divergence between the firms' collateral record and the size of their balance sheets because firms have begun reporting netting amounts. As of 2013:Q1, counterparty netting reduced the amount of reverse repo and securities borrowing reported on-balance-sheet by $268 billion, which is approximately 16 percent of the total stock of collateral received (Table 4). In sum, this proxy estimates all collateral received from reverse repo and securities borrowing transactions, a portion of which will be delivered into repo and securities lending transactions to form a "matched book."

Additionally, the amount of collateral received in connection with derivatives transactions is reported directly by our sample of dealer banks, but this number only includes cash collateral received that qualifies for netting treatment under U.S. GAAP. This proxy will also underestimate the actual collateral received from derivatives, since dealers receive cash collateral that does not qualify for netting as well as noncash collateral. Again, more recent disclosures from our sample of banks show that about $27 billion of other collateral is received in connection with derivatives, or about 2 percent of the total stock of collateral received (see Table 4). A section below furthers expands upon cash collateral received from derivatives transactions.

The amount of collateral received from brokerage activity is estimated as the total amount of collateral received less the amounts attributed to matched-book dealing and derivatives. This will include collateral received from margin lending, of which a portion was likely delivered into customer or firm short positions, or "internalized." However, this residual balance will also include the amount of residual error resulting from the proxies used above, or specifically the amount of counterparty netting for repo/reverse repo transactions, aggregate repo haircuts, and the amount of cash and noncash collateral received from derivatives that does not qualify for netting under U.S. GAAP. This is reported in Table 4 to amount to $407 billion, or 24 percent of the total collateral received by the dealer banks, indicating that margin and securities lending and other brokerage activities are a powerful source of collateralized financing efficiency for the dealer banks.

Prior to the crisis, brokerage activities contributed the majority of collateral to the total stock received, with reverse repo and securities borrowing contributing a close second (see Chart 6). At the height of the crisis and around the point of Lehman's failure, our sample of dealer banks were all deleveraging at a breakneck pace. As observed in Charts 3 and 5, this entailed major reductions in assets and wholesale secured liabilities. We highlight above how this had an outsized effect on the stock of collateral as reported on the collateral record. Chart 6 attempts to attribute that contraction to the various

Chart 7
Net Derivatives Cash Collateral Position




Source: Company 10K/10Q filings.

activities of the dealer banks. Gorton and Metrick (2012) and Duffie (2011) discuss the runs occurring in dealer banks, with Gorton and Metrick focusing specifically on repo runs. Our analysis suggests that there may also have been runs affecting margin and securities lending, and brokerage services, in addition to those on repos.

Based on our approximations, the collateral received in relation to brokerage activities collapsed dramatically in a remarkably short time frame, accounting for most of the aggregate decline. This may suggest that prime brokerage clients were selling assets or closing out short positions in an attempt to withdraw funds and limit credit exposure to the dealer banks. At its most severe, this likely would result in a significant loss of internalization, as discussed through our stylized framework. At a minimum, it implies that the collateral financing efficiencies obtained by dealer banks are fleeting, and that they can disappear during a period of severe market disruption.

### *Cash Collateral in Relation to OTC Derivatives*

Cash collateral received in relation to derivatives transactions exceeds that posted for most of the dealer banks in our sample. For derivatives collateral, we can now expand our sample of firms to include Citigroup and J.P. Morgan Chase, as the reporting conventions are more homogenous among the five banks. In Chart 7, we see that the dealer banks, especially Goldman Sachs, typically receive in cash much more from derivatives counterparties than the amount they post to their counterparties. This excess cash usually earns a short-term money market rate for the counterparty that posted it, and so to the extent that it can be rehypothecated, represents a very low-cost source of funding for the dealer banks.[15] Chart 7 shows that derivatives cash collateral is a significant source of low-cost funding for the largest OTC derivatives dealer banks.

The time series of net derivatives cash collateral position shows a trend that is significantly at odds with the reductions in collateral received with the other dealer bank activities during the financial crisis. In Chart 7, we see that during the crisis period, the levels of net funding generated from derivatives activities actually increased. A closer look at individual firms reveals that Goldman Sachs was by far the primary beneficiary, but that Morgan Stanley and J.P. Morgan also benefited. While this is at first blush surprising, it reflects a broad shift toward increased collateralization in the wake of the failure of Lehman Brothers, and the near-failure of AIG may underlie these figures. In other words, the prior deficiencies in collateralization of derivatives positions may have been corrected as the crisis developed.

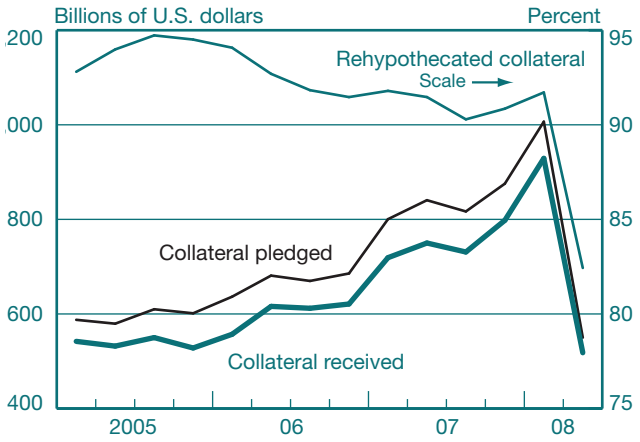
### *Performance under Severe Duress: A Lehman Brothers Case Study*

The asset and liability perspectives both highlight how the financing and collateral efficiency and the gross stock of rehypothecatable collateral evaporate during a period of market stress; however, in this case Lehman serves as a more targeted example. Although data limitations prevent a similar asset and liability analysis, we can observe changes in Lehman's levels of collateral pledged, collateral received, and the percentage of collateral received that had been rehypothecated. Depicted in Chart 8, all levels fell dramatically between 2008:Q1 and 2008:Q2, presumably surrounding the market turmoil related to J.P. Morgan's acquisition of Bear Stearns. Of note, these levels declined well in advance of Lehman's actual failure, with the last disclosure as of May 31, 2008. Additionally, Lehman's levels of rehypothecation were elevated relative to the rest of our sample at 92 percent in 2008:Q1 versus an average of 83 percent, which may have contributed to its downward spiral of deleveraging and asset fire sales.

[15] As discussed above, it is not fully clear in the financial reporting of the dealer banks whether cash is included or excluded from the collateral record. As a result, in the collateral record it is not clear if cash collateral is always included. That is why we provide the range of possible collateral in Chart 3, in one case excluding from the collateral record the derivatives cash collateral figures reported below. Consequently, one should not necessarily conclude that the net derivatives cash position reported in Chart 7 is an additional collateralized financing efficiency, over and above that reported in Chart 3.

Chart 8

Lehman and the Collateral Record in the Run-Up to Collapse




Source: Company 10K/10Q filings.

## 5. Conclusion

The economies of the activities undertaken by dealer banks relate intrinsically to the way these banks source and use collateral. In this article, we describe three types of activities—matched-book financing, internalization, and derivatives collateral received in excess of posted—that allow dealer banks to reap efficiencies by reusing collateral provided by customers. Additionally, we discuss how netting accounting rules, excess collateralization, cheaper internal sources of cash and securities, and other collateral efficiencies allow them to finance customer demands in excess of their own liabilities. We attempt to measure these sources using publicly disclosed data in 10-Q and 10-K filings, illustrating how these sources of financing have evolved over time, including during the financial crisis of 2007-09. The data reveal that, while efficient in normal times, such financing drastically and abruptly dries up during times of financial stress.

In particular, we describe two types of efficiencies gained by dealer banks: collateral efficiency and collateralized financing efficiency. First, dealer banks realize "collateral efficiencies" by rehypothecating collateral they have received from their customers. This ability to rehypothecate collateral allows them to "internalize" their sources of collateral and cash, finding uses for them among their other customers, or for their own trading. Collateral efficiency is likely related to the scale of the dealer bank's activity and the distribution of securities pledged as collateral by its customers. Second, dealer banks reap "collateralized financing efficiencies," which allow them to engage in a larger amount of collateralized lending than is reported on their balance sheets. A dealer bank's collateralized financing efficiency is related to the amount of netting allowed by U.S. and international accounting standards; the accounting treatment of brokerage activities, such as shorts; the differential between the cost of internal sources of funding and external ones; and the fees/income earned on lending activities. To determine the level of a firm's collateralized financing efficiency, an analyst must consult the collateral record of the banks, which is embedded within the text of firms' 10-Q and 10-K reports.

Unsurprisingly, we find that the experience of the financial crisis was especially troubling for dealer banks. The collateral they had received from customers disappeared when customers exited positions that the dealer bank had financed. Because dealer banks had heavily utilized the customer-provided collateral, they were forced to source collateral and cash externally to manage and meet their obligations at the same time that markets were most disturbed. Notably, the dealer banks' brokerage receivables were most affected by the crisis, plummeting significantly more than the firms' other sources of collateral and much more than the balance sheet assets of the firms. This likely is the result of the significant moves in markets, including the equity markets, which at the height of the crisis led customers to exit leveraged bets (such as margin loans) on those markets as quickly as possible. The dealer banks were heavily exposed to this source of risk in their financing profile. In contrast, the dealer banks received more collateral in connection with derivatives during and after the financial crisis. This likely reflects a widespread undercollateralization of derivative positions prior to the crisis, as well as a renewed focus on counterparty credit risk during the crisis as many dealer bank counterparties experienced credit rating downgrades.

Our observations raise the question of whether the risk of dealer financing, which is more comprehensively, although still imperfectly, reflected in a bank's collateral record than in its balance sheet, is managed appropriately. That the amount of financing extended by dealer banks, as measured by the collateral record, fell further and more swiftly than the amount measured by the banks' balance sheets suggests that a prudent risk management framework would acknowledge the risks inherent in collateralized finance, and allocate both capital and liquidity to be available to address any shortfalls that would arise in a risk event. Our observations reflect the fact that reputational and other economic considerations provide incentives to dealer banks to roll over one side of a customer's trade, while the other side is extinguished, which brings the exposure on-balance-sheet. Accounting netting in this case does not reflect true economic netting of risk exposures. This line of reasoning leads us to suggest that the recent consulta-

tive document of the Basel Committee on Bank Supervision (2013) that outlined a revision to the Basel III leverage ratio framework which, when measuring securities financing transactions, excludes any recognition of accounting netting, may be warranted as a measurement approach.[16] We do not advocate that a binding leverage requirement for capital should be applied, as this would essentially equalize the risk weights for different types of risk exposures, opening the window for dealer banks to increase the risk of their positions while not increasing their required regulatory capital.[17] However, some capital and liquidity charge (as, for example, is the case with the Liquidity Coverage Ratio) for financing transactions that are currently subject to accounting netting treatment, and are therefore off-balance-sheet, does seem warranted.

Our measures of collateral and collateralized financing efficiencies have declined in the aftermath of the financial crisis. That trend likely reflects some greater regulatory limitations on collateral rehypothecation, and some greater restrictions put in place by customers on the reuse of their collateral. Nonetheless, the size and importance of the financing and collateral efficiencies we describe in this study remain large for the dealer banks.

It is important to acknowledge the limitations of the data used in this study, which reflect the inadequate reporting requirements for collateral used by dealer banks. More regular, frequent, and standardized public disclosures on asset encumbrance—including the level of unencumbered assets relative to unsecured liabilities, overcollateralization levels, and received collateral that can be rehypothecated—would allow for more reliable measurements of these activities. Such data could provide a fuller picture of the financial condition and vulnerabilities of dealer banks.

[16] Note that this is also the approach taken by the Liquidity Coverage Ratio, which requires the reporting of gross contractual obligations for secured transactions that mature within the thirty-day period. This is impactful for the collateral swap/optimization trades we discuss in the context of matched book, which allow the dealer to transform its collateral profile without expanding its balance sheet. Under circumstances where dealers exchange less liquid collateral for highly liquid collateral, they must hold liquidity in an amount equivalent to the difference in stressed run-off rates applied to each class of collateral. Furthermore, in case of cash brokerage internalization, the Liquidity Coverage Ratio requires liquidity to be held for instances where offsetting customer-to-customer or customer-to-firm exposures are used to finance one another.

[17] Darrell Duffie makes this point most clearly in his October 13, 2013, Brookings Institution presentation, "Capital Requirements with Robust Risk Weights."

# Data Appendix

In our study, we choose to focus on data from firms' 10-Q/10-K filings to examine dealer banks' financing transactions. The 10-Q balance sheet data are firm specific and consolidated at the bank holding company level, which include U.S. and U.K. broker-dealer subsidiaries. However, as we discuss in the study, using 10-Q/10-K data restricts which firms we can analyze; of the major OTC derivatives dealers, only three institutions report their balance sheet and collateral record in a consistent way.

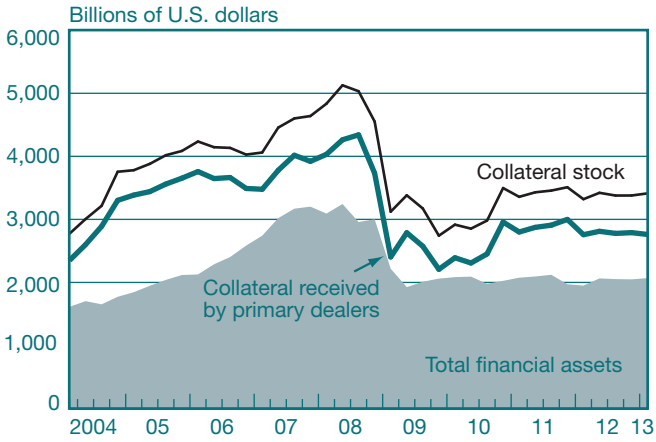
There are other data sources that potentially offer similar insights, namely, the Federal Reserve Board's Flow of Funds data and the Federal Reserve Bank of New York's data on primary dealers. In this appendix, we describe the advantages and disadvantages of these alternative data sources and offer a robustness check for some of our main findings.

The Flow of Funds data aggregate all broker-dealer quarterly balance sheets from their FOCUS regulatory submissions to the SEC and provide industry-wide data on those activities of dealer banks. However, the Flow of Funds data are inadequate for our analysis in four respects. First, U.K. broker-dealer subsidiaries of U.S. bank holding companies are not included in the Flow of Funds data. This omission could have a sizable effect on the balance-sheet data since the U.K. dealer banks are particularly large prime brokers and are not bound by SEC rules 15c3-3, allowing them to rehypothecate securities to a larger extent than their U.S. counterparts. Second, the Flow of Funds only reports a combined number for repurchase agreements and federal funds, and this number represents a "net" amount, that is, total fed funds and repo borrowing less fed funds and repo lending. Third, the Flow of Funds does not offer data on firms' collateral sources and uses, such as collateral received or pledged by the dealer. Fourth, the Flow of Funds does not report firm shorts, that is, securities sold but not yet purchased. As a result, we can only proxy one component of our stylized framework—the stylized balance sheet—using the Flow of Funds, and we cannot isolate all the components of dealer banks' secured funding or proxy the sources of dealer banks' collateral received.

The Federal Reserve Bank of New York provides at a weekly frequency aggregate data on primary dealers' positions, financing, and settlement activities across asset classes, collected from their FR 2004 regulatory filings. Financing data are split into two categories that together represent a view of the collateral record: securities received as collateral by the dealer from its counterparties ("securities in") and securities pledged by the dealer as collateral ("securities out"). This includes collateral received and pledged in connection with securities lending, repurchase agreements, and margin loans,

Chart A1

Collateral Received Compared with Total Financial Assets




Sources: FR 2004 Financing Data for Primary Dealers; Flow of Funds Data for Securities Brokers and Dealers.

and is reported on a gross basis. Additionally, the FR 2004 data report the portion of securities pledged and received in connection with repos and reverse repos, which is a useful proxy for dealers' matched-book transactions. However, these data exclude collateral received and pledged in connection with derivatives activity and do not distinguish between firms' own collateral that was pledged and collateral received that the dealer rehypothecated. As a result, the FR 2004 data underestimate collateral pledged/received and preclude any measure of dealers' "collateral efficiency" as we have defined it. Additionally, like the Flow of Funds data, the FR 2004 data exclude financing activities of U.K. broker-dealer subsidiaries of U.S. bank holding companies.

Though these data are limited for the reasons described above, they do allow for a rough check for some of our main conclusions. We combine Flow of Funds balance sheet data for U.S. broker-dealers with FR 2004 data describing the primary dealers' quarter-end collateral record to obtain a time-consistent series.[18]

Chart A1 confirms that dealers generate stocks of collateral in excess of their balance sheet (see the similarity to Chart 5

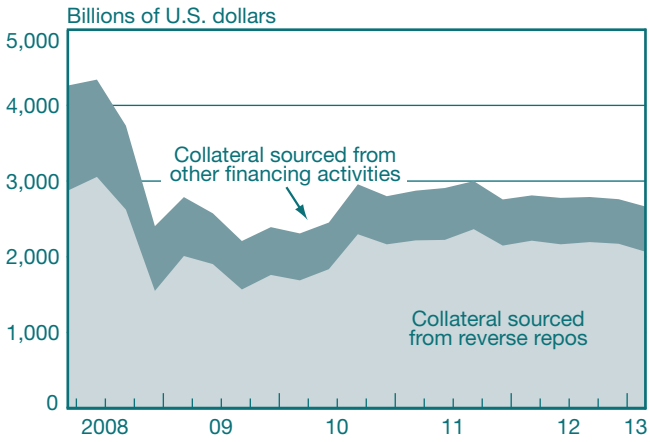
[18] We recognize that these data sources cover different populations and, unlike the sources we use in the study, do not cover collateral associated with derivatives.

in our study). We proxy the collateral stock by taking the sum of the primary dealers' "Securities In" (from the FR 2004) and dealer banks' credit market instruments owned (from the Flow of Funds); here, we measure the balance sheet using broker-dealers' total financial assets (from the Flow of Funds). The drop in the collateral stock greatly exceeds that of the balance sheet during the crisis, suggesting that balance-sheet declines do not fully reflect the reduced provisioning of secured financing by the dealers. The collateral stock peaked at $5.1 trillion in 2008:Q1 and subsequently fell 46 percent (or $2.3 trillion) to a trough of $2.7 trillion in 2009:Q3. In contrast, the balance sheet dropped from $3.2 trillion in 2008:Q1 to $2 trillion in 2009:Q3, representing a fall of 36 percent (or $1.2 trillion). In sum, these data indicate that dealers' collateralized financing efficiencies can vanish precipitously during periods of market disruption.

It is important to note that these two data sources represent different samples, with the Flow of Funds representing all U.S. broker-dealers and the FR 2004 data representing just primary dealers, a subset of the total industry. This means our measure of the dealers' balance sheet encompasses the entire (domestic) broker-dealer industry, while our measure of the collateral stock only includes the primary dealers. It is likely that the collateralized financing activities are concentrated at the largest broker-dealers, and so the primary dealers' collateral record could be expected to represent the vast majority of all dealer banks' collateral received. That said, our measure of the collateral stock would tend to underestimate the total for all broker-dealers, meaning that the level of the collateral stock for all broker-dealers would be even higher and thus more in excess of the broker-dealers' aggregate balance sheet. This result, then, would likely be even stronger with aggregate collateral record data from the full broker-dealer industry.

Chart A2 plots the composition of the collateral received by primary dealers as is reported in the FR 2004. These data confirm the significant contraction in matched-book and other sources. Additionally, and perhaps more importantly, "other sources" declined as a percentage of total collateral received. These observations are consistent with the firm-specific data from the SEC disclosures we present in Chart 6 in the study, and indicate that both brokerage activities and matched-book dealing were significant sources of dealer collateral precrisis, and that both of these activities plunged dramatically during the crisis, along with total collateral received. In contrast to Chart 6, Chart A2 attributes a larger portion of total collateral received to matched book. This could be a result of accounting idiosyncrasies of the FR 2004; for example, primary dealers may have included collateral received in connection with other secured transactions (such as margin loans) with that sourced from reverse repos in their FR 2004 reports.

Chart A2
Collateral Received by Primary Dealers ("Securities In")




Source: FR 2004 Financing Data for Primary Dealers.

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Phoebe White and Tanju Yorulmazer

# Bank Resolution Concepts, Trade-offs, and Changes in Practices

- As the 2007-08 financial crisis demonstrated, the failure or near-failure of banks entails heavy costs for customers, the financial sector, and the overall economy.
- Methods used to resolve failing banks range from private-sector solutions such as mergers and acquisitions to recapitalization through the use of public funds.
- The feasibility and cost of these methods will depend on whether the bank failure is idiosyncratic or part of a systemic crisis, and on factors such as the size, complexity, and interconnectedness of the institution in distress.
- This study proposes a simple analytical framework—useful to firms and regulators alike—for assessing these issues and determining the optimal resolution policy in the case of particular bank failures.

## 1. Introduction

During the recent crisis, some of the world's largest and most prominent financial institutions failed or nearly failed, requiring intervention and assistance from regulators. Measures included extended access to lender-of-last-resort facilities, debt guarantees, and injection of capital to mitigate the distress.[1]

Chart 1 shows some of the largest financial institutions that failed and/or received government support during the recent crisis. As we can see, these institutions were large and systemically important. For example, for a brief period in 2009, Royal Bank of Scotland (RBS) was the largest company by both assets and liabilities in the world. Table 1 summarizes the interventions and resolutions of major financial institutions that experienced difficulties during the recent crisis. The chart and the table indicate the extraordinary levels of distress throughout the system and the unprecedented range of actions taken by resolution

[1] For a discussion of the disruptions and the policy responses during the recent crisis, see Yorulmazer (2014).

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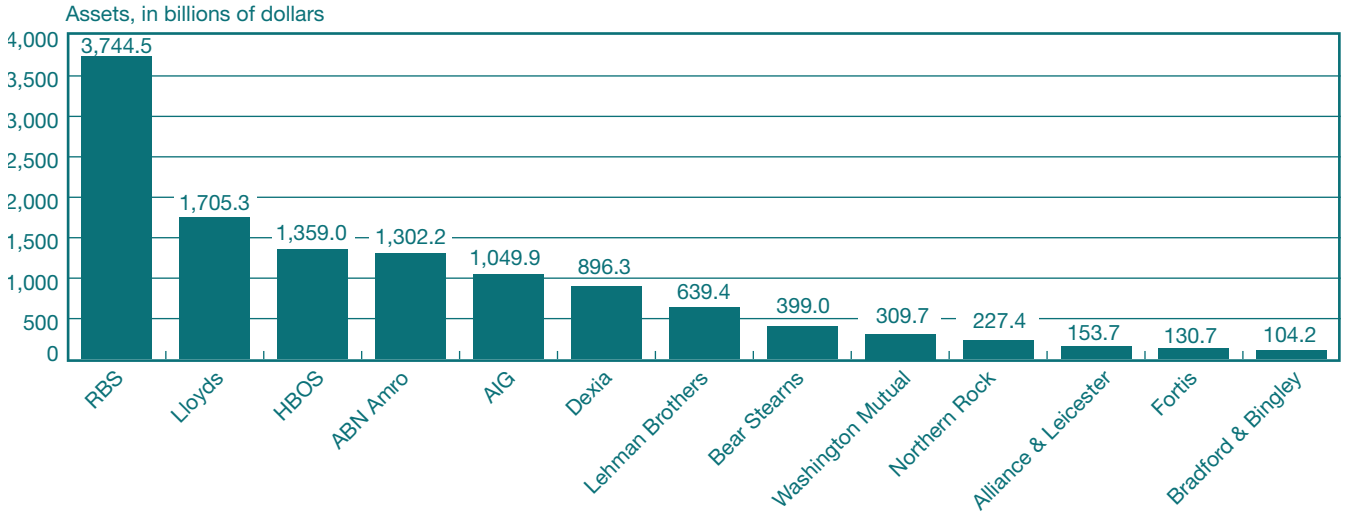
The authors thank Hamid Mehran and seminar participants at the Federal Reserve Bank of New York and the Dutch National Bank for very helpful comments. The views expressed in this article are those of the authors and do not necessarily represent the position of the Federal Reserve Bank of New York or the Federal Reserve System.

Chart 1

## Some of the Largest Institutions that Failed and/or Received Government Intervention during the Recent Crisis




Source: Public filings as of period before resolution.

authorities, since many countries lacked an efficient framework for resolving large and systemically important financial institutions (SIFIs).

In the United States, prior to the passage of the Dodd-Frank Wall Street Reform and Consumer Protection Act, insolvent nondeposit-taking institutions were dealt with under the Bankruptcy Code, as opposed to the special resolution regime administered by the Federal Deposit Insurance Corporation (FDIC). Chart 2 shows the largest corporate bankruptcies in U.S. history; Lehman Brothers was by far the greatest. In the absence of an orderly resolution regime, the failure of Lehman led to unprecedented disruptions in financial systems globally. While many counterparties to Lehman suffered direct losses, others experienced distress owing to information contagion and fire-sale externalities from a sell-off in assets.

One of the most significant effects was on the money market mutual fund industry, where the Reserve Primary Fund, the oldest money market fund, "broke the buck" because of its exposure to Lehman Brothers debt securities and had to be liquidated, marking only the second such episode in history. This event led to a run on the money market mutual fund industry, a development that adversely affected the shadow banking industry.[2] Regulators attempted to contain the disruptions in financial markets with extraordinary interventions including capital injections, debt guarantee programs, and many lending facilities.

Financial intermediaries and banks perform important roles for the efficient functioning of the economy, such as channeling funds from savers to investors and providing payment services, and their liquid liabilities can act as money. As a result, failure of these institutions can pose significant disruptions, and corporate bankruptcy may not be the

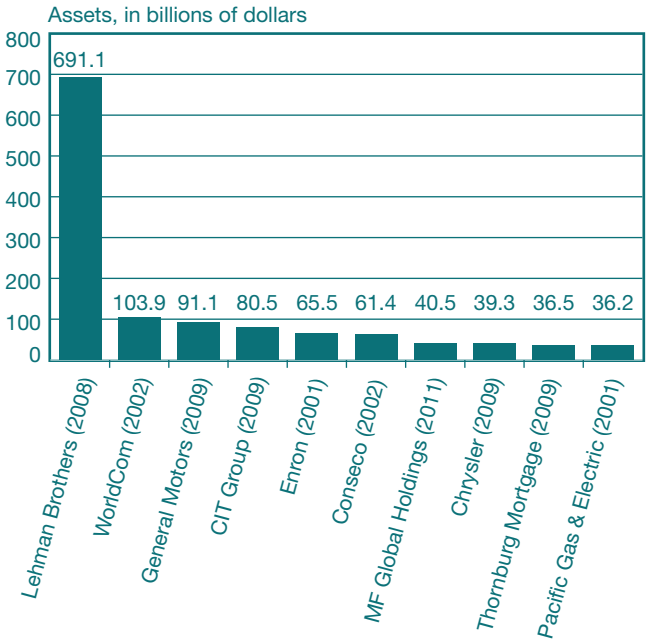
[2] On September 19, 2008, the Federal Reserve announced the institution of the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF). The AMLF provided nonrecourse loans to commercial banks to purchase eligible asset-backed commercial paper from money market mutual funds (MMFs). The U.S. Treasury also provided a temporary guarantee on the share price of MMFs through the Temporary Guarantee Program for Money Market Funds and the Federal Reserve announced another lending program, the Money Market Investor Funding Facility (MMIFF), as a complement to the AMLF intended to provide nonrecourse loans to money market funds. However, no loans were made under the MMIFF. The facility was closed on October 30, 2009.

Table 1

## Major Interventions and Resolutions during the Recent Financial Crisis

| Institution | Date | Resolution Method/Support |
|---|---|---|
| ABN Amro | October 2007 | The private acquisition by a consortium consisting of the Royal Bank of Scotland (RBS), Banco Santander, and Fortis marked the largest worldwide acquisition of a bank and the second largest European cross-border transaction. When Fortis and RBS ran into trouble, their holdings of ABN Amro's assets were nationalized by the Dutch and U.K. governments, respectively. |
| ING Group | October 2008 | Received a €10 billion capital injection from the Dutch government in exchange for securities and veto rights on major operational changes and investments. The injection was also conditional on ING divesting certain operations. |
| Fortis | September 2008 to May 2009 | The Netherlands, Belgium, and Luxembourg provided a capital injection of €11.2 billion on September 28, 2008, each taking a 49 percent stake in Fortis's banking operations in their respective countries. Fortis was sold in parts, with a majority stake sold to BNP Paribas on May 13, 2009. |
| Dexia | September 2008 | Dexia was recapitalized by the French and Belgian governments through a capital injection of €3 billion, and it received a state guarantee in order to regain access to wholesale funding markets. |
| Northern Rock | September 2007 to February 2008 | In September 2007, the Bank of England provided a liquidity support facility and government guarantee of certain liabilities. In February 2008, the bank was nationalized by the British government. |
| Alliance & Leicester | July 2008 | Private acquisition by Banco Santander for £1.26 billion |
| Bradford & Bingley | September 2008 | The U.K. government nationalized the institution on September 29, 2009, selling the savings unit and branches to Banco Santander. |
| HBOS | September 2008 to January 2009 | The terms of a takeover by Lloyds TSB were agreed to in September 2008. In October 2008, the U.K. Treasury injected new capital amounting to £17 billion, or a 43 percent equity stake in the combined Lloyds TSB and HBOS. In January 2009, HBOS was acquired by Lloyds TSB. |
| UBS | December 2007 to October 2008 | In December 2007, the bank received a capital injection from the Government of Singapore Investment Corporation. In October 2008, UBS sold CHF 60 billion of its troubled assets to a special purpose vehicle acting as a "bad bank" entity, a transaction that was funded by a CHF 6 billion capital injection from the Swiss government and a CHF 54 billion loan from the Swiss National Bank. |
| Anglo Irish Bank | January 2009 | Nationalized when the Irish government determined that recapitalization would not be enough to save the bank. |
| Allied Irish Bank | February 2009 | Received capital injection of €3.5 billion |
| Bank of Ireland | February 2009 | Received capital injection of €3.5 billion |
| Bankia SA | May 2012 | Bank was partly nationalized through a €19 billion recapitalization by Spain. |
| Bear Stearns | March 2008 | The bank was sold to JPMorgan Chase with assistance from the Federal Reserve in the form of a nonrecourse loan of $29 billion. |
| Lehman Brothers | September 2008 | Lehman filed for chapter 11 bankruptcy. It was the largest bankruptcy filing in U.S. history. |
| AIG | September to November 2008 | On September 16, 2008, the Federal Reserve extended a credit facility of $85 billion, secured by stock in the form of warrants for a 79.9 percent equity stake. The loan was restructured in November in coordination with the U.S. Treasury, which extended the facility and lowered its rate. AIG also received $40 billion in a capital injection under the Troubled Asset Relief Program (TARP). |
| Washington Mutual | September 2008 | On September 25, 2008, Washington Mutual was seized by the Office of Thrift Supervision and placed in receivership with the Federal Deposit Insurance Corporation. The banking subsidiaries were sold through purchase and assumption to JPMorgan Chase, while the holding company filed for chapter 11 bankruptcy. |
| Citigroup Incorporated | October 2008 to January 2009 | Received two capital injections through TARP: $25 billion in October 2008 and an additional $20 billion in January 2009. Also in January 2009, Citigroup separated its core and noncore assets in a good bank–bad bank split (Citicorp and Citi Holdings). |
| Wells Fargo & Company | October 2008 | Received $25 billion capital injection under TARP |
| State Street Corporation | October 2008 | Received $2 billion capital injection under TARP |
| Bank of America Corporation | October 2008 to January 2009 | Received two capital injections through TARP: $25 billion in October 2008 and an additional $20 billion in January 2009 |
| JPMorgan Chase & Company | October 2008 | Received a $25 billion capital injection under TARP |
| Morgan Stanley | October 2008 | Received $10 billion capital injection under TARP |
| Goldman Sachs Group | October 2008 | Received $10 billion capital injection under TARP |
| Bank of New York Mellon | October 2008 | Received $3 billion capital injection under TARP |
| Wachovia | September 2008 | The Federal Reserve provided Citigroup with liquidity to aid in purchase of Wachovia. Ultimately, the bank was acquired by Wells Fargo. |

Chart 2
Largest Public Company Bankruptcy Filings
1980–Present




Source: BankruptcyData.com.

appropriate resolution regime.[3] Hence, authorities use various methods to resolve failed banks, ranging from full or partial private-sector resolution methods, such as the sale of a bank to a healthy bank via merger and acquisition (M&A), the transfer or sale of all or parts of the assets and liabilities to another bank via purchase and assumption (P&A), or government intervention using public funds to recapitalize banks.

This paper provides a discussion of the costs associated with different resolution methods. Furthermore, we provide a simple framework to analyze the optimality of resolution methods. We show that private resolution methods, such as M&A and P&A, are preferred options since they minimize the costs associated with bank failures and their resolution.

The availability of resolution options depends on the characteristics of the failed bank. For example, when the losses in the failed bank are large, there may not be a ready buyer for the bank without assistance. Furthermore, if the failed bank is large and complex or if failure occurs during a systemic crisis that causes many banks to experience distress, it may not be feasible to find a healthy bank to acquire the failed bank, and the regulators may need to employ alternative resolution methods such as liquidation or recapitalization. In this case, resolution is more challenging since it entails trade-offs between disruptions arising from a disorderly liquidation and the fiscal costs and moral hazard resulting from using public funds for recapitalization. Hence, regulators need to employ a "state-contingent" resolution policy that depends on whether failure occurs in an idiosyncratic failure state or in a systemic-crisis state.

Empirical evidence on the timing of bank failures suggests that failures are not uniformly distributed over time; instead, they are clustered. So when banks fail, they tend to fail together around the same time. Charts 3 and 4 show the number of failed banks in the United States and the size of their assets and deposits, respectively.

The pattern of bank-failure clustering in systemic crises makes the resolution of failed banks more challenging for authorities, since in such states of the world, the availability of preferred resolution options is limited, which is the primary theme of the article.

The article is organized as follows: Section 2 discusses the corporate bankruptcy regimes in the United States and the costs associated with bank failures and their resolution. Section 3 examines the resolution methods used by authorities. Section 4 discusses the trade-offs associated with resolution of failed banks and provides an analytical framework to develop an optimal resolution regime, which would depend not only on the failed institution itself, but also on its macro environment. Section 5 reviews recent steps taken by authorities to improve resolution regimes, and section 6 presents concluding remarks.

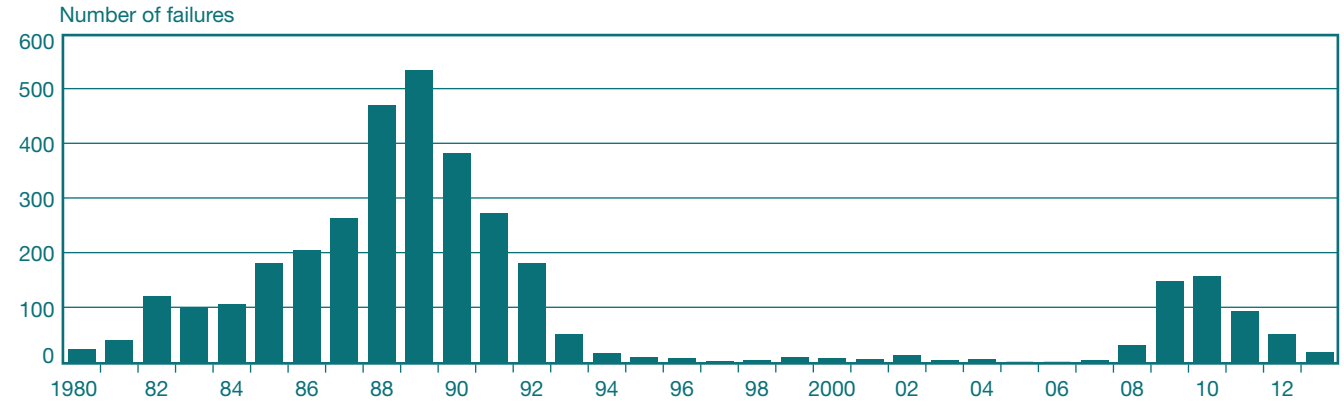
## 2. Bankruptcy Regimes and Costs of Bank Failures

In this section, we provide a brief summary of the corporate bankruptcy regime in the United States. Many aspects of corporate insolvency proceedings have proved problematic in the case of a bank failure, which we address in the subsequent discussion of costs.

Bankruptcy can be initiated voluntarily by the debtor or involuntarily by the petitions of creditors whose claims are in default. The initiation of the process automatically prevents (or "stays") creditors from collecting on their claims, therefore providing the bankruptcy court with time for review. Importantly, all creditors have "standing" to be

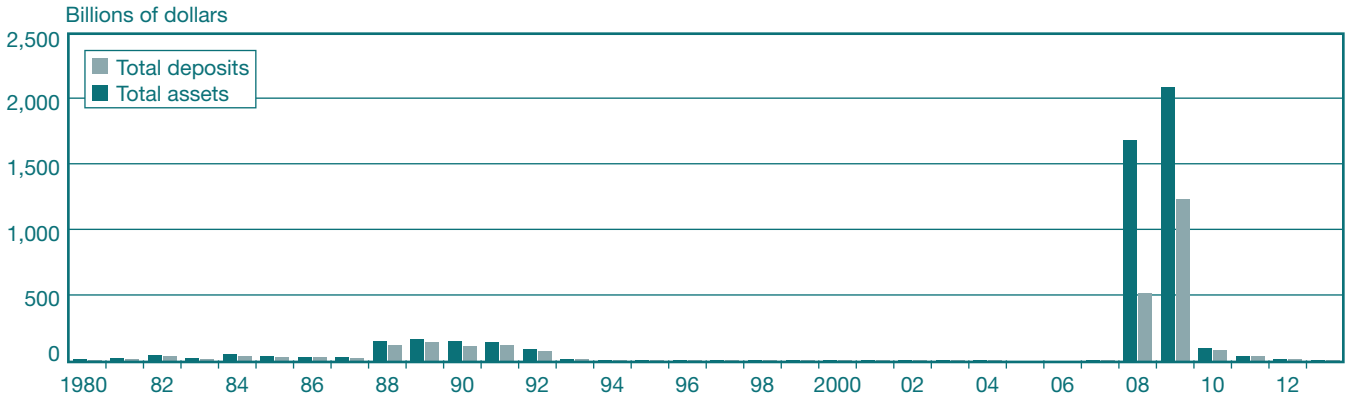
[3] Section 3 provides a discussion of the resolution methods used by authorities. DeYoung, Kowalik, and Reidhill (2013) highlight the importance of resolution technologies showing that the limited set of failed bank resolution technologies can leave regulators with little choice but to bail out systemically important banks.

Chart 3
Number of Bank Failures in the United States




Source: Federal Deposit Insurance Corporation.

Chart 4
Assets of Failed Banks in the United States




Source: Federal Deposit Insurance Corporation.

represented in the proceedings, and often their consent is required in a number of areas.

In the United States, two common forms of bankruptcy are Chapter 7 liquidation and Chapter 11 reorganization. In Chapter 7 liquidation, the firm is taken over by a receiver who liquidates the assets and distributes the proceeds to the creditors. Alternatively, in Chapter 11 reorganization, the firm's management typically acts as trustee and leads the creation of the reorganization plan, which must ultimately be approved by the creditors; otherwise, the parties can seek an alternative plan under a newly appointed trustee. The creditors are typically paid in securities of the reorganized firm. Furthermore, during the reorganization proceedings, the firm can arrange for debtor-in-possession (DIP) financing to continue operations.

In Chapter 7 liquidation, bankruptcy courts usually adhere to the priority schedule of claims, with secured creditors experiencing higher recovery rates on their claims than unsecured creditors. The priority of claims is more likely to be renegotiated, however, in the case of Chapter 11 reorganization.

Resolving a failed bank through general insolvency proceedings is difficult for a number of reasons. First, banks are characterized by significant financial fragility owing to their unique structure. Their liabilities are primarily composed of liquid deposits, redeemable at par, whereas their assets are usually long-term loans which are often illiquid. Bank assets are also typically less transparent, which would make DIP financing expensive or unattainable. Furthermore, as banks perform essential roles in the

functioning of financial markets and the economy, their failures can have considerable costs and externalities. Thus, the primary objective of a resolution regime should be to minimize these costs.[4] Prompt action, as opposed to the delayed and lengthy administrative bankruptcy process, is important for resolving these institutions effectively while maintaining public confidence.

Next, we explore in detail the costs associated with bank failures and their resolution. We put these costs into four broad categories: disruptions to the customers of the bank, disruptions to other financial institutions through contagion, fiscal costs associated with the resolution of failed banks, and distorted incentives and moral hazard.

## 2.1 Disruptions to the Failed Bank's Customers

On the asset side, banks have loans through which they channel funds from savers to the firms that invest in profitable projects. Firms that use bank financing and have an established relationship with their bank may find it difficult and costly to find other sources of financing when their bank fails.[5] On the liability side, banks have liquid liabilities that act as money. Therefore, a bank's failure can disrupt payment services for the depositors and creditors, resulting in significant welfare losses (Kahn and Santos 2005; Gorton and Huang 2004, 2006).

## 2.2 Contagion

The failure of a bank can have adverse effects on other banks and financial institutions. This contagion can arise through various channels such as direct exposures through interlinkages, information contagion, and fire-sale externalities, to list a few.

Banks and financial institutions in general have direct exposure to each other through borrowing and lending. When a bank fails, other institutions can experience direct losses (Allen and Gale 2000).[6] Furthermore, these losses can create distress for the affected institutions and may lead to their failure, resulting in knock-on effects and further rounds of failures and potential system-wide distress.

Another important channel through which a financial institution's difficulties can affect other institutions is created by information contagion, which occurs when creditors of other banks perceive the institution's difficulties as a negative signal about the health of their own bank (Chen 1999; Acharya and Yorulmazer 2008). While such actions can be a rational response of creditors, they can lead to "wrong runs" where even healthy institutions can experience a creditor run.[7] Such runs are more likely when financial institutions are opaque and when creditors do not have detailed information about the health of their financial institution.

As more prominently observed during the recent crisis, contagion can also arise through fire-sale externalities, where the sales of assets of the institution in distress can depress asset prices (Shleifer and Vishny 1992; Allen and Gale 1994, 1998) and the value of the assets of other institutions, thereby possibly triggering additional asset sales leading to a fire-sale spiral.[8]

## 2.3 Fiscal Costs

Resolution of failed banks is usually associated with fiscal costs that can arise from payments through a deposit

[4] For more discussion on costs associated with bank failures, see Bliss and Kaufman (2006) and Hüpkes (2004). On the resolution of failed banks, see Santomero and Hoffman (1998), Basel Committee on Banking Supervision (2002), Hoggarth, Reidhill, and Sinclair (2004), and Beck (2011), to cite a few.

[5] For a discussion of relationship banking, see Boot (2000) and the references therein.

[6] See also Leitner (2005). Rochet and Tirole (1996) provide a model where banks monitor each other (peer monitoring) through cross-holdings. A series of papers, Sheldon and Maurer (1998) for Switzerland, Furfine (1999) for the United States, Upper and Worms (2002) for Germany, Wells (2002) for the United Kingdom, and Elsinger, Lehar, and Summer (2006) for Austria, to cite only a few, provide empirical analyses of contagion through interlinkages. Nier et al. (2007) provide a theoretical model and simulation results to analyze contagion through interlinkages.

[7] Saunders and Wilson (1996) examine deposit flows in 163 failed and 229 surviving banks over the Depression era of 1929-33 in the United States. For the years 1929 and 1933, they find evidence of "flight to quality" where withdrawals from failed banks were associated with deposit increases in surviving banks. However, they observe a decrease in deposits in both failed and surviving banks for the period 1930-32. One possible explanation for these events is that the depositors may not have had accurate information about each bank and may have based their decisions on publicly available information, such as the overall state of the economy or even the number of recent bank failures. Therefore, imperfect information can lead to runs on healthy banks.

[8] Cifuentes, Ferrucci, and Shin (2005) simulate a model where banks are interconnected through cross-holdings and sales by distressed institutions depress the market price of assets. An initial shock may force some banks to liquidate some of their illiquid assets to satisfy the regulatory solvency constraints. Marking to market of the asset book can induce more asset sales, depressing prices further and inducing even more sales. Therefore, contagious failures can result from small shocks through asset prices.

insurance fund when available cash in the fund has been exhausted, from recapitalization of distressed banks, and from administrative costs associated with restructuring or liquidating the failed bank. These costs are exacerbated when governments need to intervene and come up with funds quickly; that is, immediacy can entail further costs.

The fiscal costs of providing funds with immediacy can be linked to a variety of sources, most notably: 1) the distortionary effects of tax increases and 2) the likely effect of government deficits on the country's exchange rate, manifested in the fact that banking crises and currency crises have often occurred in tandem in many countries (especially in emerging market countries). Ultimately, immediacy can result in further fiscal costs: Government expenditures and inflows during the regular course of events are smooth, relative to the potentially rapid growth of off-balance-sheet contingent liabilities, such as deposit insurance funds and the costs of bank bailouts.[9]

## 2.4 Incentives

During times of systemic crises regulators may feel compelled to provide assistance to banks that experience difficulties. This assistance may be in the form of access to lender-of-last-resort facilities, guarantees for the bank's debt, and capital injections. This safety net provided by regulators may create incentives for banks to take excessive risk, leading to moral hazard. Hence, during any regulatory intervention, the potential costs of moral hazard should be taken into account.

An important issue is that regulatory actions may entail time inconsistency, where ex ante regulators would like to be tough to prevent incentives for excessive risk-taking. However, during a systemic crisis, the costs associated with not assisting (such as the costs of liquidation) can be so high that regulators may feel compelled to provide help (Mailath and Mester 1994; Acharya and Yorulmazer 2007, 2008).

[9] See, for example, the discussion on fiscal costs associated with banking collapses and bailouts in Calomiris (1998). Hoggarth, Reidhill, and Sinclair (2004) find that the cumulative output losses have amounted to an astounding 15 to 20 percent of annual GDP in the banking crises of the past twenty-five years. Caprio and Klingebiel (1996) argue that the bailout of the thrift industry cost $180 billion (3.2 percent of GDP) in the United States in the late 1980s. They also document that the estimated cost of bailouts, as a share of GDP, were 16.8 percent for Spain, 6.4 percent for Sweden, and 8 percent for Finland. Honohan and Klingebiel (2000) find that countries spent 12.8 percent of their GDP to clean up their banking systems whereas Claessens, Djankov, and Klingebiel (1999) set the cost at 15 to 50 percent of GDP.

## 3. Resolution Methods

When a bank experiences difficulties or eventually fails, regulators use various resolution methods. A brief description of the widely used methods follows, with Table 1 providing examples of the various resolution methods used in the most recent crisis.

- *Mergers and acquisitions:* A bank that experiences difficulties can be acquired by a healthy bank. Even though the distressed bank may be approaching insolvency, it may still be an attractive target for other banks due to its franchise value, which derives from its customer base and established relationships. This private-sector resolution technique does not require any public-sector intervention or administration.
- *Purchase and assumption*: The failing institution enters receivership and its charter is terminated. In a P&A transaction, all or part of the bank's assets and liabilities are transferred to another institution. In the United States, the FDIC pays to the successor the gap in value between assets and liabilities transferred, and the receivership liquidates any assets not transferred. For example, Washington Mutual, after being placed in FDIC receivership, was sold through P&A to JPMorgan Chase in 2008 without government assistance.[10] While P&A is still a private-sector resolution, it may require the use of some public funds as we explain below.
- *P&A with assistance*: In an assisted P&A transaction, authorities provide guarantees, including loss-sharing agreements or put options to sell the assets back to the authority. An early and large transaction of this type in the United States took place in 1991, when the FDIC's resolution of Southeast Banking Corporation included a provision to reimburse acquirers for 85 percent of net losses on the acquired assets. More recently, the acquisition of Bear Stearns by JPMorgan Chase was facilitated by assistance from the Federal Reserve.
- *Bridge bank*: A new bank, called the bridge bank, is set up in order to maintain banking operations until a permanent solution can be implemented. Typically, only a portion of the assets would be transferred to the bridge bank, while the remaining assets would be passed to the receiver for liquidation. The ultimate aim is to sell the bridge bank through a P&A transaction. An example of this method was seen in the resolution of Bank of New England in 1991, when the FDIC created a bridge bank for each of Bank of New England's three subsidiary banks, all of which were ultimately sold to Fleet/Norstar Financial Group.

[10] While the Washington Mutual transaction was regarded as a private resolution, it has been argued that it would not have been successful without the receivership powers of the FDIC.

• *Good bank–bad bank separation*: The bank in distress is split in two: a "good bank" that retains the performing assets, and a "bad bank" that receives the remaining assets that would be restructured or liquidated. Often a trust or asset management company structure is used. This is a more general method that could also be used in conjunction with a restructuring and recapitalization. A good example is the resolution of banks during the Swedish Financial Crisis, which is discussed as a case study (see box).
• *Liquidation and deposit payoff*: In liquidation, the institution is closed and the assets are placed in a liquidating receivership. The liquidation value of the assets is used to repay creditors. In the United States, the FDIC pays insured depositors either directly or through an acquiring institution serving as a paying agent. An insured deposit payoff was used in the failure of Penn Square Bank, N.A., in 1982.[11] More than half of the bank's deposits were uninsured, including significant funds of other banks, which led to serious adverse effects on the banking industry.
• *Recapitalization*: The institution is kept open through public assistance. This can be done in a number of ways, including a restructuring, a "bail-in" that forces creditors to write off some of their claims, an outright nationalization in which shareholders are wiped out and management is replaced, or a capital injection in which shareholders are diluted but remain and management does not change.[12] Table 1 lists many examples of recapitalizations and capital injections from the recent crisis.

Each of the resolution options discussed comes with certain trade-offs and imposes, to varying degrees, some or all of the costs outlined previously. Furthermore, the availability and the relative costs of the resolution methods depend on the state of the world we are in (whether facing an idiosyncratic bank failure or a systemic crisis), and on factors such as the size, complexity, and interconnectedness of the institution in distress. In the next section, we provide a framework to analyze the feasibility and optimality of the resolution methods and the trade-offs that may arise.

## 4. Feasibility and Trade-Offs

So far, we have discussed the costs associated with the failure and resolution of banks and the methods authorities use to resolve failed banks. In this section, we analyze the costs associated with different resolution methods and try to formalize an optimal resolution policy.

A private-sector resolution, through which the failed bank is acquired by a healthy bank, imposes the least cost, since the franchise value is preserved, there is no disruption to the bank's customers or the payment system itself, and there are no fiscal costs.[13] However, the feasibility of such an option depends on the size and complexity of the failed bank, as well as the state of the world. When a private-sector resolution is not feasible, the authorities resort to methods such as assisted sales, liquidation, and recapitalization, each of which entails certain trade-offs and higher costs. Next, we provide a simple analytical framework to analyze these issues formally.

### 4.1 An Analytical Framework

Suppose we have the following framework involving two banks that are identical to start. The banks have the following balance sheet:

| Assets | Liabilities |
|---|---|
| Risky assets ($a$) | Insured deposits ($id$) |
| | Uninsured debt ($d$) |
| | Equity ($e$) |

The bank finances itself with insured deposits (insurance is provided by the FDIC), uninsured debt, and equity capital, where $id + d + e = 1$. The bank has one unit of the risky investment ($a = 1$), which has a random return with the high return $R > 1$ and the low return $r < id$. So, when the return is high, the bank is solvent and does not require any intervention. However, when the return is low, the bank's capital is wiped out, so the bank becomes insolvent and needs to be resolved.

To keep the framework simple, we first focus on the following resolution methods: 1) whole-bank purchase and assumption, 2) liquidation, and 3) recapitalization. Next, we analyze the costs associated with different resolution methods and the optimal choice in different states of the world.

Along the lines of our earlier discussion, we assume that the bank's assets are specific so that sale of the assets to another bank (via P&A) and liquidation can result in

[11] *Managing the Crisis: The FDIC and RTC Experience*, Part II, Chapter 2, in FDIC (1998).

[12] See Philippon and Schnabl (2013) for an analysis of efficient recapitalization of banks.

[13] In evaluating the costs of resolution methods, we should take into account the potential effects on size and complexity of the institutions resulting from a private transaction. For example, these institutions may become larger and more complex and therefore more difficult to resolve in the case of future distress.

## A Good Example: Lessons from the Resolution of the Swedish Financial Crisis

Sweden experienced a twin crisis in the early 1990s, which marked the first systemic crisis in industrialized countries since the 1930s. It is usually argued that this episode can be regarded as a good example of a swift, effective, and low-cost resolution of banking crisis. However, the Swedish experience has some unique features that may be difficult to replicate in all crises.[a]

**Crisis and intervention:** After deregulation of the credit markets in 1985, low interest rates, lax supervision, and the credit expansion contributed to an overheating property market.[b] Finance companies were less regulated compared to banks and were financed by a new type of commercial paper called "marknadsbevis" guaranteed by banks. When one of these companies folded in September 1990, the market for these securities dried up and banks had to keep funding the companies since they were closely linked.

In the early stages, no comprehensive framework existed and the government tackled problems case by case. By the fall of 1991, two of the six largest financial institutions, Forsta Sparbanken and Nordbanken, had inadequate capital. The state guaranteed a loan for Forsta and took over Nordbanken injecting capital to own 77 percent of its shares and split Nordbanken by transferring nonperforming loans to an asset management company (AMC) called Securum. Within a year, Gota Bank experienced difficulties and was also taken over by the government and split into a good bank and an AMC, called Retrieva.[c]

While there were no significant banks runs, the banks' foreign creditors started to cut their credit lines, and the Swedish authorities needed to restore confidence. In December 1992, Sweden guaranteed all bank deposits and creditors of the nation's 114 banks, but not the shareholders. The parliament passed the Bank Support Act authorizing the government to provide support in the form of loan guarantees, capital contributions, and other appropriate measures.[d] Overall, to resolve the crisis, Swedish authorities forced banks to write down their losses, used methods such as capital injections (both private and public), and separated troubled institutions into "good banks" and "bad banks," employing AMCs to restructure and divest the assets of the bad banks. Banks were told to write down their losses promptly. Bank owners were invited to inject capital, or let the Swedish authorities intervene, which implied wiping out shareholders.

**Exit:** Exit from the guarantees and the divesting of assets was smooth with low cost. In 1996, Sweden rescinded the guarantees, replacing them with a bank-financed depositor-protection scheme. Securum sold its real estate assets in 1995 and 1996, when the market had started to recover, and was dissolved at the end of 1997 much faster than originally envisaged.[e]

Sweden shelled out 4 percent of its GDP to rescue its financial system. After the recovery from asset sales, the cost ended up being less than 2 percent. It is argued that factors such as political consensus, decisiveness, and transparency surrounding the management of the crisis contributed to restoring confidence and to the eventual success of the resolution. As well as the right policies, various other factors that may not be present in all crises have an influence on this favorable outcome.

**Complexity of financial instruments:** The assets that were resolved mostly involved those related to real estate and were not very complex, factors that made the resolution easier and less costly. However, over time, the financial industry and financial contracts became much more complex. An important feature of the recent crisis was the difficulty of assessing complex financial instruments and structures, as well as off-balance sheet commitments and bank-related vehicles such as structured investment vehicles and conduits. These complex instruments, valuation issues, and institutional arrangements make it more difficult for analysts and counterparties to understand a bank's financial position, adding to the difficulties of the resolution.

**Macroeconomic factors helped recovery in Sweden:** Sweden had a fixed exchange rate before the crisis. Once the krona peg had been abandoned and the currency depreciated, Swedish goods regained competitiveness in export markets. Furthermore, a quick rebound in the Swedish economy stemmed from an increase in economic growth in Europe. The strong international recovery helped push up real estate values in Sweden and improved the balance sheet of banks, which played an important role in the recovery process. While Sweden is a small economy compared to the rest of the world, slowdowns in big industrial countries such as the United States and those in Europe can themselves drag the global economy down and such an export-led recovery may not be feasible, especially when countries are in a currency union, such as in Europe.

[a] This discussion of Sweden's experience builds on Yorulmazer (2009).

[b] From 1987 to 1990, credit rose from 90 to 140 percent of GDP and prices of commercial real estate doubled.

[c] During 1993, Nordbanken and Gota bank were merged, retaining the name Nordbanken, and becoming Sweden's fourth largest bank. The bank was operationally restructured and partially sold to the private sector. Their respective AMCs—Securum and Retrieva—were merged in December 1995.

[d] The parliament gave the Bank Supervisory Authority the power to decide and manage support operations.

[e] Several factors contributed to the AMCs' success. AMCs could rely on an efficient judicial system, which allowed them to force most of their debtors into bankruptcy when their operations did not prove economically viable. The restructuring of the assets was also facilitated by the fact that most of the assets transferred were related to real estate and were not like the complex assets seen in the most recent crisis.

Table 2
## Costs Associated with Different Resolution Methods

| | Cost to FDIC[a] | Fiscal Cost | Moral Hazard |
|---|---|---|---|
| Purchase and assumption (P&A) | $id - (r - \Delta_{PA})$ | N/A | N/A |
| P&A plus liquidation | $id - (r - (\alpha\Delta_{PA} + (1 - \alpha)\Delta_L))$ | N/A | N/A |
| Assisted P&A | $id - (r - \Delta'_{PA}) + \beta$ | N/A | N/A |
| Liquidation | $id - (r - \Delta_L)$ | N/A | N/A |
| Recapitalization | $id - r$ | $f(d)$ | $m$ |

[a] The cost to the Federal Deposit Insurance Corporation (FDIC) incorporates customer and market disruptions.

misallocation costs. However, we assume that this cost is lower under P&A compared with liquidation since the assets stay with the banking system, which helps preserve their value. In particular, we assume that when the assets are sold to another bank, they generate a value of $r - \Delta_{PA}$, whereas when the assets are liquidated they generate a value of $r - \Delta_L$ with $0 \leq \Delta_{PA} < \Delta_L$.

Let $p$ be the price at which the assets are sold by the FDIC. Suppose that the assets can be sold at their fair value so that $p = r - \Delta_{PA}$ under P&A and $p = r - \Delta_L$ under liquidation. Note that the difference between the value of insured deposits and the value of the asset recovery needs to be covered by the FDIC. Hence, the cost to the FDIC is $c = id - p$, with the cost to the FDIC under liquidation being higher than the cost under P&A. Therefore, the FDIC prefers P&A to liquidation. Note that in both P&A and liquidation, shareholders are wiped out so moral hazard is not a concern.

The other alternative is to recapitalize the failed bank. While there can be many variations of a recapitalization in terms of which stakeholders receive how much (discussed below), here we focus on the case where insured depositors and debt holders are paid in full, but the shareholders are wiped out. The recapitalization will result in fiscal costs but help keep the bank open and preserve its going-concern value so that the assets generate a return of $r$. In this case, in addition to the shortfall $(id - r)$ that will come from the FDIC, the government needs to come up with $d$ to pay debt holders. This would result in a cost of $f(d)$. Hence, the additional costs beyond the loss of the FDIC in this case would be $f(d) + m$, where $m$ represents the costs associated with adverse incentives arising from recapitalization. (In this case, the adverse incentives refer to those of debt holders since shareholders are wiped out.) We assume that $\Delta_{PA} < f(d) + m$ so that the aggregate resolution cost under P&A is lower than the cost of recapitalization.

Within this framework, P&A results in the lowest resolution cost and is the preferred option, where the comparison between liquidation and recapitalization depends on the relative costs of $\Delta_L$ and $f(d) + m$, respectively. Table 2 summarizes the costs associated with different resolution methods.

Next, we focus on different states of the world and the feasibility of each option. In an "idiosyncratic" failure state, only one bank fails, while the other stays healthy. In an "aggregate" failure state, both banks fail, resulting in a systemic crisis. P&A would be available only in an idiosyncratic failure state, where there are available buyers. Hence, in an aggregate failure state, the regulators face the trade-off between a disorderly liquidation with the cost of $\Delta_L$ and recapitalization with the cost of $f(d) + m$.

The framework is kept simple on purpose to illustrate the primary trade-offs regulators face, particularly during systemic crises. However, it can easily be extended to analyze a wider range of resolution options discussed earlier. For example, when we analyzed P&A above, we assumed that all the assets were being sold to the healthy bank. However, in practice, only a fraction of the assets can be transferred while the rest is liquidated. Let $\alpha$ be the fraction of assets sold under P&A and $(1 - \alpha)$ be the remaining fraction that is liquidated. In that case, the cost would be $\alpha\Delta_{PA} + (1 - \alpha)\Delta_L$. Note that the cost is decreasing in the fraction of assets that have been sold through P&A.

While passing a greater amount of assets in P&A typically lowers the cost to the FDIC, large and complex assets held by the failed institution may lead to lower bids by potential successors, who incorporate large discounts to compensate for the uncertain asset value. This, in turn, increases the loss in value by $\Delta_{PA}$. In this case, rather than accepting a high cost to the FDIC associated with the low bids, or the alternative option of passing only the most transparent assets and

liquidating the rest, the resolution authority may face a lower cost by assisting the P&A through a loss-sharing agreement.

Suppose that with this type of assistance, an acquirer will purchase all assets instead at a cost of $\Delta'_{PA} < \Delta_{PA}$, since the loss-sharing agreement provides insurance for the acquirer. However, assistance can increase the cost to the FDIC since the FDIC may have to absorb a portion of the acquirer's losses.[14] Let $\beta$ be the expected cost of the assistance. While the assistance (such as in the form of guarantees) can weaken the incentives of the acquirer to exert effort to generate the full return from the acquired assets—in turn, increasing $\beta$—an assisted P&A can still be a better option than liquidation if the cost of a disorderly liquidation is significant (high $\Delta_L$) and/or the expected cost of the assistance is not very high.

Another important issue is that during a recapitalization, different stakeholders can suffer varying levels of costs. In the benchmark case above, we assumed that uninsured debt holders are paid in full. However, uninsured debt holders can suffer some losses as well, resulting in a bail-in of the bank (discussed later in detail). In general, the uninsured debt holders can be paid an amount $x \in [0, d]$. In that case, the fiscal cost of the recapitalization would be $f(x)$. Since debt holders suffer some losses, they would have incentives to monitor the banks properly so that the cost of moral hazard $m$ would decrease to $m' < m$. In other versions of recapitalization, it is also possible that the shareholders are not wiped out completely. In this case, the fiscal cost as well as the cost of moral hazard would increase.

Various other factors such as size and complexity affect the cost of resolution and the feasibility of resolution options. One would expect that, as the assets get more complex, they would be harder for the acquirers to value and even manage, regardless of whether it is a P&A agreement or liquidation. Hence, as assets become more complex, $\Delta_{PA}$ and $\Delta_L$ would increase.

The size of the failed institution would also have an important effect on the resolution. In our simple framework, suppose that one bank is large, whereas the other is relatively small. If the small bank fails, the large bank, if healthy, can acquire the small bank. However, if the large bank fails, the small bank may not have the means to acquire the large bank and may not have the expertise to run the assets of the large bank efficiently, especially since, in most cases, size and complexity go hand in hand. Hence, when a large bank fails, the result would be a systemic crisis even though the small bank is healthy, and the private resolution options such as P&A may not be available. Hence, bank size can lead to a systemic crisis on its own.

[14] In the United States, loss sharing typically provides for the FDIC to cover up to 80 percent of losses on specific assets, while offering even greater loss protection "in the event of financial catastrophe."

Our simple framework can easily be extended to model a wide range of resolution options, such as the use of a bridge bank or an asset management company (AMC). In certain cases, when immediate P&A would be too disorderly and entail high costs, regulators may resort to methods that would allow them to restructure the failed institution and increase the feasibility of a P&A agreement in the future—for example, the creation of a bridge bank. While the bridge bank can create administrative costs, setting one up can provide other institutions with time to conduct due diligence and evaluate asset values without inhibiting operations or disrupting payment systems and loan creation. The authorities should compare the premium over market value that could be expected from the eventual sale with the additional administrative costs arising from the bridge bank. Hence, a bridge bank is a preferable option if it leads to a profitable P&A down the road net of any administrative costs. Furthermore, the bridge bank can facilitate the resolution of multiple failures at once, where the failed banks merge into the bridge bank.

Regulators also use other methods such as a good bank–bad bank separation followed by the setting-up of an AMC. First, the bad assets of the bank are separated from the good assets so that confidence can be restored in the good and it can continue operation. Then, the AMC can focus on restructuring or liquidating the bad assets. This method can have various advantages over market-based solutions such as liquidations, including 1) economies of scale in administering workouts and in forming and selling portfolios of assets, 2) benefits from special powers to expedite loan resolution, 3) allowing the good bank to focus on normal banking business such as issuing loans, and 4) enabling the AMCs, which have longer horizons, to recover more compared with an immediate liquidation of assets. Table 3 summarizes the options for resolution and their relative costs, and Chart 5 illustrates the decision process taken by resolution authorities along the lines of our analytical framework.

## 4.2 Evidence from the FDIC

We have pointed out the many costs associated with certain resolution methods, although quantifying and comparing the magnitude of each component empirically across varying time horizons and failure periods is challenging. However, data provided by the FDIC's *Historical Statistics on Banking* (HSOB) allow us to compare various resolution methods

Table 3

## A Summary of Options for Failure Resolution and Relative Costs

| Option | Costs | | | | |
|---|---|---|---|---|---|
| | Feasibility | Disruptions to Customers | Disruptions to System | Fiscal | Moral Hazard |
| Mergers and acqusitions | Not feasible when there are no willing, healthy buyers | None | None | None | None |
| Purchase and assumption (P&A) | | | | | |
| Without assistance | Not feasible when there are no willing, healthy buyers<br><br>There may be willing buyers with assistance (next option) | The smaller the amount of assets and liabilities transferred to the acquirer, the greater the disruptions | The smaller the amount of assets transferred to the acquirer, the more assets need to be liquidated, leading to fire-sale externalities<br><br>The smaller the amount of liabilities transferred to the acquirer, the greater the direct losses to the creditors | When recovery from the transfer or sale of assets is lower compared with transferred liabilities, the greater are the fiscal costs | Moral hazard introduced if uninsured deposits and any additional debt claims are transferred, requiring payment from public sources that is not recovered |
| With assistance | Not feasible when there are no willing, healthy buyers<br><br>A bridge bank may help facilitate transaction (next option) | Assistance may facilitate the transfer of a greater portion of assets and liabilities, reducing disruptions | Assistance may facilitate the transfer of a greater portion of assets and liabilities, reducing disruptions | Higher potential costs due to guarantees<br><br>But assistance may facilitate transfer of greater assets and liabilities reducing fiscal costs | If losses are not shared appropriately between acquirer and the authorities, guarantees can distort acquirer's incentives to maximize the value from the assets |
| Bridge bank | A bridge bank may facilitate a restructuring and P&A in the future<br><br>Not a preferred option if the bridge bank will not increase asset value | The smaller the amount of assets and liabilities transferred to the bridge bank, the greater the disruptions | A bridge bank may prevent the disorderly liquidation of assets and provide time for an orderly restructuring | Setting up a bridge bank can increase administrative costs | Moral hazard introduced if creditor losses are covered using public funds |
| Liquidation | Not a preferred option if disruptions arising from liquidation are too great | Going-concern value and customer/bank relationships are destroyed<br><br>Potential disruptions to payment services | Disorderly liquidation is likely to lead to fire-sale externalities, greater direct losses to the creditors, and loss of confidence | Fiscal costs may be high if low recovery from disorderly liquidation does not cover payout of insured deposit claims | Moral hazard is very low, as liquidation promotes market discipline |
| Recapitalization through private bail-in (shareholders wiped out) | Not a feasible option if creditors do not agree | Creditors suffer some losses but going concern and customer/bank relationships are preserved | This option prevents disorderly liquidation, although there are some direct losses to the creditors | Bail-in helps lower fiscal costs | Mitigates moral hazard since recapitalization is done through private rather than public funds |
| Recapitalization using public funds (shareholders wiped out) | Not a feasible (or preferred) option if government does not have funds to recapitalize | Mitigates disruptions as going-concern value and customer/bank relationships are preserved | Mitigates disruptions as direct losses are limited and fire-sale externalities are avoided | High fiscal costs | Moral hazard is created since creditors do not suffer losses |
| Recapitalization using public funds (shareholders diluted but retain some stake in firm) | Not a feasible (or preferred) option if government does not have funds to recapitalize or moral hazard would be too great | Mitigates disruptions as going-concern value and customer/bank relationships are preserved | Mitigates disruptions as direct losses are limited and fire-sale externalities are avoided | High fiscal costs | Moral hazard is highest since even shareholders' losses are limited |

empirically in terms of the cost to the FDIC.[15] The estimated losses to the fund are available for most bank failures since 1986, although it is important to note that the processes used by the FDIC have evolved over time.[16] Generally, when a failing institution is taken into receivership, the FDIC solicits bids from acquirers to purchase all or part of the assets and assume all or part of the liabilities (P&A). However, prior to the passage of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in 1991, bids were accepted from potential acquirers for the assumption of all deposits only.

The passage of the FDICIA imposed a number of provisions, including requirements for prompt corrective action (PCA) and least-costly resolution methods. Under PCA, a conservator or receiver must be appointed within ninety days of an institution becoming critically undercapitalized; that is, its tangible equity falling to (or below) 2 percent of total assets. Further, while it has access to a number of resolution tools, the FDIC is required to perform a least-cost test when deciding how to resolve the institution. However, the "systemic risk exception" allows the FDIC to bypass the least-cost method if it would have serious adverse effects on financial stability.

It wasn't until after the FDICIA that bids were also accepted for insured deposits only. Table 4 shows that, on average, P&A transactions in which only insured deposits are transferred are less costly to the FDIC. If a bid is for all deposits, the premium offered by the acquirer—reflecting the value of relationships—has to be at least as much as the amount of uninsured deposits in order for the transaction to be less costly than an (insured) deposit payoff by the FDIC.

The authority for the FDIC to establish a bridge bank, chartered by the Office of the Comptroller of the Currency, was provided by the Competitive Equality Banking Act (CEBA) of 1987. Before a failed bank enters a bridge, the FDIC must apply the least-cost test, considering the premium over market value that could be expected from the eventual sale compared with an immediate liquidation of assets. The least-cost test is applied again at the final sale resolution of the bridge bank before a sale can be made.

As shown in Table 4, P&A transactions implemented after setting up a temporary bridge bank, have, on average, led to lower costs to the FDIC; over the period from 1987 to 2012, losses to the FDIC in an insured-deposits-only P&A transaction represented 14.8 percent of bank assets when a bridge bank was established, compared to 19.9 percent of assets without the use of a bridge bank. Note that losses were considerably higher if a bridge bank was set up and no effective P&A transaction was available.

[15] The data are available at http://www2.fdic.gov/hsob/.

[16] FDIC (1998) provides a history of bank failure resolutions from 1980-94.

Last, the data show that, when liquidation was used by the FDIC, it was very costly; however, liquidation was used when P&A was not feasible (or more costly) and the failure did not trigger the systemic risk exception to use open bank assistance. The costs associated with assisted transactions are slightly more difficult to evaluate, although on average, the FDIC recovered most of the funds, resulting in losses of only 8 percent of bank assets. The 115 assisted transactions included in the table all occurred prior to 1993, when an amendment to the Federal Deposit Insurance Act of 1950 prohibited "the use of insurance fund monies in any manner that benefits any shareholder of an institution that had failed or was in danger of failing." (Eighty of the 115 assisted transactions occurred in 1988.)

In interpreting these results, we find our analytical framework very helpful. One of the interesting empirical results from the FDIC data is the striking difference between the cost associated with liquidation and that of other resolution methods. As our framework shows, everything equal, liquidation is more costly than P&A, and would therefore only be used when options such as P&A are not available. To start with, the banks that were liquidated may have been in worse shape or may have failed in a systemic crisis if a ready buyer was not available. These two factors together help explain the high costs of liquidation shown in the data.

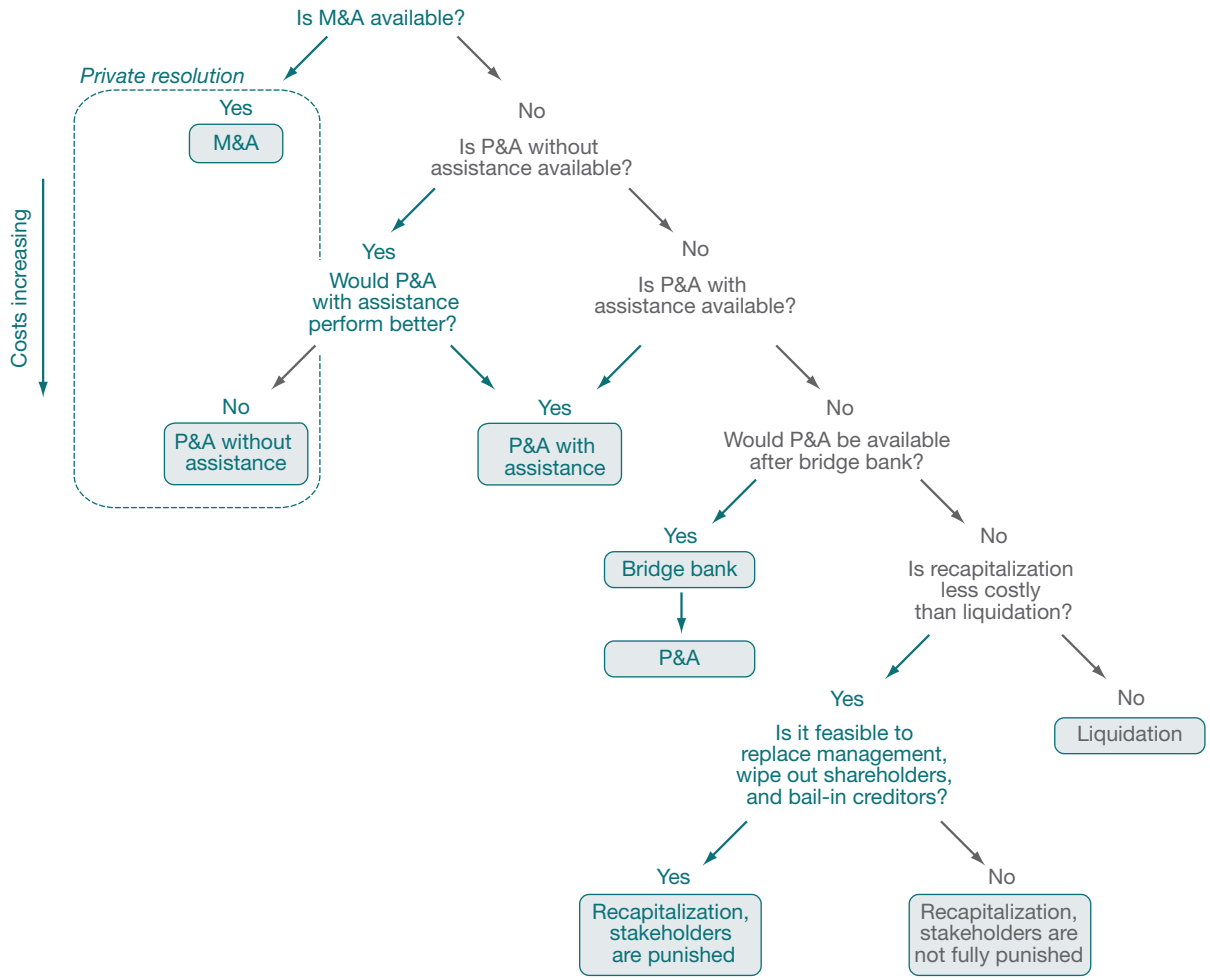
## 5. Recent Developments

During the recent crisis, we witnessed the failure or near failure of some of the most prominent financial institutions around the globe. Recent experience highlighted some of the shortcomings of the regulatory framework to resolve financial institutions and the need for a special resolution regime for systemically important institutions in cases where bankruptcy is not an effective option. The crisis led to a revision of the current regulatory framework to deal with distressed institutions. In this section, we review recent developments in the United States, the United Kingdom, and the European Union.

### 5.1 United States

In the United States, the FDIC possesses expansive powers to resolve failed federally insured depository institutions under the statutory objective to maximize the institution's

Chart 5
Resolution Decision Tree




return on assets and minimize costs to the insurance fund. In contrast with corporate bankruptcy proceedings, the FDIC, acting as receiver of a failed institution, is not subject to court supervision, and assumes the rights and powers of the institution's stockholders, directors, and parties with contractual rights. This authority includes the power to merge the institution with another insured depository institution without the need for consent.

The failure of a number of firms such as Lehman Brothers during the recent crisis proved that U.S. regulatory agencies did not have adequate tools for resolving systemically important nonbank institutions. Below we discuss two recent developments that resulted from Dodd-Frank: 1) the resolution and recovery plans of the act's Title I, and 2) the Orderly Liquidation Authority (OLA) of its Title II.

### *Living Wills*

Title I of Dodd-Frank requires all bank holding companies with total consolidated assets greater than $50 billion and all nonbank financial companies designated as systemically important by the Financial Stability Oversight Council to submit resolution plans, or "living wills," to the Federal Reserve and the FDIC.[17] Each plan must provide a strategic analysis of the institution's rapid and orderly resolution in the event of material financial distress or failure, through a reorganization or liquidation under the Bankruptcy Code.

[17] The final rule was effective November 30, 2011. See "Resolution Plans Required," 76 *Federal Register* (November 1, 2011). The final rule also applies to a foreign bank or company treated as a bank holding company under the International Banking Act of 1978 that has total consolidated assets greater than $50 billion.

Table 4

## Summary of Costs to the FDIC under Various Resolution Methods, 1986-2012

| Resolution Method | Number of Institutions | Average Assets (Millions of U.S. dollars) | Average Cost-to-Assets Ratio (Percent) |
|---|---|---|---|
| Purchase and assumption (P&A) | | | |
| Insured deposits only | 112 | 293.31 | 19.9 |
| All-deposits transfer | 1,263 | 587.00 | 23.7 |
| Bridge bank[a] | | | |
| P&A-insured only | 26 | 3,324.11 | 14.8 |
| P&A-all-deposits | 499 | 667.78 | 19.2 |
| Liquidation | 256 | 229.15 | 51.7 |
| Assisted transactions[b] | 115 | 165.52 | 8.4 |
| Liquidation | | | |
| Insured deposit transfer | 106 | 157.60 | 30.1 |
| Deposit payoff (direct) | 160 | 66.53 | 27.8 |

Source: Federal Deposit Insurance Corporation, *Historical Statistics on Banking*.

Notes: The table only includes resolutions for which estimated costs were available and excludes transactions where it was not determined if all deposits or insured deposits only were transferred in P&A. Additionally, the table excludes thirty-seven transactions where the Federal Savings and Loan Insurance Corporation took over management and generally provided assistance and one reprivatization transaction.

[a]Bridge banks also include thrift conservatorships.

[b]Assisted transactions include open bank assistance transactions and assisted whole-bank P&A transactions.

As firms conduct their strategic analyses of orderly resolution, the assumptions made concerning economic conditions at the time of failure are critical for determining the availability of tools and techniques, as we set forth in our framework. For their initial resolution plans, filers were provided with a set of baseline economic conditions to use in their analysis, although subsequent submissions will need to create a plan for resolution under "adverse" and "severely adverse" economic conditions.[18] Our framework shows that the availability of options for resolution depends not only on the institution in distress but also the health of other institutions. Hence, any resolution and recovery plan should have a macroprudential view and should not treat the institution in distress in isolation. At least the "adverse" and "severely adverse" scenarios should take into account the possibility of a systemic crisis in cases where many banks experience distress at the same time, huge fire-sale discounts are commonplace, and certain resolution options are not available.

[18] Conditions developed pursuant to Section 165(i)(1) of the Dodd-Frank Act may be referenced.

### *Orderly Liquidation Authority*

The OLA, established in 2010 under Title II of Dodd-Frank, expands the FDIC's authority to resolve failing banks by including systemically important nonbank financial institutions (SIFIs), which previously would have been resolved through corporate bankruptcy.[19] Further, for banks that are consolidated under a bank holding company, Title II acts under a "single point of entry" framework to facilitate continuity of critical services and reduce costs.

In resolving a failed institution, the FDIC would assign losses to shareholders and unsecured creditors of the holding company and transfer sound subsidiaries to a new solvent entity. As receiver, the FDIC can raise funds (up to a limit) through a line of credit from the U.S. Treasury, but Title II includes a provision that prohibits the use of taxpayer funds to cover the cost of resolution; therefore, all funds must be recovered.

[19] See "Certain Orderly Liquidation Authority Provisions under Title II of the Dodd-Frank Wall Street Reform and Consumer Protection Act, Final Rule," 76 *Federal Register* (July 15, 2011). Additionally, in a speech to the U.S. House of Representatives' Committee on Financial Services, Osterman and Wigand (2013) explore the application of OLA in resolutions.

Before a firm can enter orderly liquidation proceedings, the Treasury secretary must receive a written recommendation based on a two-thirds vote from the Board of Governors of the Federal Reserve System and another regulator, and, in consultation with the U.S. president, determine that the financial institution is in danger of default and that failure would have "serious adverse effects on the financial stability of the United States." It must also be determined that there is no viable private sector alternative available.

While Title II takes steps towards outlining viable alternatives to the bailout of a private institution, it has been argued that the legislation can be further improved. Plosser (2013) contends that it affords significant discretion to regulators, and that the complicated procedure to invoke the OLA may take time, increasing costs and limiting options. Still, the expanded powers of the FDIC to take into receivership those SIFIs that otherwise would have relied on the bankruptcy process for resolution should significantly reduce the costs associated with failure that we have outlined in our framework.

## 5.2 United Kingdom

The failure of Northern Rock in 2007 was a wake-up call for regulators and since then there have been wide reforms of financial regulation in the United Kingdom. Prior to 2008, the British legal system did not distinguish between banks and other failing companies, and therefore authorities did not have the ability to take Northern Rock into receivership.[20] The Banking (Special Provisions) Act was passed in 2008 as a temporary measure, giving the U.K. Treasury powers to facilitate orderly resolution through directed transfers of property, rights, and claims of a failed depository institution.

The Banking Act of 2009 replaced the temporary regime and created a Special Resolution Regime (SRR) for failing banks, influenced by the U.S. approach. The Financial Services Authority (FSA), the regulator of financial firms at the time, was given the right to trigger the SRR. Under the SRR, the U.K. authorities have powers similar to the FDIC in resolving a failed institution, and the choice of method would also involve a cost test.[21]

However, the regime set up under the Banking Act of 2009 did not cover nondeposit-taking financial firms. To address this flaw and improve financial supervision generally, further reforms were implemented in April 2013. Under the new regulatory regime, the FSA ceased to exist, and the Prudential Regulation Authority (PRA) was formed as part of the Bank of England to regulate deposit-takers, insurers, and major investment firms. Firms will assist the PRA and the SRR in assessing resolvability and drawing up recovery and resolution plans. The PRA, in consultation with the Bank of England and the Treasury, makes the decision to initiate the SRR for a failing institution.

In addition, the publication of the *Report of the Independent Commission on Banking* led by John Vickers (known as the "Vickers Report") made formal recommendations for further reform in 2011.[22] The focus of the Vickers Report is the notion that banks should "ring-fence" retail and commercial banking operations by establishing a separate legal entity to carry out these activities. The purpose is to protect these operations from the riskier wholesale and investment banking services. The Vickers Report also recommends that large U.K. ring-fenced retail banks hold a greater amount of capital than what is proposed under Basel III in order to improve their "loss absorbency." Many of the recommendations outlined in the Vickers Report have been incorporated in the Banking Reform Act of 2013, which is being implemented in 2014. This legislation gives the new PRA power to enforce the full separation of banking activities.

## 5.3 European Union

More recently, in response to the financial crisis, European Union (EU) authorities have worked to improve the framework of banking regulation within the European Economic and Monetary Union. Prior to the crisis, many EU countries relied on insolvency (bankruptcy) proceedings to deal with bank failures, which is suboptimal for a number of reasons we have already outlined. The European Commission has taken steps under the Bank Recovery and Resolution Directive to establish a common set of rules for national authorities to follow when winding down failed banks.

In 2012, the European Central Bank (ECB) proposed the creation of a European Banking Union, which would involve the establishment of the Single Supervisory Mechanism (SSM), the Single Resolution Mechanism, and a common system of deposit protection. Under the SSM proposal, the ECB supervises banks in the euro area and other member states, and, when a bank is in severe stress, it informs the Single Resolution Board, which would oversee

[20] For a discussion of the Northern Rock episode, see Shin (2009) and Goldsmith-Pinkham and Yorulmazer (2010).

[21] See Brierley (2009).

[22] The report is available at http://bankingcommission.independent.gov.uk/.

the resolution.[23] The Single Resolution Authority (SRA) will have access to a privately funded European Resolution Fund, generated by levies on the private sector, replacing the national resolution funds of the euro area states. The fund will need to cover 0.8 percent of the total insured deposits in any given country. The SRA will be expected to choose the least-cost resolution method, as practiced by the FDIC, but it will require access to the European Stability Mechanism as a fiscal backstop in case a systemic crisis develops.

## 5.4 Bail-In Debt

The resolution directive proposed by the EU is focused on the idea that the shareholders and creditors must face losses before a failing bank can receive any taxpayer bailouts. It proposes that shareholders, unsecured creditors, and uninsured depositors (with deposits greater than 100,000 euros), in that order, would be forced to cover at least 8 percent of the institution's total liabilities before the resolution fund provides any support. Power to carry out bail-in within resolution is listed as one of the "key attributes" of effective resolution regimes for financial institutions by the Financial Stability Board (FSB 2011), which the Federal Reserve and the FDIC helped to develop and which G-20 leaders endorsed in 2011. In general, this method could include writing down and/or converting to equity any or all unsecured and uninsured creditor claims in a manner that respects the hierarchy of the claims. Importantly, it would provide a capital buffer for distressed firms that would otherwise have difficulty raising new equity.

In the United States and elsewhere, requirements for contingent convertible bonds (CoCos) and bail-in debt have been proposed.[24] CoCos are loss-absorbing instruments which are converted to equity if a predetermined trigger, based on regulatory capital levels, is hit. The United Kingdom is working to include bail-in measures in its resolution regime.[25] Meanwhile, Swiss authorities support bail-ins of a range of creditors, including shareholders, holders of CoCos, and other bondholders, especially for the country's largest banks, UBS and Credit Suisse.[26] In general, while a number of issues will need to be addressed, a bail-in resolution method may come with significant advantages relative to the costs we have outlined; it can provide capital during times of distress and reduce moral hazard and disruptions to customers and markets in the case of a systemic failure.

## 5.5 Cross-Border Issues in Resolution

Another important issue emerging from the recent crisis was the lack of a framework for resolving banks with cross-border operations. For example, the failure of Lehman Brothers had widespread repercussions given its operations across fifty countries. Indeed, the FSB's key attributes state that institution-specific cooperation agreements should be in place between the home and host authorities for all global SIFIs (G-SIFIs).

The United States has been one of the first countries to incorporate cross-border planning into its statutory regime as it is home country to eight of the twenty-eight global systemically important banks identified by the FSB.[27] OLA requires the FDIC to coordinate with the foreign regulatory authorities in resolving G-SIFIs. In addition to resolution planning, the United States has taken steps to improve the supervision of U.S. operations of foreign banks, and last year the Federal Reserve sought comment on its proposal to require large foreign banking organizations to organize their U.S. subsidiaries under an intermediate holding company, subject to the requirements of U.S. bank holding companies.

Owing to the connections between financial institutions in the United States and the United Kingdom, the bilateral relationship is perhaps the most significant with regard to the resolution of G-SIFIs, especially given the need to prevent disruptive forms of ring-fencing of the host country's operations of a failed firm. Working relationships will also be established with the European Union, Switzerland, and Japan, which also host a number of G-SIFIs. As resolution regimes are developed internationally to address cross-border issues explicitly, the feasibility of an orderly and timely resolution that minimizes disruptions and panic should improve, although there is still considerable work to be done in most jurisdictions.

[23] See European Commission (2013).

[24] For analysis of contingent capital, see Sundaresan and Wang (forthcoming), Bank of Canada (2010), Calomiris and Herring (2011), Flannery (2002, 2009), Glasserman and Nouri (2012) and Pennacchi (2010), to cite a few.

[25] Lloyds Banking Group was the first to issue CoCo bonds in 2009, which included the terms that the security would be converted to ordinary shares if the Tier I capital ratio fell below 5 percent.

[26] A recent CoCo deal issued by Credit Suisse included terms that holders of the security stood to lose the whole investment if the bank breached its 5 percent Tier I capital ratio.

[27] In a speech given in 2013, the Federal Reserve's Michael Gibson reviews the steps taken by the United States to formalize cross-border resolution planning. See Gibson (2013).

## 6. Conclusion

Bank failures entail costs for bank customers, for the financial sector, and the overall economy. Hence, efficient resolution of financial institutions in distress is an extremely important issue.

This article provides a discussion of the costs associated with bank failures and the methods authorities use to resolve banks. While regulators can employ various methods ranging from private-sector resolution in the form of M&A and P&A to government intervention and recapitalization of banks using public funds, we have shown that some of these methods may not be feasible in certain states of the world.

In particular, although private-sector resolution is a preferred option in terms of minimizing costs associated with bank failures, it may not be a feasible one when the failing institution is large and complex or when its failure occurs during a systemic crisis. When many banks experience distress simultaneously, there may not be a ready buyer for the failed bank. Hence, when the preferred option is not available, the authorities face certain trade-offs, as they choose from second-best options such as disorderly liquidation and the use of public funds to resolve banks. Thus, systemic crises always entail higher aggregate resolution costs and trade-offs.

The optimal design of regulation and a resolution regime needs to take into account the fact that certain preferred options may not be available during systemic crises. Further, it should aim to minimize the probability of systemic crises and the costs associated with resolving failures in those scenarios.

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Michael J. Fleming and Asani Sarkar

# The Failure Resolution of Lehman Brothers

- The experience of resolving Lehman in the bankruptcy courts has led to an active debate about the effectiveness of U.S. Chapter 11 proceedings for complex financial institutions.
- Lehman's poor pre-bankruptcy planning may have substantially reduced the value of Lehman's estate and contributed to many ensuing disputes with creditors.
- For over-the-counter (OTC) derivatives transactions, where much of the complexity of Lehman's bankruptcy resolution was rooted, creditors' recovery rate was below historical averages for failed firms comparable to Lehman.
- The settlement of OTC derivatives was a long and complex process, occurring on different tracks for different groups of derivatives creditors.
- Some of the losses borne by Lehman investors stemmed from the manner in which Lehman failed and could have been avoided in a more orderly process.

## 1. Introduction

Lehman Brothers Holdings Inc. (LBHI) filed for Chapter 11 bankruptcy on September 15, 2008, while its subsidiaries did so over the subsequent months (see Exhibit 1 for Lehman's organizational structure).[1] With 209 registered subsidiaries in twenty-one countries, Lehman's Chapter 11 filing was one of the largest and most complex in history. Creditors filed about $1.2 trillion of claims against the Lehman estate (LBHI, "The State of the Estate," September 22, 2010), which was party to more than 900,000 derivatives contracts at the time of bankruptcy.

Several bodies of law applied to Lehman's various corporate entities (Exhibit 2):

- The U.S. Bankruptcy Code applied to LBHI and its subsidiaries.
- The Securities Investor Protection Act (SIPA) regime applied to the insolvent broker-dealer, Lehman Brothers Inc. (LBI).
- More than eighty jurisdictions' insolvency laws applied to the non-U.S. Lehman Brothers entities, such as Lehman's U.K.-based broker-dealer Lehman Brothers International (Europe) (LBIE).

[1] When referring to LBHI and all its subsidiaries as an ensemble, we use "Lehman." Otherwise, when referring to the holding company (subsidiary), we use "LBHI" (the subsidiary name). Appendix A lists the acronyms and initialisms used in the article.

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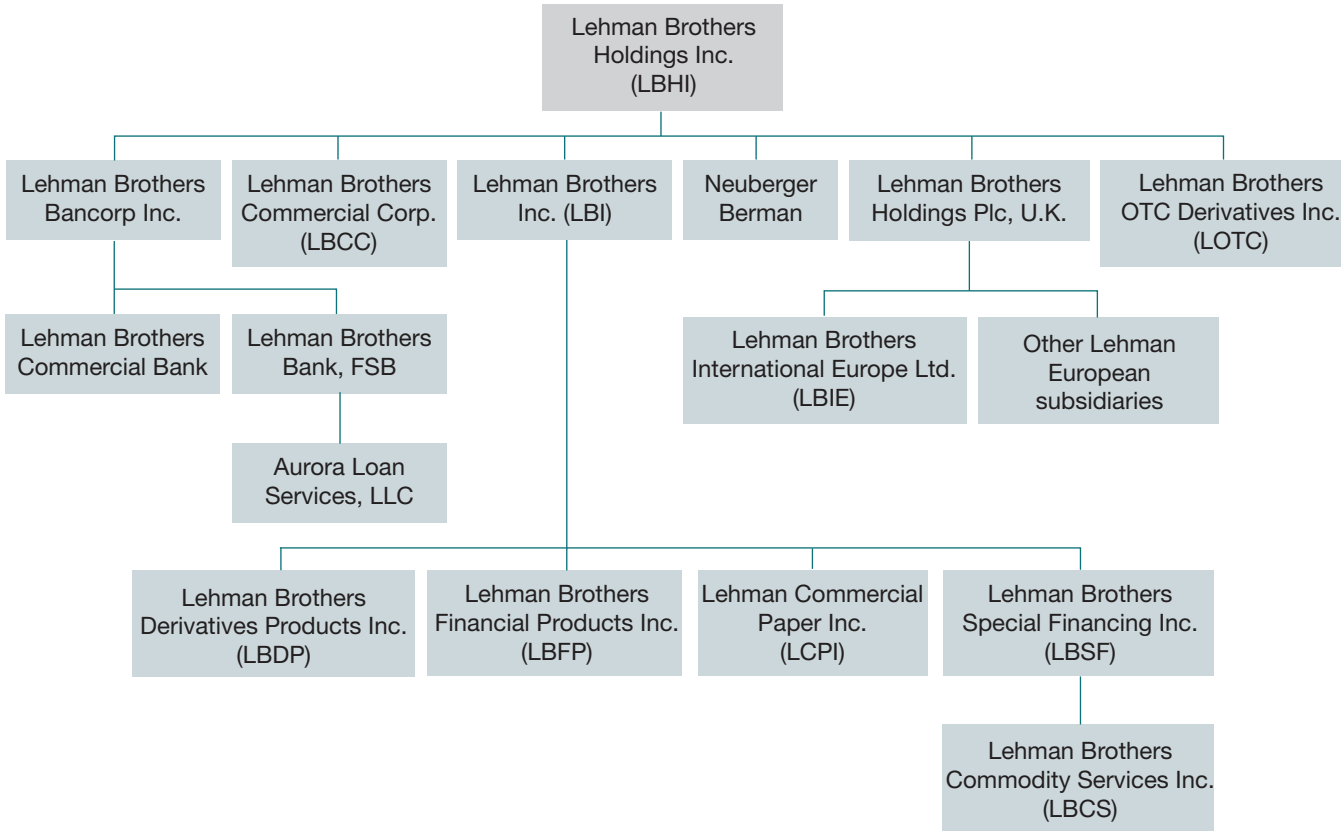
The authors thank Tobias Adrian, Wilson Ervin, Sahil Godiwala, Anna Kovner, Lisa Kraidin, Antoine Martin, James McAndrews, Hamid Mehran, João Santos, Joseph Sommer, and Emily Warren for helpful discussions and/or comments on earlier drafts as well as Samuel Antill, Weiling Liu, and Parinitha Sastry for excellent research assistance. The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

Exhibit 1

Organization Chart for Lehman's U.S. and European Subsidiaries




Sources: Derived from Valukas (2010).

Notes: The exhibit shows the organizational structure for Lehman Brothers' U.S. and major European subsidiaries.

- The Federal Deposit Insurance Act applied to its state-chartered bank and federally chartered thrift.
- U.S. state insurance laws applied to its insurance subsidiaries.

The failure of Lehman Brothers was associated with substantial losses for its equity holders and creditors. The experience of resolving Lehman in the bankruptcy courts has since led to an active debate regarding the effectiveness of U.S. Chapter 11 proceedings for complex financial institutions. Some economists have suggested a modification of Chapter 11, called Chapter 14, to apply to all financial companies exceeding $100 billion in consolidated assets (Jackson 2012). In contrast, Title II of the Dodd-Frank Wall Street Reform and Consumer Protection Act, passed in 2010, creates an alternative resolution mechanism, the Orderly Liquidation Authority, that expands the reach of the Federal Deposit Insurance Corporation (FDIC) to resolve large non-bank financial institutions such as Lehman.

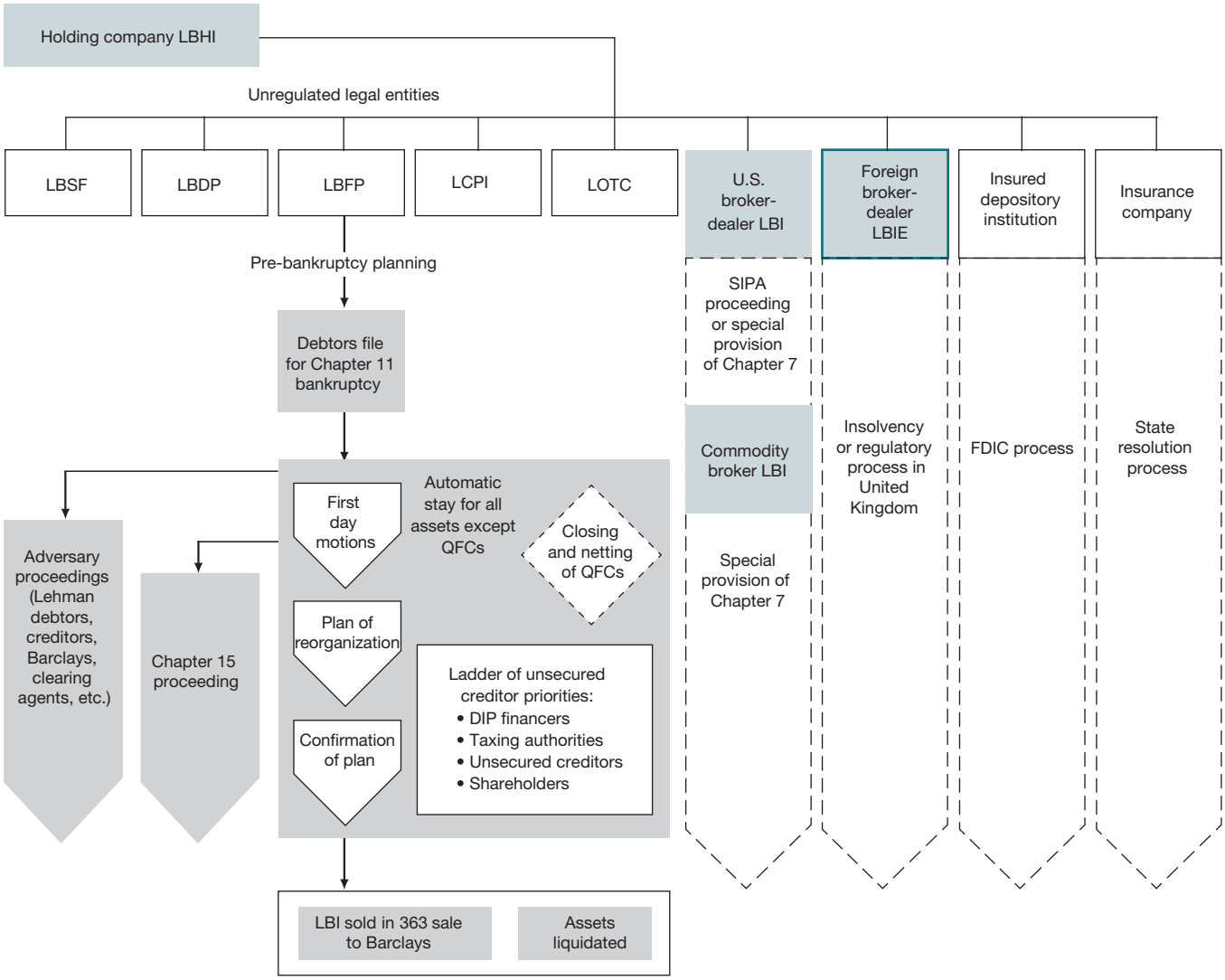
In this article, we examine the resolution of Lehman in the U.S. Bankruptcy Court proceedings[2] with a view toward understanding the sources of complexity in its resolution to thereby inform the debate on appropriate resolution mechanisms for complex financial institutions. Below are the main steps involved in Lehman's bankruptcy process (Exhibit 2):[3]

[2] While this article focuses on the application of the U.S. Bankruptcy Code to Lehman, we include two appendixes on the settlement of centrally cleared derivatives (Appendix B) and the resolution of LBI under the SIPA regime (Appendix C). Moreover, in a companion article, we discuss the value destruction resulting from the Lehman bankruptcy (Fleming and Sarkar 2014).

[3] At various points during the bankruptcy proceedings, the Lehman estate also brought a number of motions and adversary proceedings to facilitate the case, to determine liabilities, and to recover or sell assets, as shown in Exhibit 2.

Exhibit 2

## Chapter 11 Bankruptcy Process for Lehman Brothers




Source: Derived from U.S. Government Accountability Office (2011).

Notes: The exhibit shows the bankruptcy process for Lehman Brothers and its affiliates. LBHI is Lehman Brothers Holdings Inc.; LBSF is Lehman Brothers Special Financing; LBDP is Lehman Brothers Derivatives Products; LBFP is Lehman Brothers Financial Products; LCPI is Lehman Commercial Paper Inc.; LOTC is Lehman Brothers OTC Derivatives; LBI is Lehman Brothers Inc.; LBIE is Lehman Brothers International (Europe); SIPA is Securities Investor Protection Act; FDIC is Federal Deposit Insurance Corporation; QFCs are qualified financial contracts; DIP is debtor in possession. Chapter 15 of the Bankruptcy Code governs judicial cross-border coordination. Sale of the company, in whole or in part, is commonly called a Section 363 sale because that is the section of the Bankruptcy Code that applies to sales that are free and clear of creditor claims.

- Pre-bankruptcy planning, including searching for potential buyers and preparing for filing of a bankruptcy petition;
- First-day-of-bankruptcy motions to obtain funding in order to operate businesses during bankruptcy and permission to use cash collateral on which secured creditors had claims;
- Closing and netting out qualified financial contracts (QFCs);
- Section 363 asset sales;[4]

[4] Sale of the company, in whole or in part, is commonly called a Section 363 sale because this section of the Bankruptcy Code applies to sales that are free and clear of creditor claims. Asset sales also occur as part of the confirmation plan.

- Establishing the total amount owed to creditors through the claims process, by providing reports on the debtor's financial condition and reviewing (and objecting to, if necessary) creditor claims;
- Filing a plan of reorganization[5] after negotiations with significant creditors, along with a disclosure statement to inform creditors about the plan;
- Confirming the plan to settle creditor claims through voting by creditors and a confirmation hearing; [6] and
- Making payments to creditors under the plan.

We discuss Lehman's pre-bankruptcy planning, its funding sources during bankruptcy, the settlement of QFCs, the claims process, and the amounts recovered by different creditor groups. The bulk of our study is devoted to the settlement of Lehman's creditor and counterparty claims, especially those relating to over-the-counter (OTC) derivatives. We focus on derivatives because we find that much of the complexity of Lehman's bankruptcy was rooted in the settlement procedures for its OTC derivatives positions. Moreover, derivatives receive special treatment under the U.S. Bankruptcy Code through exemptions or "safe harbor" from several provisions of the code (for example, exemption from the automatic stay; see Appendix D for a more complete discussion of safe harbor provisions). However, questions have been raised regarding the desirability of providing these exceptions. For example, Andrew Gracie, the executive director of the Bank of England's special resolution unit argues that the onset of a bank resolution should not, by itself, be considered an event of default that allows counterparties to quickly terminate derivative contracts, as happened with Lehman.[7] By providing a detailed description of the use of safe harbor provisions and other derivatives settlement procedures in the Lehman bankruptcy, our study may help inform the discussion on the role of derivatives in bankruptcy.

[5] In Lehman's case, the reorganization plan resulted in liquidation of the company. There are advantages to using Chapter 11, rather than Chapter 7, for liquidation (for example, the debtor, rather than a trustee, has control over the sale process). However, failed Chapter 11 cases are often converted to Chapter 7 cases.

[6] Lehman was also involved in Chapter 15 cases, which were ancillary to the U.S. bankruptcy case and involved cross-border insolvency. Such cases allowed Lehman's foreign creditors (who had claims against a Lehman foreign subsidiary in a foreign judicial or administrative proceeding) to be recognized by the U.S. Bankruptcy Court and to participate in Lehman's U.S. bankruptcy case. See http://www.uscourts.gov/FederalCourts/Bankruptcy/BankruptcyBasics/Chapter15.aspx. In this article, we do not cover cross-border issues, although to the extent that the resolution of Lehman's U.K. broker-dealer affected the SIPA proceedings, these are discussed in Appendix C.

[7] See http://www.bloomberg.com/news/2014-03-04/boe-seeks-derivatives-pact-to-prevent-a-repeat-of-lehman-cascade.html.

The payout ratio to Lehman's creditors was initially estimated to be about 21 percent on estimated allowable claims of $362 billion, implying a loss to creditors and counter- parties of roughly $286 billion. Actual distributions to date appear to have exceeded initial estimates, although some of the amount distributed has gone to other Lehman creditors rather than third-party creditors. Comparison with historical experience indicates that the recovery rate for LBHI's senior unsecured creditors has been below average so far, even after accounting for possible mitigating factors (for example, the state of the economy and the credit cycle). However, recovery rates varied across creditor groups. Creditors of three Lehman derivatives entities received full recovery on their claims, and counterparties of centrally cleared securities were mostly made whole. In contrast, many of Lehman's OTC derivatives' counterparties suffered substantial losses.

Some of the losses borne by Lehman investors emanated from the manner in which Lehman failed and could have been avoided in a more orderly liquidation process. The bankruptcy was poorly planned, for example, which may have substantially reduced the value of Lehman's estate (Valukas 2010, p. 725) and contributed to ensuing litigation with creditors.

Creditor losses would have been more substantial without the ability of LBI, the U.S. brokerage subsidiary of LBHI and subsequently of Barclays Plc, to finance positions through the Federal Reserve's (Fed) liquidity facilities. Such financing was critical to the relatively smooth transfer of LBI customer accounts to Barclays and the preservation of firm value. Since then, the Dodd-Frank Act has circumscribed the ability of the Fed to act as lender of last resort to the same extent that it did during the financial crisis.

We assess the effectiveness of the settlement procedures with respect to their speed, predictability, and transparency. We find that the speed of resolution varied across claimant groups. Retail OTC derivatives counterparties of Lehman terminated their contracts within weeks of LBHI's bankruptcy filing under the safe harbor provisions, but final settlement of their claims remains incomplete.[8] In contrast, derivatives contracts of large, institutional counterparties (which constituted a small share of Lehman's derivative contracts by number, but a significant share by value) took several years to terminate, let alone finally settle.

Regarding the predictability of the settlement process, while existing case law provided a useful starting point for the Lehman resolution, the court provided new

[8] As explained in Appendix D, while termination is the first step in settling an OTC derivatives position, final settlement of terminated derivatives contracts requires further steps, such as valuing transactions.

interpretations of provisions in the Bankruptcy Code (regarding, for example, some aspects of the safe harbor provisions for derivatives). In part, this reflected the importance of complex financial securities to which Lehman was a party. The bankruptcy court had to analyze these securities for the first time and sometimes came out with controversial judgments that surprised many observers.

Finally, regarding transparency, we find that while the Lehman estate provided substantial ongoing information on the progress of resolution, the information was sometimes either incomplete or reported in a piecemeal manner that made it difficult to obtain an integrated view of bankruptcy outcomes.

In the remainder of the article, we discuss the effectiveness of Lehman's pre-bankruptcy planning (Section 2), funding during the first week of bankruptcy (Section 3), the settlement of financial contracts with an emphasis on QFCs (Section 4), and creditors' recovery rates under Chapter 11 (Section 5). Section 6 summarizes our findings.

## 2. Pre-Bankruptcy Planning

Companies facing potential bankruptcy find it advantageous to consult a Chapter 11 attorney early so that there is more time to put together a plan and assemble a team of professionals (such as counsel and financial advisors) to work with the company. An important goal of pre-petition planning is to maintain the operations of the business during the bankruptcy process (for example, by arranging for funding and preparing an operating budget to conserve cash).

The Lehman bankruptcy was considered disorderly, in part because the institution did not plan sufficiently for the possibility of bankruptcy. Indeed, Lehman's actions were not those of a company husbanding resources in anticipation of bankruptcy. For example, Lehman continued to repurchase shares at the beginning of 2008 and decided against hiring bankruptcy counsel in August 2008 (Valukas 2010, p. 718). Management did not seriously consider bankruptcy until a few days before filing, and Lehman did not try to sell its subsidiaries until the week before its collapse (U.S. Government Accountability Office 2011).[9] Lehman consciously avoided bankruptcy planning owing to continuing interest from strategic partners and its belief that such planning would be a self-fulfilling prophecy (Valukas 2010, p. 718).

The three or four days prior to LBHI's bankruptcy filing were filled with confusion and indecision. Lehman engaged bankruptcy counsel on September 10, 2008, and preparation for filing of the bankruptcy petition began the following day (Valukas 2010, p. 719). At the same time, however, Lehman continued to believe that it would be rescued. Indeed, as late as September 14, 2008, Lehman contemplated a six-month period to unwind its positions, during which it would employ many people (Valukas 2010, p. 371).

A key step in planning for a Chapter 11 bankruptcy filing is to have certain "first day" motions and orders ready so that the judge can consider them at the beginning of the case. These orders facilitate the operational aspects of the bankruptcy filing and contribute toward a prompter and more orderly resolution (Wasserman 2006). LBHI and its bankruptcy counsel initially filed few of the typical first-day motions that seek the bankruptcy court's authorization to carry on the many facets of "business as usual" that otherwise would be prohibited by various Bankruptcy Code provisions (for example, maintain accounts and current cash management systems, affirm clearinghouse contracts, and so on; see Azarchs and Sprinzen [2008]).

Similarly, LBHI's affidavit accompanying its bankruptcy petition was unusually brief. Typically, these affidavits set out in some detail the debtor's business rationale for its first-day motions and provide the outlines of its Chapter 11 strategy. In Lehman's case, other than "preserve its assets and maximize value for the benefit of all stakeholders," little was set out (Azarchs and Sprinzen 2008). The lack of first-day motions and the sparseness of the debtor's affidavit suggest a lack of preparedness for bankruptcy.

The abruptness of LBHI's filing is reported to have reduced the value of Lehman's estate by as much as $75 billion (Valukas 2010, p. 725). For example, 70 percent of derivatives receivables worth $48 billion were lost that could otherwise have been unwound.[10] The lack of planning also contributed to many ensuing disputes with creditors.

[9] Lehman had discussions with Bank of America (for a proposed merger between the two companies) in July 2008 and again in September 2008, when U.S. Treasury Secretary Henry Paulson urged Bank of America to buy Lehman (Valukas 2010, p. 697).

[10] An alternative view is that the Lehman estate did not suffer any substantial loss on its derivatives position since LBHI's counterparties initially overstated some of their claims, which were subsequently overturned by the bankruptcy court (U.S. Government Accountability Office 2013).

## 3. Funding in the First Week of Bankruptcy

Unlike LBHI, LBI did not file for bankruptcy on September 15, 2008, because it expected to conduct an orderly liquidation by unwinding its repos and matched books while attempting to find a buyer (Valukas 2010, p. 2117). Ownership of LBI's assets was transferred to Barclays on September 22. However, in order to remain a going concern, LBI needed liquidity between September 15 and 22. Absent such liquidity, the sale would have failed, further impairing the value of Lehman's estate.

At, and just after, the time of LBHI's bankruptcy filing, LBI's cash position was precarious ("Trustee's Preliminary Investigation Report and Recommendations," August 25, 2010). More than 90 percent of LBI's assets had been composed of reverse repos, stock borrowing agreements, and financial instruments owned. Reverse repos and securities loans had declined since May 2008 (Panel A of Table 1). Tri-party repo funding in particular had dropped from $80 billion on May 31, 2008, to $650 million on September 19, 2008. Failed transactions and the failure of counterparties to return margin posted by LBI harmed its cash position. Finally, customer and prime broker accounts moved to other broker-dealers, while clearing firms required additional collateral, deposits, and margins.[11]

In order to operate until its sale was completed, LBI had to rely on other funding sources, including the Fed's liquidity facilities and advances by Barclays and LBI's clearing agents.

### 3.1 Post-Petition Financing of LBI by the Fed

In connection with LBHI's preparations for bankruptcy petition, the Fed, acting in its capacity as lender of last resort, advised Lehman that it would provide up to two weeks of overnight secured financing through the Primary Dealer Credit Facility (PDCF) to facilitate an orderly unwind of LBI (Valukas 2010, p. 2118). Without Fed funding, LBI's customers would have faced long delays in accessing their accounts while their claims were resolved in the SIPA proceedings (as discussed further in Appendix C).

On September 14, 2008, the Fed expanded the set of collateral acceptable at the PDCF to include all tri-party-eligible collateral.[12] Under the PDCF, the Fed extended between $20 billion and $28 billion per day to LBI from September 15 to September 17, 2008 (Panel B of Table 1). However, the Fed limited the collateral LBI could pledge to what it had in its clearance box at JPMorgan Chase (JPMC) on September 12 and also imposed higher haircuts on LBI than on other dealers (Valukas 2010, p. 2119).[13] Nevertheless, LBI borrowed against a wide variety of collateral, such as asset-backed securities and equity (Panel B of Table 1).

In addition to the PDCF, the Fed had introduced the Term Securities Lending Facility (TSLF) and single-tranche term repurchase agreements in March 2008 to address the liquidity pressures in secured funding markets.[14] While LBI had outstanding borrowing of $18.5 billion from the TSLF at the time of bankruptcy, it did not undertake new borrowing from the TSLF *after* bankruptcy. Similarly, LBI had single-tranche term repos outstanding of $2 billion at the time of bankruptcy, but did not undertake new borrowing through the program after bankruptcy.

### 3.2 Post-Petition Financing of Lehman by Barclays

On September 17, 2008, the Fed and Barclays formally agreed that Barclays would replace the Fed as a source of secured funding for LBI (Valukas 2010, p. 2162). On September 18, in exchange for $46.2 billion in cash, the Fed delivered LBI collateral to Barclays and advised it of the option to finance the collateral at the PDCF (Valukas 2010, p. 2165). Between September 18 and September 22, 2008, Barclays borrowed up to $48 billion from the PDCF and $8 billion from the TSLF (Panel C of Table 1).

[11] An additional factor, noted by Duffie, Li, and Lubke (2010), is the use of novations by LBHI's counterparties (whereby they would exit their positions by assigning them to other dealers) in the days before bankruptcy. These novations depleted LBHI's cash reserves and, effectively, those of LBI (since LBHI was the main source of LBI's funding).This occurred because when Lehman's original dealer counterparty, through novation, transferred its position to another dealer, Lehman lost the associated "independent amount" of collateral (which functions similar to an initial margin). The collateral was not replaced because initial margins are not posted in dealer-to-dealer trades.

[12] Eligible collateral originally comprised Fed-eligible collateral plus investment-grade corporate securities, municipal securities, mortgage-backed securities, and asset-backed securities. See http://www.federalreserve.gov/newsevents/press/monetary/20080914a.htm.

[13] Clearance box assets are securities that were held in LBI's "clearing box accounts" at JPMC. These assets facilitated securities trading by providing collateral against which open trading positions could be secured.

[14] For the Fed's announcement of the TSLF program, see http://federalreserve.gov/newsevents/press/monetary/20080311a.htm. Under single-tranche repurchase agreements, the Fed's Open Market Trading Desk lent money in the form of term twenty-eight-day repurchase agreements against Treasury, agency debt, or agency mortgage-backed securities. Dealers could borrow against all three types of collateral, which constituted a single tranche, as opposed to the Desk's conventional repurchase arrangements whereby each type of collateral constitutes a separate tranche. See http://www.newyorkfed.org/markets/operating_policy_030708.html for further details.

Table 1

## Funding for Lehman around the First Week of Its Chapter 11 Filing

Panel A: Short-term Assets of LBI, May 31–September 19, 2008
Billions of dollars

| | May 31, 2008 | August 31, 2008 | September 19, 2008 |
|---|---|---|---|
| Reverse repos | 141.2 | 143.5 | 11.1 |
| Securities loans | 87.7 | 68.2 | 41.8 |
| Repos plus securities loans | 228.8 | 211.6 | 121.9 |

Panel B: Borrowing by LBI, September 15-17, 2008

| | | | | Share of Collateral Pledged (Percent) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Loan Date | Source of Funding | Type of Funding | Amount (Billions of Dollars) | UST/ Agency Securities | Agency MBS | Private-Label MBS | Corporate Bonds | Municipal Bonds | ABS | Equity | Other[a] |
| 09/15/2008[b] | Fed | PDCF | 28.0 | 13.1 | 7.0 | 5.0 | 41.8 | 10.0 | 12.2 | 7.6 | 3.3 |
| 09/16/2008[c] | Fed | PDCF | 19.7 | 6.5 | 0.0 | 9.6 | 53.9 | 1.7 | 14.9 | 9.0 | 4.4 |
| 09/17/2008[d] | Fed | PDCF | 20.4 | 16.4 | 13.3 | 2.1 | 31.5 | 0.4 | 16.6 | 18.6 | 1.1 |
| 09/15/2008 | Barclays | Tri-party repo | 15.8 | Not known | | | | | | | |
| 09/16/2008 | Barclays | Tri-party repo | 15.8 | Not known | | | | | | | |
| 09/17/2008 | Barclays | Tri-party repo | 15.8 | Not known | | | | | | | |

Panel C: Borrowing by Barclays, September 18-22, 2008

| | | | | Share of Collateral Pledged (Percent) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Loan Date | Source of Funding | Type of Funding | Amount (Billions of Dollars) | UST/ Agency Securities | Agency MBS | Private-Label MBS | Corporate Bonds | Municipal Bonds | ABS | Equity | Other[a] |
| 09/18/2008 | Fed | PDCF | 47.9 | 14.7 | 52.8 | 5.9 | 7.4 | 0.5 | 3.1 | 15.5 | 0.1 |
| 09/18/2008 | Fed | TSLF Schedule 2 | 5.0 | 0.0 | 45.4 | 20.1 | 0.0 | 0.0 | 34.4 | NE | NE |
| 09/19/2008[e] | Fed | PDCF | 16.0 | 0.8 | 10.3 | 11.9 | 20.3 | 2.7 | 3.4 | 50.4 | 0.3 |
| 09/19/2008[e] | Fed | TSLF Schedule 1 | 2.7 | 0.0 | 2.0 | 35.6 | 27.4 | 0.0 | 34.4 | NE | NE |
| 09/22/2008[f] | Fed | PDCF | 16.0 | 0.4 | 11.0 | 10.4 | 20.4 | 2.7 | 3.7 | 51.1 | 0.3 |

Sources: Trustee's Preliminary Investigation Report and Recommendations (2010), Valukas (2010), and http://federalreserve.gov/newsevents/reform_transaction.htm.

Notes: LBI is Lehman Brothers Inc.; UST is U.S. Treasury; MBS is mortgage-backed securities; ABS is asset-backed securities; Fed is Federal Reserve; PDCF is Primary Dealer Credit Facility; TSLF is Term Securities Lending Facility; NE is not eligible.

[a] For PDCF, the "other" category includes international securities (securities issued by non-U.S. entities, government, and private sources, including supranational agencies) and other eligible collateral.

[b] Lehman and Barclays begin to negotiate sale of LBI's business and assets to Barclays.

[c] Lehman and Barclays execute Asset Purchase Agreement, providing for sale to Barclays of selected Lehman assets.

[d] Lehman asks Bankruptcy Court to schedule sale hearing and establish sale procedures.

[e] Bankruptcy Court holds sale hearing to consider proposed sale of LBI to Barclays.

[f] Barclays buys LBI, and sale transaction is closed. Almost all of LBI assets and employees are transferred to Barclays.

Barclays also provided overnight funding to LBI of $15.8 billion through tri-party repo transactions between September 15 and September 17 (Panel B of Table 1). And on September 17, Barclays provided $450 million in debtor-in-possession financing to LBHI secured by LBHI's assets in Neuberger Berman (Azarchs and Sprinzen 2008). Funds under the facility helped sustain LBHI's businesses pending the completion of LBI's sale.

### 3.3 Post-Petition Financing by LBI's Clearing Agents

JPMorgan Chase and Citibank advanced credit to LBI after the bankruptcy of LBHI, allowing LBI to clear trades and obtain funding. For example, at the urging of the Fed and LBHI, JPMC made clearing advances to unwind LBI's outstanding tri-party repos worth $87 billion on September 15 and substantial additional amounts on the following day to "avoid financial market disruption" (LBHI, "Debtors versus JPMorgan Chase Bank, N.A.," April 19, 2012). LBI was a party to tri-party term repos that continued to perform, and it obtained overnight funding through general collateral finance (GCF) repos (Valukas 2010, p. 2124).

JPMC and Citibank were faced with requests for advances *after* the bankruptcy filing of LBHI. Although they may have had *pre-petition* secured claims against LBHI under its guarantees, these guarantees were cut off by the filing and would not cover later events. The court confirmed that their new, post-petition advances would continue to benefit from the pre-petition guarantees under securities contracts and thereby allowed LBI to continue clearing and settling securities trades until its sale.[15]

### 3.4 Sale of LBI to Barclays

The Section 363 sale of LBI to Barclays (Exhibit 2) illustrates the complexities of an expedited sale of a large financial institution during bankruptcy under the Bankruptcy Code. For example, the Fed had to finance LBI temporarily and then arrange for Barclays to replace it, as discussed previously.

[15] The court also denied the rights of other parties, such as Bank of America and Swedbank AB, a Swedish bank and creditor to LBHI, to set off Lehman's pre-petition obligations against its cash deposit accounts, thus allowing Lehman to preserve cash. Swedbank sought to offset Lehman's payment obligations under pre-petition swaps with deposits Lehman had made at Swedbank post-petition. Bank of America seized Lehman's account funds, which were unrelated to safe harbor transactions.

Later, Barclays argued that it had not agreed to purchase some of the collateral that it was being asked to finance, leading to disputes with its clearing agent JPMC and also with LBI that persisted and threatened to derail the transaction during the weekend following September 19, 2008 (when the sale of LBI to Barclays closed). Eventually, a resolution was reached with the help of the Fed and with the Depository Trust and Clearing Corporation (DTCC) agreeing to clear LBI trades for less than the required collateral (Valukas 2010, p. 2197).[16] Even after the sale closed, unsecured creditors tried to get the sale order overturned.

## 4. Settlement of Lehman's OTC Derivatives Positions

Lehman traded in equities, fixed-income securities, and derivatives in U.S. and international markets. In the United States, many of these securities (such as equity, listed corporate and municipal bonds, U.S. government debt, and certain derivatives contracts) are centrally cleared, and their settlement occurred outside of the Chapter 11 bankruptcy process. Where Lehman acted as a broker on behalf of retail or wholesale clients and the securities were centrally cleared, the central clearinghouse was the client's counterparty. Accordingly, the central counterparties (CCPs) acted on behalf of the clients to either close out or transfer their accounts to third-party brokers. Where Lehman acted for its own account, the CCPs were Lehman's counterparty, and they generally closed out Lehman's house (proprietary) positions. Since our focus is on Lehman's resolution under the U.S. Chapter 11 Code, we relegate discussion of Lehman's centrally cleared positions to Appendix B.

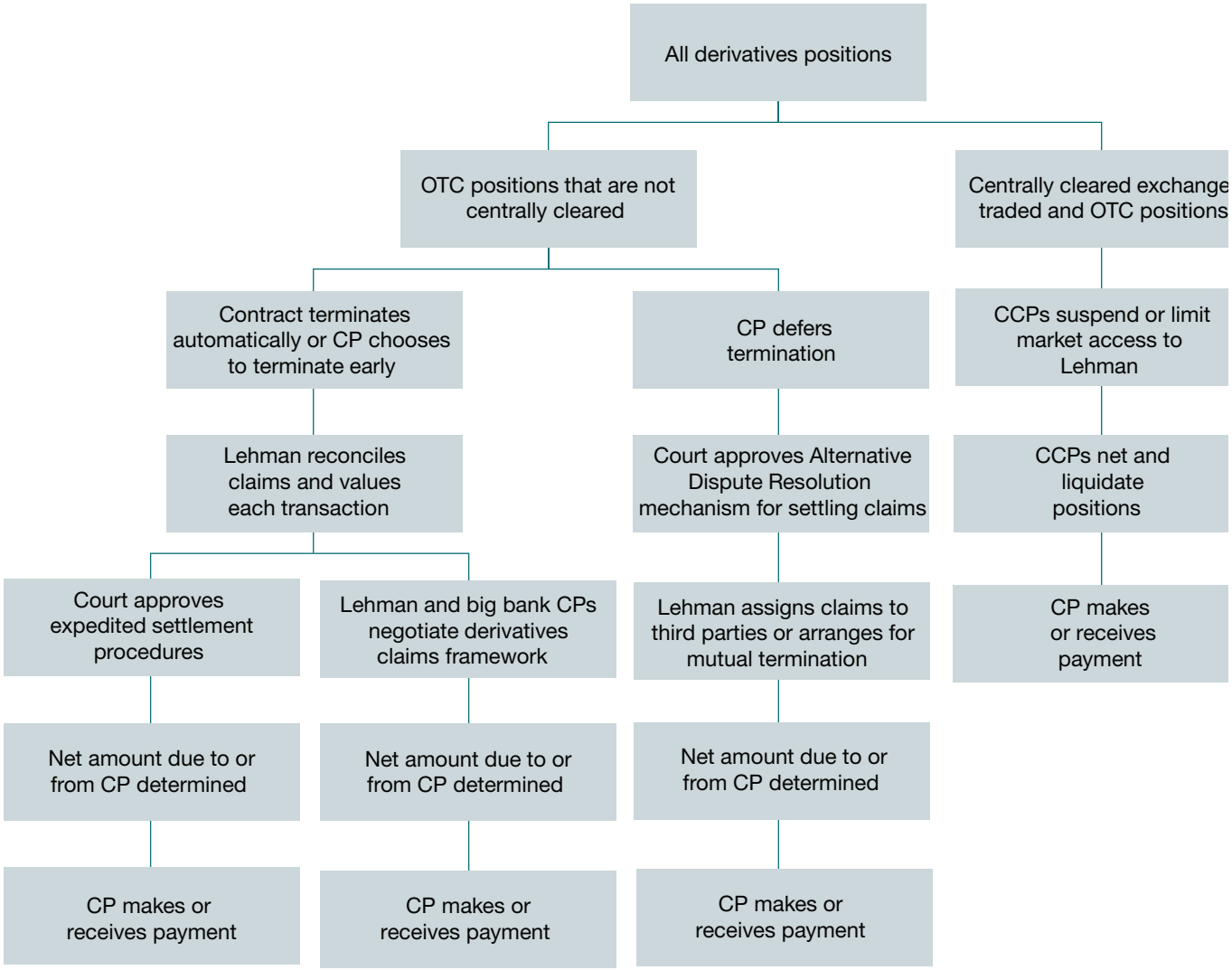
The remainder of this section describes the settlement of Lehman's OTC derivatives contracts (for example, interest rate swaps) that were bilaterally cleared (Exhibit 3).[17] Prior to bankruptcy, Lehman's global derivatives position was estimated at $35 trillion in notional value, accounting for about 5 percent of derivatives transactions globally

[16] Specifically, DTCC agreed to clear LBI trades even though the available collateral was $6 billion less than what it had previously required.

[17] A derivatives contract is an International Swaps and Derivatives Association (ISDA) Master Agreement, supplemented with a schedule. The Master Agreement and schedule collectively set forth the fundamental contractual terms of all derivatives transactions that are executed between the parties. Each individual transaction is documented with a confirmation. There may be several confirmations (corresponding to individual derivatives transactions) under a single Master Agreement and schedule (Durham 2010). Hence, there will typically be multiple trades associated with each derivatives contract.

Exhibit 3

## Lehman's Derivatives Settlement Procedures




Source: Authors' compilation.

Notes: The exhibit shows the detailed settlement procedure for derivatives contracts of Lehman Brothers. OTC is over-the-counter; CP is counterparty; CCP is central counterparty.

(Summe 2012).[18] Its OTC derivatives positions represented 96 percent of the net worth of its derivatives-related entities (Panel A of Table 2). The settlement of these contracts under the Chapter 11 provisions proved challenging, partly owing to the inherent complexity of these procedures and to the presence of large and global derivatives counterparties, as discussed below.

Concern over the size of Lehman's OTC derivatives positions led to a special trading session on September 14, 2008,

[18] Outside of the United States, derivatives transactions were executed through LBIE.

Table 2

## Settlement of Lehman's Over-the-Counter Derivatives Contracts

Panel A: Lehman Derivative Positions, at Time of Bankruptcy

| | Net Worth[a] (Billions of Dollars) | Share of Net Worth (Percent) |
|---|---|---|
| All positions | 21.0 | 100.0 |
| OTC positions | 20.3 | 96.2 |
| Exchange-traded positions | 0.8 | 3.8 |

Panel B: Termination of Derivative Claims

| | Contract | | Transactions | |
|---|---|---|---|---|
| | Number | Not Terminated (Percent) | Number | Not Terminated (Percent) |
| Initial position[b] | > 6,000 | 100.0 | > 900,000 | 100.0 |
| Terminated as of Nov. 13, 2008 | | — | 733,000 | 23.8 |
| Not terminated as of Jan. 2, 2009 | 2,667 | 43.6[b] | 18,000 | 2.0[b] |
| Not terminated as of June 17, 2009 | 1,068 | 16.9[b] | 5,858 | 0.5[b] |

Panel C: Timeline of Final Settlement of Derivative Claims

| Settled as of: | Contracts Reconciled (Percent) | Contracts Valued (Percent) | Contracts Finally Settled (Percent) | Estimated Number of Contracts Not Finally Settled[c] |
|---|---|---|---|---|
| 07/31/2009 | 45 | 35 | 6 | 5,960 |
| 09/16/2009 | 53 | 44 | 11 | 5,643 |
| 11/05/2009 | 61 | 50 | 17 | 5,262 |
| 09/30/2010 | 95 | 87 | 46 | 3,449 |
| 03/31/2011 | 99 | 99 | 59 | 2,631 |
| 12/31/2012 | — | — | 84 | 1,014 |

Panel D: Derivative Claims of Large ("Big Bank") Counterparties, January 13, 2011

| | Number of Trades | Claims (Billions of Dollars, Except as Noted) | Number of Contracts[d] |
|---|---|---|---|
| Initial position, all counterparties | 961,436[e] | 45.31 | 2,961 |
| Finally settled, all counterparties | 69,684 | 5.04 | 1,561 |
| Outstanding, all counterparties | 891,752 | 40.37 | 1,400 |
| Outstanding, thirty largest counterparties | 817,221 | 21.75 | 148 |
| Share of remaining, thirty largest counterparties (percent) | 85 | 48.00 | 5 |

Sources: Debtors' Disclosure Statement for First Amended Joint Chapter 11 Plan (January 25, 2011); Debtors' Disclosure Statement for Second Amended Joint Chapter 11 Plan (June 30, 2011); Debtors' Disclosure Statement for Third Amended Joint Chapter 11 Plan (August 31, 2011); Lehman Brothers Holdings Inc.: Debtor's Motion (November 13, 2008, and January 16, 2009), §341 Meeting (January 29, 2009, and July 8, 2009), State of the Estate (November 18, 2009), Plan Status Report (January 13, 2011), 2013+ Cash Flow Estimates (July 23, 2013); Valukas (2010).

[a] Amount equals the value of assets minus liabilities of LBHI-controlled derivative entities.

[b] Different numbers were reported for total number of contracts and trades in different reports. Shares are based on the numbers reported in the associated reports.

[c] Amount is based on an assumption of 6,340 derivative contracts at the beginning of bankruptcy.

[d] Number of contracts excludes the number of guarantee claims (that is, claims based on guarantees by LBHI).

[e] Number of trades does not correspond to that reported in Panel B as it comes from a report at a different time, and adjustments were made by the estate in the interim.

organized by major market participants to net their mutually offsetting positions. However, the netting effort largely failed as there was little trading during the session.[19] LBHI filed for bankruptcy the following day, but Lehman's derivatives entities did so only some days later.[20] However, since LBHI was the credit support party for almost all of Lehman's derivatives transactions, its bankruptcy filing constituted a default event under the ISDA Master Agreement (Appendix D provides background on the settlement of derivatives in bankruptcy). More than 6,000 derivatives claims involving more than 900,000 transactions were filed against Lehman and its affiliates.[21] Counterparties that had terminated their derivatives contracts or otherwise had claims against the estate were required, by October 22, 2009, to file a special Derivative Questionnaire and to provide a valuation statement for any collateral, specify any unpaid amounts, and supply their derivatives valuation methodology and supporting quotations.

The settlement of Lehman's OTC derivatives positions proceeded along three tracks (Exhibit 3). Most derivatives contracts were terminated early, under the safe harbor provisions that provide statutory exceptions to the automatic stay of debt in bankruptcy (see Appendix D). However, out-of-the-money counterparties, which owed money to Lehman, typically chose not to terminate their contracts. Even after termination, the parties had to agree to a termination value of their trades, which proved difficult in illiquid markets and especially so for large positions; therefore, settlement with large ("big bank") counterparties proceeded along a third track. We describe the settlement of OTC derivatives for each of these three cases.

## 4.1 OTC Derivatives Contracts That Were Terminated Early

According to the ISDA Master Agreement, the bankruptcy filing of LBHI meant that derivatives contracts with automatic early termination clauses terminated immediately (Appendix D). In addition, those counterparties of Lehman's derivatives entities without the automatic early termination option could elect to terminate their transactions by giving written notice.

The majority of Lehman's derivatives contracts, by number (but not by value, as we shall see later), were terminated shortly after LBHI's bankruptcy filing. Out of more than 900,000 trades, 733,000 were automatically terminated by November 13, 2008 (Panel B of Table 2). About 80 percent of the derivatives counterparties to Lehman Brothers Special Financing (LBSF) terminated their contracts under the ISDA Master Agreement within five weeks of the bankruptcy filing, the largest-ever termination of derivatives transactions (U.S. Government Accountability Office 2011).

Final settlement of terminated derivatives contracts required further steps (Appendix D). The Lehman estate had to 1) reconcile the universe of all trades between Lehman and a particular counterparty, 2) value each transaction, and 3) negotiate settlement amounts with the counterparty. The sheer number of derivatives contracts made each of these steps an arduous process ("Debtors' Disclosure Statement for First Amended Joint Chapter 11 Plan," January 25, 2011). Accordingly, on November 13, 2008, Lehman asked the court to approve procedures for entering into settlement agreements with counterparties that had terminated their contracts with Lehman, in order to establish termination payments and the return or liquidation of collateral, without the need for further action by the bankruptcy court. Lehman asked that these procedures also apply to counterparties that had not yet terminated their contracts but were considering doing so. The court approved these procedures on December 16, 2008. Nevertheless, only 6 percent of ISDA contracts had been settled by July 2009, with this number rising slowly to 46 percent by September 2010 (Panel C of Table 2).

## 4.2 OTC Derivatives Where Out-of-the-Money Counterparties Chose Not to Terminate Early

Many nondefaulting counterparties were out-of-the-money and would have owed large termination payments to Lehman, so they chose not to send a termination notice.[22] The Lehman estate estimated these payments to be of significant value and feared that market movements would reduce the amounts owed to it (LBHI, "Debtor's Motion for an Order

[19] See "Derivatives Market Trades on Sunday to Cut Lehman Risk," *Reuters*, September 14, 2008, available at http://www.reuters.com/article/2008/09/14/us-lehman-specialsession-idUSN1444498020080914.

[20] For example, Lehman Brothers Special Financing did not file for bankruptcy until October 3, 2008.

[21] The exact total number of Lehman's derivatives trades and contracts at the time of bankruptcy remains unclear. Reports by the Lehman estate variously put the number of trades at 906,000, 930,000, and 1,178,000, and the number of contracts at 6,120, 6,340, and 6,355.

[22] For example, many municipalities and nonprofits had issued floating-rate bonds and entered into interest rate swaps with Lehman where they paid a fixed rate and received a floating rate. Some of these swap counterparties were out-of-the-money to Lehman as the fixed rate was higher than the floating rate prior to Lehman's bankruptcy (Braun 2013).

Pursuant to Sections 105 and 365 of the Bankruptcy Code," November 13, 2008). Moreover, the counterparties refused to make required periodic payments to Lehman on out-of-the-money contracts on the grounds of Lehman's default under the ISDA Master Agreement.[23]

Lehman and its counterparties were often unable to agree on the amount due on contracts when the counterparty was out-of-the-money, partly because of the prevailing illiquidity of markets, which made valuing derivatives trades difficult. Under the Master Agreement, valuation claims are determined primarily by replacement costs, which diverged substantially from fair market value owing to the wide bid-offer spreads at the time. Moreover, Scott (2012) argues that replacement costs likely did not track actual costs, because nondefaulting parties had considerable leeway in arriving at their estimates and also because it was likely difficult to obtain three dealer quotes as required (see Appendix D).

On November 13, 2008, Lehman asked the court to approve procedures to realize the value of nonterminated derivatives contracts either by Lehman assigning them to third parties in exchange for consideration, or alternatively by mutual termination. The court gave its approval (LBHI, "Debtor's Motion for an Order Approving Consensual Assumption and Assignment of Prepetition Derivative Contracts," January 28, 2009), authorizing Lehman to assign nonterminated derivatives contracts with the consent of unsecured creditors and the counterparty, but without the need for further court approval. The effect of the court's decisions was to strongly encourage out-of-the-money counterparties to comply with these Alternative Dispute Resolution (ADR) procedures and to substantively engage in settlement and termination discussions.[24] Indeed, by January 2, 2009, just 2,667 contracts (out of more than 6,000 contracts at the time of bankruptcy) and 18,000 derivatives trades remained outstanding, and by June 17, 2009, less than 17 percent of contracts and less than 1 percent of trades were not terminated (Panel B of Table 2).

Assignment of claims moved slowly, partly because of market illiquidity and the balance sheet constraints of financial firms, and partly because the positions were less valuable. For example, some were uncollateralized, had weak credits, or involved long maturity instruments (LBHI, "§341 Meeting," July 8, 2009). Nevertheless, the Lehman estate made good progress on collecting derivatives receivables, with cash collections increasing from less than $1 billion through November 7, 2008, to about $8 billion through November 6, 2009 (LBHI, "The State of the Estate," November 18, 2009) and to about $11.5 billion through June 30, 2010 (LBHI, "The State of the Estate," September 22, 2010). As of January 10, 2011, Lehman had issued notices to counterparties commencing ADR procedures in connection with 144 derivatives contracts and resolved fifty-two of these contracts, resulting in receipt of approximately $356 million ("Debtors' Disclosure Statement for First Amended Joint Chapter 11 Plan," January 25, 2011).

## 4.3 OTC Derivatives Contracts with Big Bank Counterparties

The OTC derivatives market was highly concentrated at the time of LBHI's bankruptcy (and remains so today), with a few large banks accounting for a substantial share of market activity. This fact was reflected in counterparty shares of the value of derivatives claims against Lehman and, in particular, the shares of the thirty largest "big bank" counterparties, all of which were affiliates of thirteen major financial institutions.[25] Thus, in January 2011, the Lehman estate reported that, of the outstanding contracts, the share of the thirty big bank counterparties was 85 percent of the number of trades and 48 percent of derivatives contracts by dollar value, but only 5 percent of the number of contracts (Panel D of Table 2).

Settlement of derivatives with big bank counterparties proved challenging owing to difficult legal and valuation issues (LBHI, "The State of the Estate," September 22, 2010). First, the total amount distributable to derivatives creditors depended upon the resolution of the basis for the distribution of creditor claims (that is, whether it should be the assets of subsidiaries or of Lehman's consolidated balance sheet—the "substantive consolidation" issue). As further discussed in Section 5, after negotiations between Lehman and its creditors, between 20 and 30 percent of payments owed to creditors (including derivatives creditors) of affiliates such as LBSF were reallocated to holding company creditors. Second, the Lehman estate and the big bank counterparties needed to negotiate a uniform method for settling the remaining outstanding derivatives contracts.

The Lehman estate argued that big bank counterparties submitted inflated claims ("Debtors' Disclosure Statement for

[23] For example, Metavante Corporation refused to make payments on an interest rate swap agreement with LBSF ("Debtors' Disclosure Statement for First Amended Joint Chapter 11 Plan," January 25, 2011).

[24] The rules of discussions were formalized by the court's order on September 17, 2009, approving the ADR and mediation procedures for nonterminated derivatives trades. The purpose of the order was to promote "consensual recovery" and to encourage effective communication between Lehman and its counterparties.

[25] The thirteen major financial institutions were Bank of America, Barclays, BNP Paribas, Citigroup, Credit Suisse Group, Deutsche Bank, Goldman Sachs, JPMorgan Chase, Merrill Lynch, Morgan Stanley, the Royal Bank of Scotland, Société Générale, and UBS.

First Amended Joint Chapter 11 Plan," January 25, 2011).[26] Their disagreements centered on 1) the time and date of valuation, 2) the method of valuation (for example, use of the bid or ask price as opposed to the mid-market price, as well as the inclusion of additional amounts added to the mid-market prices), and 3) setoff.[27] As previously discussed, the valuation of claims proved particularly difficult because of the "replacement cost" methodology required by the Master Agreement and the wide bid-offer spreads at the time.[28] Lehman and its counterparties also disagreed on the discount rate and prices that were inputs into valuation models (for example, whether to use end-of-day prices on a particular date).

To avoid the costs and delays of litigating disputes with the big bank counterparties individually (and a potentially different outcome in each case), a derivatives claims settlement framework was included as part of Lehman's January 2011 liquidation plan. The framework provided for rules to settle the half of derivatives claims that remained outstanding at the time and a commitment to a process and timeline (LBHI, "The State of the Estate," September 22, 2010). The derivatives claims settlement rules offered a standardized methodology. In particular, these derivatives contracts were valued at mid-market at the market close of a specified termination date with an "additional charge" based on the maturity and risk of the contracts ("Debtors' Disclosure Statement for Third Amended Joint Chapter 11 Plan," August 31, 2011).[29] Also, the number of maturity "buckets" used for aggregating and offsetting exposures was reduced. With regard to the process, the framework was used to determine most unsettled derivatives claims (all claims except for those already settled, those not disputed by Lehman, or those previously allowed by the bankruptcy court).

Confirmation of the Joint Chapter 11 plan by the court on December 6, 2011, did not completely resolve the settlement of derivatives with big bank counterparties, as the Lehman estate had entered into settlement with only eight of thirteen major financial firms at the time. The slow progress of negotiations can be gauged by the fact that, in 2012, the estate settled only about 1,000 of the roughly 2,000 contracts open at the beginning of the year (LBHI, "2013+ Cash Flow Estimates," July 23, 2013). This implies that an estimated 16 percent of contracts remained to be finally settled almost a year after confirmation of the liquidation plan (Panel C of Table 2). Nevertheless, sufficient progress was made such that the Lehman estate was able to make the first distribution to creditors on April 17, 2012.

### *Discussion: Settlement of Lehman's Derivatives Claims*

For a firm, like Lehman, that was planning to liquidate its assets, the objective of Chapter 11 bankruptcy is to maximize the present recovery value of the bankruptcy assets of each of its entities. However, there is a trade-off between obtaining the highest possible recovery value of assets, which may require a lengthy bankruptcy process, and minimizing costs (such as legal and administrative fees) that increase with time.[30] Moreover, uncertain and unpredictable resolutions may destroy value by increasing systemic risk through information contagion (in other words, bad news about Lehman's resolution adversely impacting other firms) or fire sales of correlated assets of entities unrelated to Lehman. Conversely, resolutions that largely follow case law, and that keep claimants informed on a regular basis, are likely to mitigate value destruction from resolution. Accordingly, we assess the efficiency of the claims settlement process with respect to its duration, predictability, and transparency.

### *Promptness of Resolution Varied across Creditor Claims*

The speed of resolution varied across claimant groups. Retail OTC derivatives counterparties of Lehman terminated their contracts within weeks of the bankruptcy filing under the safe harbor provisions. But despite a perception to the contrary,[31] the final settlement of their claims was a long

[26] The disagreements between Lehman and the big bank counterparties stem from the rights of the debtor and its counterparties under Section 562 of the Bankruptcy Code.

[27] Lehman's out-of-the-money counterparties attempted to reduce their payments by "setting off" the amount they owed to Lehman against money that (they claimed) Lehman owed to them in a separate transaction.

[28] An example of inflated claims resulting from the changed valuation methodologies occurred with respect to Lehman's derivatives transactions with Nomura Holdings (Das 2012). Prior to their termination on September 8, 2008, Nomura appeared to owe Lehman $484 million. Subsequently, however, Nomura lodged a calculation statement claiming that Lehman owed it $217 million. The $700 million difference was the result of Nomura changing from the quotation method to the loss method, according to Lehman.

[29] If the big banks could prove that they entered into economically identical and commercially reasonable replacement trades on the date of LBHI's filing, they could use the value of these trades instead of the methodology.

[30] Covitz, Han, and Wilson (2006) find that firm value initially increases with time spent in default, but declines thereafter. Earlier research that does not account for the endogeneity of time in default finds a negative relationship between value and the time spent in default (see, for example, Acharya, Bharath, and Srinivasan [2007]).

[31] For the contrary perspective, see Liew, Gu, and Noyes (2010), who state that "counterparties of Lehman Brothers were able to close out their OTC trades

process, proceeding along three separate tracks, requiring two settlement mechanisms in addition to the one specified in the ISDA Master Agreement, and involving continuing litigation and numerous operational problems.[32] Thus, about 1,000 derivatives contracts remained "not settled" by the beginning of 2013, more than four years after the start of Lehman's bankruptcy.

The Lehman estate pointed to the need for doing due diligence on numerous, complex claims on an individual basis as the chief cause of delay. The Lehman estate had statutory duties and fiduciary obligations to review and reconcile how each party reached its early termination amount so that all creditors would be treated equally ("Debtors' Disclosure Statement for First Amended Joint Chapter 11 Plan," January 25, 2011). For example, the Lehman estate had to identify and object to claims that were inflated in value or were duplicative of other claims. Claims that involved complex and illiquid securities were difficult to value. The estate's determinations of claims were frequently subject to litigation by creditors. Indeed, the two new settlement mechanisms approved by the courts were a means of applying uniform methods to a large number of claims, and it appears that they proved effective in facilitating settlement.

Another factor delaying the resolution of claims was the lack of pre-bankruptcy planning by Lehman, resulting in LBI being sold to Barclays in haste. The rushed sale caused numerous problems—uncertainty regarding the number of Lehman customer accounts transferred to Barclays or left behind, lack of access to the accounts that were left behind, and litigation with Barclays, CCPs, and clearing firms regarding the LBI sale—all of which prolonged the resolution process (see Appendix C).

Finally, the organizational complexity of Lehman contributed to delays. In many instances, Lehman and its counterparties were uncertain of the identity of the specific Lehman entity against which creditors had claims. Moreover, different Lehman entities had different bankruptcy filing dates in different international legal jurisdictions, which created problems in cases where one subsidiary was acting as an agent of another subsidiary in client transactions. Further, Lehman's interconnectedness (in particular, guarantees by the holding company to affiliates) led to delays as holding company creditors argued in favor of a greater share of recovery than expected under strict priority rules.

### *Predictability of Resolution Outcomes Was Less than Expected*

Some legal experts have considered the Chapter 11 process predictable because it follows a long-standing legal tradition with an established set of rules for allocating creditor claims (U.S. Government Accountability Office 2011). This was only partly true for Lehman's bankruptcy, as new precedents were set for many aspects of its resolution. For example, the allocation of creditor claims did not follow standard priority rules. While deviations from priority rules are not unusual in Chapter 11 proceedings, they have declined substantially over time, dropping from 75 percent of cases before 1990 to only 9 percent during the period 2000-05 (Bharath, Panchapagesan, and Werner 2010). Moreover, deviations from absolute priority have typically favored equity holders (Bharath, Panchapagesan, and Werner 2010), whereas under Lehman's Chapter 11 liquidation plan, creditors of derivatives entities with positive net worth received less than their strict priority shares, while holding company creditors received more.

In the Lehman bankruptcy, complex financial structures were analyzed and adjudicated in the bankruptcy court for the first time, and consequently the court's judgments were sometimes controversial and even surprising to many observers (as acknowledged by Judge Peck in "Lehman Brothers Special Financing Inc. versus BNY Corporate Trustee Services Limited," January 25, 2010). Thus, in some cases, Lehman's counterparties may have been denied the benefits of certain safe harbor provisions, such as when the court refused to enforce "flip clauses" (widely used in collaterized debt obligations and other financial structures).[33] Since the U.S. court's decision contradicted an earlier U.K. court decision, and the U.S. case was subsequently settled out of court, the legal validity of flip clauses became uncertain and potentially affected the credit ratings of financial structures.[34] Also, the

smoothly under ISDA Master Agreements, despite severely stressed market conditions." See also Summe (2012) for a similar viewpoint.

[32] Operational problems resulted from market participants that traded with different Lehman entities having multiple ISDA Master Agreements in place with different transactions recorded under each contract, according to Das (2012), who adds that many counterparties' information systems inaccurately grouped contracts for determining netting and net exposure.

[33] In the case involving flip clauses, LBSF was a credit default swap counterparty to a special purpose vehicle that issued credit-linked synthetic portfolio notes, with LBHI acting as LBSF's guarantor. The notes were secured by collateral, which Bank of New York held in trust for the benefit of both the note holder and LBSF. When LBHI filed for bankruptcy, the swaps were terminated, and LBSF had priority over the collateral. But Bank of New York argued that, since LBSF also filed for bankruptcy later, the priority reverted to the note holder instead because of a "flip clause" specified in the swap contract. However, the court ruled that the flip clause was unenforceable under the *ipso facto* doctrine prohibiting the modification of a debtor's contractual rights because of the debtor's bankruptcy ("Lehman Brothers Special Financing Inc. versus BNY Corporate Trustee Services Limited," January 25, 2010).

[34] In other cases, the bankruptcy court was thought to have defined the rights of nondefaulting parties under safe harbor provisions more narrowly than previously—for example, by imposing a time limit on a counterparty's right to seek relief, as in the Metavante case (LBHI, "Order Pursuant to

settlement of Lehman's OTC derivatives with large institutional counterparties followed different rules compared with those that were terminated early. For example, the valuation methodology for calculating termination amounts for big bank counterparties, as outlined in the derivatives claims settlement framework, was different from that followed for non-big bank counterparties.

### *Transparency of Resolution Was Good, but Could Have Been Better*

The Lehman estate issued numerous reports and created websites containing archives of court documents and presentations. Nevertheless, the level and accuracy of detail provided by the Lehman estate could have been better. For example, at least three different versions of Lehman's initial derivatives positions were provided in different reports. Moreover, numbers were reported piecemeal rather than in the aggregate and often without much context. For example, it is difficult to estimate the total amount paid by the Lehman estate in consulting and professional fees and administrative expenses since the inception of the bankruptcy filing. One report showed the fees and expenses paid since 2011 (the amount reported in the media), while the fees and expenses paid prior to 2011 were reported in multiple other documents. Moreover, the fee and expense categories sometimes differed between the earlier and later reports. In a similar vein, information about the number of claims reconciled, valued, settled, and still open was provided piecemeal and at different points in time. In some respects, the dribbling out of information reflected the fact that the Lehman estate was engaged in settling thousands of complex claims dynamically, with the relevant information subject to periodic revisions. Nevertheless, it would be valuable if, in future resolutions, the bankruptcy estate provided more comprehensive statistics so that interested parties could obtain a better understanding of the resolution process.

Sections 105(a), 362, and 365 of the Bankruptcy Code," September 17, 2009). However, a counterparty waiting too long to terminate could be deemed to have waived its right to do so (Charles 2009). Some commentators have argued that creditor rights under safe harbor provisions were limited when the court granted Lehman the right to choose the time of termination, to determine the termination value, and to act as the calculating agent for valuing derivatives—rights that would normally by exercised by the nondefaulting party (Ricotta 2011; Das 2012). A counterargument is that Section 562 of the Bankruptcy Code gives Lehman certain rights to make some of these determinations. Finally, the Lehman bankruptcy raised new issues regarding the applicability of safe harbor provisions to setoff rules, such as whether such provisions may eliminate the requirement that the obligations are mutual—that is, creditor A and debtor B must owe money to each other (Smith 2010).

## 5. Recovery Estimates for Lehman Creditors under Chapter 11

At the time of the bankruptcy filing, there were 67,000 claims against Lehman worth $1.16 trillion (Panel A of Table 3). Under a plan that Lehman submitted to creditors and the court on June 29, 2011, initial claims were reduced to $764 billion, after adjusting for duplicate, inflated, and invalidly filed claims.[35] Of this amount, claims totaling about $214 billion, or 28 percent of the total, were effectively "double counted" since they were either guarantee claims (claims based on guarantees by LBHI) or affiliate claims (claims by Lehman entities against each other).[36] After this and other adjustments, allowed claims to third-party creditors across twenty-three Lehman entities totaled $362 billion.

Of the total allowed claims, recovered assets were originally estimated at nearly $84 billion—prior to administrative expenses of $3.2 billion, amounts due to intercompany entities or affiliates of nearly $2.9 billion, and operating disbursements of approximately $3.1 billion—for a net distributable amount to third-party creditors of $75.4 billion (second column of Panel A of Table 3). The net amount expected to be distributed to third-party creditors amounted to a claim payout ratio of 20.9 percent.

As of March 27, 2014, the Lehman estate had made five distributions to creditors, with total recoveries exceeding the initial estimates and allowed claims falling below the initial estimates. Consequently, the recovery ratio for unsecured creditors has been more than 28 percent (last column of Panel A, Table 3).[37] The amounts distributed include intercompany claims, so that third-party recovery rates have been lower than 28 percent. For example, of almost $45 billion provided in the third, fourth, and fifth distributions, third-party creditors received about $32 billion. Moreover, part of the higher recovery rate is owing to a reduction in claims allowed by the Lehman estate. Nevertheless, recoveries for third-party creditors appear to have been larger than

[35] While the recovery estimates reported in the table were as of May 13, 2011, the plan was submitted to the court on June 29, 2011.

[36] For example, a third-party guarantee claim is that of a third party against LBHI on account of its guarantee of an affiliate and is duplicative of the party's direct claim against the affiliate.

[37] We estimate the payout ratio for LBHI creditors from the distribution notices (see LBHI: "Notice Regarding Initial Distributions Pursuant to the Modified Third Amended Joint Chapter 11 Plan ," April 11, 2012; "Notice Regarding Second Distributions Pursuant to the Modified Third Amended Joint Chapter 11 Plan," September 25, 2012; "Notice Regarding Third Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan," March 27, 2013; "Notice Regarding Fourth Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan," September 26, 2013; "Notice Regarding Fifth Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan," March 27, 2014).

Table 3

## Estimated Recovery of Creditor Claims under Chapter 11

Panel A: Aggregate Recovery for Lehman and Affiliates, as of March 2014
Billions of Dollars, Except as Noted

| | Estimated Recovery for Third-Party Creditors | | Distributions to All Creditors, Unsecured Claims |
|---|---|---|---|
| | September 15, 2008 | May 13, 2011 | March 27, 2014 |
| Number of claims | 67,000 | 48,000 | |
| Value of claims | 1,160 | 764 | |
| Reductions related to: | | | |
| Accounts payable and other | | 113 | |
| Third-party guarantee claims | | 83 | |
| Affiliate guarantee claims | | 72 | |
| Affiliate claims | | 59 | |
| Number of claims based on derivative contracts | | 45 | |
| Debt | | 22 | |
| Value of claims after reduction | | 370 | |
| Other adjustments | | 8.5 | |
| Estimated allowed claims | | 361.5 | 303.6 |
| Estimated recovery | | 83.7 | |
| Administrative expenses[a] | | 3.2 | |
| Due to intercompany entities | | 2.9 | |
| Operating disbursements[b] | | 3.1 | |
| Net amount distributable | | 75.4 | 86.0 |
| Payout ratio[c] (Percent) | | 20.9 | 28.3 |

Panel B: Recovery by Affiliate as of March 27, 2014

| Affiliate | Primary Assets | Shareholder Equity/ Total Assets[d] (Percent) | Cash Position[d] (Millions of Dollars) | Distributions to All Creditors, Unsecured Claims (Billions of Dollars) | Payout Ratio, General Unsecured Creditors[c] (Percent) |
|---|---|---|---|---|---|
| LBHI | Holding company | 9.7 | 1,148 | 49.82 | 25.23 |
| LOTC | OTC derivatives | 13.5 | 132 | 1.42 | 100.00 |
| LBDP | Interest-rate and currency swaps | 51.9 | 297 | 0.67 | 100.00 |
| LBFP | Interest-rate and FX OTC derivatives; exchange-traded derivatives; government bonds | 54.9 | 7 | 0.45 | 100.00 |
| LBCC | OTC and exchange-traded foreign currency | 10.3 | 8 | 1.58 | 87.41 |
| LBCS | Commodities | 12.3 | 30 | 2.32 | 67.38 |
| LCPI | Secured and unsecured loans | Negative | 461 | 15.41 | 61.63 |
| LBSF | Interest-rate, currency, credit, and mortgage derivatives | 4.3 | 7 | 13.06 | 30.90 |

Table 3 (Continued)
## Estimated Recovery of Creditor Claims under Chapter 11

Panel C: Estimated Recovery for Derivative Claims of Large Counterparties as of May 13, 2011

| Claimants | Asserted Claims (Billions of Dollars) | Allowed Claims (Billions of Dollars) | Allowed to Asserted Claims (Percent) |
|---|---|---|---|
| Eight largest counterparties | 9.6 | 6.2 | 64.6 |
| Thirty largest counterparties | 21.8 | 10.3 | 47.4 |

Sources: Debtors' Disclosure Statement for Second Amended Joint Chapter 11 Plan (June 30, 2011); Debtors' Disclosure Statement for Third Amended Joint Chapter 11 Plan (August 31, 2011); Lehman Brothers Holdings Inc.: State of the Estate (November 18, 2009, and September 22, 2010), Notice Regarding Initial Distributions Pursuant to the Modified Third Amended Joint Chapter 11 Plan (April 11, 2012), Notice Regarding Second Distributions Pursuant to the Modified Third Amended Joint Chapter 11 Plan (September 25, 2012), Notice Regarding Third Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan (March 27, 2013), 2013+ Cash Flow Estimates (July 23, 2013), Notice Regarding Fourth Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan (September 26, 2013), Notice Regarding Fifth Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan (March 27, 2014); Valukas (2010).

Notes: LBHI is Lehman Brothers Holdings Inc.; LBDP is Lehman Brothers Derivative Products; LBFP is Lehman Brothers Financial Products; LCPI is Lehman Commercial Paper Inc.; LBCS is Lehman Brothers Commodity Services; LBCC is Lehman Brothers Commercial Corporation; LOTC is Lehman Brothers OTC Derivatives; LBSF is Lehman Brothers Special Financing.

[a] For LBHI, the amount includes $1 billion of incremental liquidation administrative expenses.
[b] From 2011 onwards; the amount includes professional fees and compensation, outsourced services, and information technology activities.
[c] Amount equals net amount distributed as percent of estimated allowed claims.
[d] Shareholder equity, total assets, and cash position numbers are as of September 14, 2008. LBHI's cash position includes $509 million seized post-filing by Bank of America.

expected, helped by settlements with other banks and Lehman's foreign subsidiaries.

Based on the cumulated distributions so far, creditors of the holding company (LBHI) have received 21.3 percent of their allowed claims in the aggregate. Senior unsecured creditors of LBHI have received 26.9 percent of their allowed claims (LBHI, "Notice Regarding Fifth Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan," March 27, 2014).[38]

We examine historical recovery rates to assess whether LBHI's recovery rate so far has been significant (as argued by Scott [2012]) or poor (according to the Federal Deposit Insurance Corporation [2011]). Average recovery rates for senior unsecured claims between 1982 and 1999, based on bonds, loans, and other debt instruments, are estimated at 56 percent for all industries and 59 percent for financial institutions (Acharya, Bharath, and Srinivasan 2007). Recovery rates are considerably lower during periods of distress: 19 percentage points lower in recessions (Schuermann 2004), 15 percentage points lower in periods of industrial distress (Acharya, Bharath, and Srinivasan 2007), and 15 to 22 percentage points lower, depending on the default event, during credit cycle downturns (Bruche and Gonzalez-Aguado 2007).[39] Thus, even after accounting for possibly reduced recovery rates owing to adverse credit and macroeconomic conditions, the recovery rate so far for LBHI has been low compared with the historical average. With additional distributions yet to come, the final recovery rate is expected to be higher, but it remains to be seen whether it will meet historical norms.

While the average payout ratio for Lehman and affiliates has been about 28 percent, recovery rates have been higher for creditors of certain derivatives subsidiaries of LBHI and, in a few cases, have reached 100 percent (Panel B of Table 3). The plan had estimated that seven of the twenty-three Lehman entities would pay all of their claims in full and have remaining funds for their shareholders. Prior to its bankruptcy filing, Lehman traded derivatives through a number of wholly owned subsidiaries, both in a trading capacity and as an end-user, as listed in Panel B of Table 3.[40] Lehman's first

[38] Other creditor groups received considerably less. For example, senior third-party guarantee claims recovered 16.7 percent and subordinate claims recovered 0 percent (LBHI, "Notice Regarding Fifth Distribution Pursuant to the Modified Third Amended Joint Chapter 11 Plan," March 27, 2014).

[39] In Bruche and Gonzalez-Aguado (2007), the credit cycle is unobservable and represented by a two-state Markov chain. While the literature does not find a statistically significant effect of macroeconomic factors on recovery rates (Altman, Brady, Resti, and Sironi 2005; Acharya, Bharath, and Srinivasan 2007), these studies have short sample periods that do not include many recession periods.

[40] Lehman's fixed-income derivatives products business was principally

liquidation plan filed in March 2010[41] had called for maintaining the corporate distinction of each of the twenty-three Lehman entities that had filed for bankruptcy, implying that each affiliate would make payments to its creditors on the basis of its own assets. Derivatives creditors would have generally benefited from such an approach, given the positive equity cushions of most Lehman derivatives entities.

General creditors of LBHI argued that parent company guarantees of affiliates' debt meant that more debt resided at the parent level while assets were at the subsidiary level.[42] As such, creditors with claims against an affiliate subject to an LBHI guarantee could recover against both LBHI and the affiliate. An ad hoc group of ten LBHI creditors submitted their own liquidation plan on December 15, 2010, proposing to "substantially consolidate" all affiliates' assets into one Lehman entity. In contrast to the existing company structure, under the consolidated structure, guarantee claims would be eliminated. Therefore, holders of parent company claims would receive more with consolidation. Lehman rejected this plan and, after further negotiations with creditors, submitted an amended plan on June 29, 2011, that proposed to retain the corporate formalities of each debtor entity, but to redistribute the payouts made to certain creditors. After further revisions to this plan, the Modified Third Amended Plan was finally confirmed on December 6, 2011, following a creditor vote, and became effective on March 6, 2012, enabling Lehman to emerge from bankruptcy and make distributions to creditors.

As a result of the plan, between 20 and 30 percent of payments owed to creditors of various operating companies were forfeited and reallocated to the parent company's creditors. In particular, distributions due to claim holders of derivatives entities such as LBSF, Lehman Commercial Paper Inc., Lehman Brothers Commodity Services, Lehman Brothers OTC Derivatives Inc., and Lehman Brothers Commercial Corporation were reallocated to holders of senior unsecured claims and general unsecured claims against LBHI. Accordingly, while Lehman Brothers OTC Derivatives Inc., Lehman Brothers Financial Products, and Lehman Brothers Derivative Products all had recovery rates of 100 percent, LBSF (the largest derivatives entity) had recovered about 31 percent, despite having a positive equity cushion (Panel B of Table 3).

Recovery rates for large derivatives counterparties are likely to be different from those of other secured creditors. This is because the Lehman estate followed a different settlement approach regarding these claims, as discussed in Section 4. Under the Chapter 11 liquidation plan, the eight largest financial institutions were allowed about 65 percent of their asserted claims, while the thirty largest big bank counterparties were allowed about 47 percent of their asserted claims (Panel C of Table 3).

### *Discussion: Recovery Rates of Lehman Creditors*

Recovery rates varied across creditor groups. Creditors of two Lehman derivatives entities received full recovery on their claims, while customers of centrally cleared securities were mostly made whole. In contrast, most counterparties of Lehman's OTC derivatives suffered substantial losses. What caused some Lehman creditors to receive better recovery rates than others?

A crucial factor for LBI customers to receive full recovery was the availability of Federal Reserve funding for LBI and Barclays in the first week after bankruptcy, which allowed LBI to continue operating until it was sold to Barclays. The Fed also urged LBI's clearing agents to continue to provide intraday liquidity so that trades could be settled (LBHI, "Debtors versus JPMorgan Chase Bank, N.A.," April 19, 2012).

Central clearing allowed Lehman's positions to be terminated rapidly and resulted in minimal losses for Lehman's customers (Appendix B). However, CCPs and clearing firms filed numerous suits against the Chapter 11 debtors and the SIPA trustee (Appendix C) that, had these suits not been decided in favor of Lehman, would have led to larger losses for Lehman's customers. Also, despite central clearing, some of Lehman's house positions suffered large losses due to the extreme illiquid market conditions prevailing during the financial crisis (Appendix B).

The positive net worth of most of Lehman's derivatives entities at the time of bankruptcy also helped, although the largest entity (LBSF) was borderline insolvent with shareholder equity of only 4 percent of total assets (Panel B

conducted through LBSF and Lehman's separately capitalized "AAA"-rated subsidiaries Lehman Brothers Financial Products and Lehman Brothers Derivative Products. Lehman's equity derivatives products business was conducted through Lehman Brothers Finance, Lehman Brothers OTC Derivatives Inc., and LBIE, and its commodity and energy derivatives product business was conducted through Lehman Brothers Commodity Services. Lehman conducted a significant amount of its spot, forward, and option foreign exchange business through Lehman Brothers Commercial Corporation.

[41] There were four versions of Lehman's joint proposed Chapter 11 plan (referred to as the liquidation plan in the text). The original proposal was filed in March 2010, followed by amended versions on January 25, 2011, June 30, 2011, and August 31, 2011.

[42] LBHI was the guarantor to the majority of ISDA derivatives contracts with about 1.7 million trades and more than 10,000 counterparties (Government Accountability Office 2011). There were also intercompany claims against Lehman's subsidiaries. For example, other Lehman entities filed 630 claims worth about $19.9 billion against LBI.

of Table 3). Indeed, derivatives positions were reliable revenue sources for the Lehman estate during bankruptcy (Summe 2012). Derivatives creditors could have received even more if some of their allocations had not been diverted to larger counterparties of LBHI under the Chapter 11 liquidation plan.

In contrast to centrally cleared derivatives, the settlement of Lehman's OTC derivatives claims may have resulted in significant losses to Lehman ("Debtors' Disclosure Statement for First Amended Joint Chapter 11 Plan," January 25, 2011; U.S. Government Accountability Office 2011) or to Lehman's counterparties. In particular, Lehman's counterparties used the safe harbor provisions to terminate contracts when they stood to gain and to keep alive contracts when they were out-of-the-money. Further, they refused to make required periodic payments to Lehman on out-of-the-money contracts on the grounds of Lehman's default under the ISDA Master Agreement.

In other cases, the settlement of Lehman's OTC derivatives claims may have resulted in significant losses to Lehman's counterparties. Some Lehman counterparties suffered losses owing to the selection of the termination date for safe harbor purposes (Ricotta 2011). Although Lehman filed for bankruptcy protection at about 1:00 a.m. on Monday, September 15, 2008, the termination date was set as Friday, September 12, for derivatives subject to automatic termination. Normally, nondefaulting derivatives counterparties of Lehman would have attempted to hedge their positions on Monday to mitigate expected losses on their positions. However, they could not do so since their positions were deemed to have terminated two days earlier. Also, in some cases, parties had sent wire transfers to various Lehman entities on Friday to satisfy their obligations to make periodic payments, even though such payments were not required once Lehman had defaulted (Ricotta 2011). Some of these parties that had elected automatic early termination tried to revoke their elections ex post, but such an election is irrevocable.

Scott (2012) argues that twenty-four of Lehman's top twenty-five counterparties by number of derivatives transactions had entered into credit support annexes with Lehman that required the out-of-the-money party to post collateral based on mark-to-market liability, greatly mitigating the effects of a default if counterparties exercised their rights under these agreements. However, the actual extent of collateralization is in dispute. For example, it has been alleged that Lehman did not post sufficient collateral, that it failed to segregate collateral, and that hypothecated collateral could not be recovered in a timely fashion (Ricotta 2011). These problems arose in part because, although counterparties posted initial margin (or "independent amount") on their OTC trades with Lehman, dealers like Lehman generally do not post initial margin to their buy-side counterparties (Scott 2012).

Under safe harbor provisions, Lehman's nondefaulting counterparties could seize collateral that Lehman posted to them before default, even if the collateral was posted just before bankruptcy. Some in-the-money counterparties suffered losses when, under the credit support annexes included in their derivatives contracts, Lehman affiliates either were never required to post collateral or did not post sufficient collateral (Ricotta 2011).[43] As a result, they were unable to make recovery through the close-out netting process and became unsecured creditors to the Lehman estate.

Although Lehman typically did not post collateral, it held collateral posted by its counterparties. Lehman sometimes commingled its counterparties' liquid collateral with its own (less liquid) assets, either because it was allowed to hypothecate collateral, or because it did not hold counterparty collateral in a segregated account (Ricotta 2011; Scott 2012). Counterparties that had allowed Lehman to hypothecate their collateral to unrelated third parties in connection with securities transactions that could not be unwound found that their collateral had become unrecoverable. When Lehman did not segregate collateral, the collateral became an unsecured claim in the Chapter 11 cases or subject to Lehman's SIPA receivership proceedings (Ricotta 2011). It follows that counterparties did not know when their collateral would be returned to them, nor did they know how much they would recover given the deliberateness and unpredictability of the bankruptcy process.

## 6. Conclusion

The bankruptcy of Lehman Brothers was one of the largest and most complex in history, encompassing more than $1 trillion worth of creditor claims, four bodies of applicable U.S. laws, and insolvency proceedings that involved more than eighty international legal jurisdictions. The payout ratio to third-party creditors was initially estimated to be about 21 percent on estimated allowable claims of $362 billion. While actual distributions appear to have exceeded initial estimates, some of it has gone to other Lehman entities. Moreover, recovery rates for Lehman's senior unsecured creditors remain below historical averages even after accounting for possible mitigating factors (such as the state

[43] In lieu of posting collateral, LBHI provided credit guarantees for nearly all the derivatives transactions of its affiliates.

of the economy and the credit cycle). Customers of centrally cleared securities were generally made whole, and most customers of Lehman's broker-dealer were able to transfer their accounts to other solvent broker-dealers. In contrast, many counterparties of Lehman's OTC derivatives suffered substantial losses.

We argue that some of the losses associated with the failure of Lehman Brothers may have been avoided in a more orderly liquidation process. The poor planning of the bankruptcy process, in particular, stands out as being especially costly. In contrast, creditor losses would have been more substantial without the ability of Lehman's U.S. brokerage subsidiary, and subsequently of Barclays, to finance positions through the Federal Reserve's liquidity facilities.

The size and complexity of Lehman resulted in costly delays in settling claims. The settlement process was long as the Lehman estate had a fiduciary duty to do due diligence on numerous, complex claims on an individual basis. Further, its determination of claims was frequently litigated, as is typical for bankruptcies of large firms. Lehman's organizational complexity also contributed to delays. For example, in many instances, Lehman and its counterparties were uncertain of the identity of the specific Lehman subsidiary against which creditors had claims. Finally, Lehman's interconnectedness led to delays as LBHI creditors argued in court that, since the holding company had guaranteed some of the subsidiaries' debt, they were entitled to a portion of recovery from subsidiary assets (the "substantive consolidation" issue).

The predictability of Lehman's claims settlement procedures was hindered by the novelty of its business and financial structure (in the context of bankruptcy cases). Chapter 11 proceedings are based on the application of case law relating to the Bankruptcy Court's prior interpretations of cases. While existing case law provided a useful starting point for Lehman's resolution, the court provided new interpretations of provisions in the Bankruptcy Code (for example, regarding some aspects of the safe harbor provisions for derivatives). In part, this reflected the importance of complex financial securities that the bankruptcy court had to analyze for the first time.

In sum, the size and complexity of Lehman, the novelty of its structure, and the rarity with which such firms go bankrupt contributed to a prolonged and costly resolution. In the future, because of the Dodd-Frank Act, regulators will have the option to resolve large, complex financial firms under the Orderly Liquidation Authority, through the expanded reach of the FDIC. Details of how such a resolution would be implemented are still being worked out, making it hard to evaluate the extent to which the resolution of large nonbank financial firms will be more efficient going forward.

## Appendix A: Glossary

| | |
|---|---|
| ADR | Alternative Dispute Resolution |
| CCP | central counterparty |
| CME | Chicago Mercantile Exchange |
| DTCC | Depository Trust and Clearing Corporation |
| FDIC | Federal Deposit Insurance Corporation |
| FICC | Fixed Income Clearing Corporation |
| GCF | general collateral finance |
| ISDA | International Swaps and Derivatives Association |
| JPMC | JPMorgan Chase and Company |
| LBHI | Lehman Brothers Holdings Incorporated |
| LBI | Lehman Brothers Incorporated |
| LBIE | Lehman Brothers International (Europe) |
| LBSF | Lehman Brothers Special Financing |
| NSCC | National Securities Clearing Corporation |
| OCC | Office of the Comptroller of the Currency |
| OTC | over-the-counter |
| PDCF | Primary Dealer Credit Facility |
| QFC | qualified financial contracts |
| SIPA | Securities Investor Protection Act |
| TSLF | Term Securities Lending Facility |

# Appendix B: Settlement of Lehman's Centrally Cleared Positions

The par value of Lehman's centrally cleared U.S. positions exceeded $520 billion at the time of bankruptcy (Panel A of Table B.1). Exchange-traded and some OTC derivatives contracts (such as futures contracts) were centrally cleared, and these positions were resolved by central counterparties acting on behalf of Lehman's clients (where Lehman acted as a broker) or on behalf of Lehman (where Lehman traded for its own accounts), as illustrated in Exhibit 3.[44] The resolution of Lehman's centrally cleared securities positions by CCPs proceeded relatively smoothly, as CCPs suspended or imposed limits on the market access of defaulting Lehman entities within hours of default (Panel B of Table B.1), with most of its client and proprietary positions settled with no large losses to CCPs (CCP12 2009). However, there was controversy regarding the Chicago Mercantile Exchange's (CME) handling of Lehman's proprietary positions, as described below.

## *Immediate Response of CCPs to LBHI's Bankruptcy Announcement*

Lehman traded in almost all developed markets and was a direct clearing participant on behalf of itself or its clients in some markets while using third-party clearing arrangements in others. Following the bankruptcy announcement of LBHI in the United States, there was uncertainty as to which of Lehman's international subsidiaries were solvent. Thus, CCPs with direct clearing relations with Lehman became unsure about Lehman's ability to deliver on obligations to them. After LBHI's bankruptcy announcement, most of these CCPs confirmed suspension, declared Lehman in default, or implemented restricted trading arrangements before markets opened in the United States. (Panel B of Table B.1). A few exchanges temporarily allowed trading and settlement by subsidiaries if they continued to meet CCP obligations (CCP12 2009). Where Lehman did not have a direct clearing relationship, the CCPs had no direct exposure to Lehman, but they worked closely with third-party clearing agents[45] to resolve Lehman's outstanding positions. Third-party clearers and trading venues quickly suspended Lehman and prevented its positions from increasing further (CCP12 2009).

In the United States, the bankruptcy announcement identified Lehman entities that remained solvent, allowing U.S. CCPs and clearing agents to continue relationships with solvent Lehman entities (although the relationship with LBI would prove to be contentious, as discussed in Appendix C). The CCPs of the Depository Trust and Clearing Corporation, namely the Fixed Income Clearing Corporation (FICC) and the National Securities Clearing Corporation (NSCC), confirmed on September 15, 2008, that Lehman's subsidiaries remained solvent participants of the CCP (CCP12 2009). ICE Clear U.S. and the CME also announced that Lehman continued to meet commitments to the clearinghouse.

## *Default Management and Risk Reduction by CCPs*

CCPs, by taking on the obligations of their clearing members, are exposed to risk, which they manage through a variety of strategies (for example, through margins and other member contributions, and capital and insurance for use in the event of default). In Lehman's case, CCPs used similar approaches to limit their exposure, with some exceptions influenced by local regulation (CCP12 2009).

In many markets, Lehman acted as a broker, making and receiving payments on behalf of its clients. Insolvency of a broker typically results in clients facing restricted access to their accounts. In response to Lehman's insolvency, CCPs acted quickly to transfer (or facilitate transfer under the client's direction) Lehman's client accounts to other nondefaulting clearing participants. In the United States, LBI's client accounts were mostly transferred to Barclays Capital or Ridge Clearing and Outsourcing Solutions, Inc. (a clearing services provider), as further discussed in Appendix C. Overall, the vast majority of Lehman's clients obtained access to their accounts within weeks (and sometimes days) of Lehman's bankruptcy (CCP12 2009).

Lehman's house positions were the outcome of proprietary trading on behalf of itself. With limited third-party interest, most CCPs closed out these positions. In the United States, following the appointment of the SIPA trustee on September 19, 2008, the DTCC announced on October 30, 2008, that it had wound down LBI's outstanding obligations. FICC netted and liquidated $329 billion in par value of outstanding forward trades in mortgage-backed securities and $190 billion in gross government bond positions (CCP12 2009).

[44] In at least one case, a CCP helped resolve Lehman's bilaterally cleared derivative position. Specifically, LCH.Clearnet resolved the default of Lehman's interest rate swap portfolio, consisting of 66,000 trades and $9 trillion in notional value, within three weeks, well within the margin held and without loss to other market participants. See *Managing the Lehman Brothers' Default*, LCH.Clearnet, available at http://www.lchclearnet.com/swaps/swapclear_for_clearing_members/managing_the_lehman_brothers_default.asp.

[45] Clearing agents are corporations or depositories that act as intermediaries in the clearing and settlement process. See http://www.sec.gov/divisions/marketreg/mrclearing.shtml.

Table B.1
## Resolution of Lehman's Centrally Cleared Positions

Panel A: Lehman's Centrally Cleared Positions at Time of Bankruptcy

| Central Counterparty | Asset Type | Par Value of Positions (Billions of dollars) | Netted and Liquidated by |
|---|---|---|---|
| CME | Derivatives | 4.00* | 09/19/2008 |
| FICC | MBS forwards, government bonds | 519.00 | 10/30/2008 |
| NSCC | Equity, municipal and corporate bonds | 5.85 | 10/30/2008 |

Panel B: CCP Actions Following LBHI Bankruptcy Filing

| Date | Actions of Global Central Counterparties with Respect to Lehman Entities |
|---|---|
| 09/15/2008 | • Six CCPs confirm no clearing relationship with Lehman<br>• Six CCPs confirm Lehman continues to meet obligations<br>• Eight CCPs announce default or suspension of Lehman<br>• One CCP announces restricted trading/clearing for Lehman |
| 09/16/2008 | • Four CCPs announce default or suspension of Lehman<br>• LCH.Clearnet and two CCPs commence transfer of client accounts<br>• Three CCPs complete close-out of positions |
| 09/19/2008 | • Two CCPs close positions without loss<br>• CME closes out Lehman house positions<br>• FICC and NSCC begin close-out of house positions<br>• LCH.Clearnet announces 90 percent risk reduction of positions<br>• LCH.Clearnet and another CCP largely complete transfer of client positions and close out house positions |
| 09/26/2008 | • One CCP completes transfer of client accounts<br>• Two CCPs close out positions |
| 10/03/2008 | • FICC, NSCC, and another CCP close out house positions without loss |

Sources: CCP12 (2009); "Debtors' Disclosure Statement for Second Amended Joint Chapter 11 Plan" (June 30, 2011); Valukas (2010).

Notes: CME is Chicago Mercantile Exchange; FICC is Fixed Income Clearing Corporation; NSCC is National Securities Clearing Corporation.

*Aggregate margin requirements on Lehman's customer and house positions.

NSCC inherited a $5.85 billion portfolio of equities, municipal bonds, and corporate bonds, used $1.9 billion in pledged securities to settle outstanding equity obligations, and liquidated or hedged remaining positions (CCP12 2009). NSCC's portfolio included $3.8 billion in options exercises and assignments from the Options Clearing Corporation for the quarterly expiration on September 19, 2008, which was liquidated with no losses to other NSCC members.[46]

[46] See "DTCC Successfully Closes Out Lehman Brothers Bankruptcy," http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aojt5wVkz_EM.

LBI had large derivatives positions at the CME, where it was a clearing member. At the time of its bankruptcy, LBI's margin requirements at the CME that were related to its proprietary and public customer positions totaled roughly $4 billion, accounting for more than 4 percent of the margin requirements of all CME clearing members (Panel A of Table B.1). Despite the size of LBI's positions, they were unwound in four days. Nonetheless, there were difficulties with the settlement, as discussed below.

On September 12, 2008, the CME was informed by federal regulators of LBHI's expected bankruptcy or sale and began preparing for a possible liquidation or transfer

of LBI positions (Valukas 2010, p. 1844). Owing to the large size and complexity of Lehman's exchange positions, the CME judged that an open market sale would not be prudent (Valukas 2010, p. 1845). Instead, on September 14, the CME selected six firms and disclosed LBI's house positions to them in order to solicit contingent bids on these positions (Valukas 2010, p. 1846). The bids, received from five of the six firms, implied substantial losses to LBI as it would lose the majority (or, in some cases, all) of its posted margins on these positions. On September 15, the CME instructed LBI to liquidate its proprietary position in bulk, the first time that it had conducted a forced transfer/liquidation of a clearing member's position.[47] The CME took this action, even though LBI was not in default of its margin requirements, because it felt that LBI would be liquidated before too long.

Between September 15 and September 17, LBI attempted to find buyers for its house positions, but was unable to do so except for its natural gas positions (Valukas 2010, p. 1849).

On September 17, the CME learned that Barclays would not assume all of LBI's customer positions and that LBI was likely to file for liquidation on September 19. Consequently, that same evening, the CME decided to re-solicit bids from the five firms that had previously submitted bids. On the morning of Thursday, September 18, the CME transferred LBI's proprietary positions to three firms.

The bulk sale resulted in a loss to LBI on its proprietary position that exceeded $1.2 billion and an additional loss of $100 million over margin requirements (Valukas 2010, p. 1854). LBI's portfolio at the CME, largely intended to hedge Lehman's OTC swaps contracts that were guaranteed by LBHI, became outright positions after the bankruptcy filing.[48] The inability to offer both legs of the hedged positions meant that LBI could not liquidate the outright positions on favorable terms, because counterparties would require substantial additional collateral and margins ("Trustee's Preliminary Investigation Report and Recommendations," August 25, 2010).

[47] However, amid the confusion, LBI modestly *added* to its position over the next two days as Lehman traders either did not show up for work or received inadequate direction from management.

[48] This is because the swaps contracts terminated when the guarantor, LBHI, defaulted. Therefore, LBI's hedge position stood on its own.

# Appendix C: Settlement of Lehman's Customer Positions under SIPA

The insolvency proceedings involving LBHI on September 15, 2008, severely limited the daily funding sources of LBI, and it was able to continue operations only by borrowing from the Fed, as detailed in Section 3.[49] On September 19, 2008, the court appointed a trustee under the Securities Investor Protection Act of 1970 to "maximize the return of customer property to customers of LBI as defined by the law, while at the same time maximizing the estate for all creditors." Different from Chapter 11, SIPA was a liquidation proceeding, with an emphasis on returning customer property wherever possible (Giddens 2008).

The LBI resolution was the largest and most complex in SIPA history. Almost 125,000 customer claims worth almost $190 billion were filed (Panel A of Table C.1). Even prior to his formal appointment, the SIPA trustee assisted in the transfer of LBI's customer accounts to Ridge Clearing and Outsourcing Solutions Inc. on behalf of NeubergerBerman, resulting in the transfer of more than 38,000 customer accounts worth over $45 billion (Panel A of Table C.1).[50] On September 19, 2008, Barclays acquired select, but not all, broker-dealer assets and customer accounts of LBI.[51] Originally, it was believed that Barclays would leave behind few significant customer accounts; accordingly, the SIPA proceedings would largely be a vehicle for effectuating customer account transfers to Barclays ("Trustee's Preliminary Investigation Report and Recommendations," August 25, 2010).

Beginning September 23, 2008, the SIPA trustee supervised and authorized the transfer of more than 72,500 private investment management accounts amounting to more than $43 billion to Barclays (Panel A of Table C.1). Effectively, these LBI account holders became Barclays account holders, and their account assets appeared on their Barclays account statements ("Trustee's First Interim Report," 2009).

In contrast to these (mostly retail) customer accounts that were transferred within weeks of LBI's liquidation filing, the resolution of institutional customer claims through the SIPA claims process remains ongoing. The resolution of institutional claims occurred through account transfers and the SIPA claims process. After Barclays unexpectedly refused to assume LBI's prime brokerage accounts, a majority of these accounts were transferred by the SIPA trustee to other broker-dealers, using an innovative protocol that expedited the transfer process ("Trustee's First Interim Report," 2009). Almost 300 accounts worth close to $3.50 billion were transferred through the SIPA trustee's Prime Brokerage Protocol (Panel A of Table C.1). However, owing to the complexity of the process, most account transfers were only partial ("Trustee's First Interim Report," 2009).

Numerous claims remained pending after the account transfers, including thousands of customer accounts that Barclays left behind, claims of Lehman's European broker-dealer LBIE, and intercompany claims of LBHI and other Lehman affiliates.[52] These claims included both customer and general creditor claims and were determined through the SIPA claims process starting on December 1, 2008 (Giddens 2008). The process proved challenging because of complex issues of statutory interpretation and the need for extensive reconciliation and analysis. Nearly 10,000 claims were investigated, denied customer status, and closed. Nevertheless, by March 29, 2013, more than 14,000 claims had been resolved, and customers and general creditors received a distribution of about $13.5 billion (Panel A of Table C.1), the bulk of which went to satisfy LBIE's intercompany claims (Panel B of Table C.1).

A relatively small number of claims remain contested (Panel A of Table C.1) and, in order to streamline the resolution of general creditor claim disputes, the SIPA trustee recently sought and received a court order establishing ADR procedures ("Trustee's Tenth Interim Report," 2014).

## *Discussion: Resolution of Lehman's Customer Accounts under SIPA*

The resolution process has resulted in 100 percent recovery for customers, a significant achievement for SIPA. Nevertheless, in his investigative report, the SIPA trustee noted many legal

[49] LBHI's rushed Chapter 11 filing also forced Lehman's European broker-dealer LBIE into administration in the United Kingdom on the morning (local time) of September 15, 2008. LBI assets that had been traded in overseas markets through LBIE (which acted as LBI's clearing and settlement agent for certain LBI overseas trades) became tied up in the LBIE administration process. At the same time, LBIE demanded more than $8 billion from LBI related to transactions allegedly made just before LBIE entered administration.

[50] Shortly after LBHI's bankruptcy filing, Neuberger Berman (which had used LBI as its clearing broker) transferred its clearing services to Ridge Clearing and Outsourcing Solutions Inc.

[51] Barclays also did not acquire LBI house positions, the resolution of which is discussed in Appendix B.

[52] LBIE's claims included those on its own behalf and those on behalf of LBIE customers, for which LBI acted as custodian and clearing broker.

Table C.1
## Estimated Recovery of Customer Claims under SIPA

Panel A: Summary of Customer Claims Resolutions as of March 29, 2013

| | Number of Claims | Amount (Billions of Dollars) |
|---|---|---|
| Total claims | 124,989 | 188.57 |
| Less: Total claims resolved by transfers or claims process | — | 105.78 |
| Less: Claims distributed by accounts transfers | 110,920 | 92.30 |
| To Barclays | 72,527 | 43.25 |
| To Neuberger Berman | 38,106 | 45.57 |
| Through Trustee's Prime Brokerage Protocol | 287 | 3.49 |
| Remaining claims | | 14.23 |
| Claims distributed through SIPA claims process | 14,069 | 13.48 |
| Claims unresolved | — | 0.75 |

Panel B: Customer Claims Distributed through SIPA Claims Process, by Group, as of March 29, 2013

| | Market Value of Securities and Cash (Billions of Dollars) | Share of Total (Percent) |
|---|---|---|
| Non-affiliate | 1.62 | 12.0 |
| LBIE | 9.23 | 68.5 |
| LBHI | 2.37 | 17.6 |
| Other affiliates | 0.26 | 1.9 |
| Total | 13.48 | 100.0 |

Sources: Trustee's Fifth Interim Report (2011) and Trustee's Ninth Interim Report (2013).

Notes: SIPA is Securities Investor Protection Act; LBHI is Lehman Brothers Holdings Inc.; LBIE is Lehman Brothers International (Europe).

and systemic difficulties in the liquidation process (albeit unnoticed by customers whose accounts were treated as intact despite the difficulties) and made recommendations for improvements ("Trustee's Preliminary Investigation Report and Recommendations," 2010). Retail customer accounts were transferred quickly, although reconciliation of accounts and delivery of property held in custodial banks around the world took more than a year (Giddens 2010). In contrast, resolution of institutional customer claims through the SIPA claims process remains ongoing.

The rushed liquidation of customer accounts left behind by Barclays resulted in a disorderly process of unwinding LBI's customer and intercompany balances ("Trustee's Preliminary Investigation Report and Recommendations," 2010). There was inadequate understanding as to how the interests of customers whose accounts Barclays rejected would be affected, leading to prolonged disputes with Chapter 11 creditors and Barclays. For example, it was initially believed that only a few customer accounts not transferred to Barclays would be liquidated under SIPA, but a substantial number of customer accounts were actually left behind.

In addition, CCPs and clearing agents took unilateral adversarial actions that made it difficult for the SIPA trustee to obtain access to customer property and records. Thus, at the time of the bankruptcy filing, JPMC unilaterally shut off access to information systems, thereby preventing LBI and the SIPA trustee from identifying and protecting customer accounts ("Trustee's Preliminary Investigation Report and Recommendations," 2010). JPMC also did not honor customer segregation requirements. These issues were ultimately resolved through formal agreements between JPMC and the SIPA trustee, but in the meantime, the ability of the SIPA trustee to transfer customer property was impaired.

Moreover, the Depository Trust and Clearing Corporation and the Office of the Comptroller of the Currency (OCC) threatened emergency actions that harmed the account

transfer process ("Trustee's Preliminary Investigation Report and Recommendations," 2010). The OCC threatened to liquidate all LBI positions unless Barclays stepped into LBI's shoes by having LBI's accounts at OCC transferred to Barclays. Although Barclays agreed, customers of LBI who did not transfer to Barclays had difficulty accessing their OCC positions and margins. Similarly, DTCC was unwilling to provide settlement services if Barclays did not take over LBI positions. The issue was settled when Barclays agreed to deposit the purchase price for LBI (due to the estate) to DTCC, but there was less cash available to settle customer claims in the interim.

The transparency of the SIPA liquidation process was good. The SIPA trustee has issued ten interim reports so far, in addition to a detailed preliminary investigative report on various aspects of LBI's resolution.

# Appendix D: The Settlement of OTC Derivatives Contracts in Bankruptcy

Derivatives settlement procedures, as documented under the ISDA Master Agreement, attempt to enable the nondefaulting party to assert a claim for an amount that, if fully recovered, would place it in the same position absent the default (Scott 2012).[53] To do so involves four steps: 1) terminate contracts and unwind all open transactions, 2) determine the value of each transaction, 3) perform close-out netting, and 4) pay out net amounts. The amount owed to or from a nondefaulting party on account of default is equal to the net value of the derivatives, as determined according to the selected valuation methodology plus any unpaid amounts offset by the value of the collateral. If the amount due to the nondefaulting party is positive, then it becomes an unsecured creditor to the estate.

In a bankruptcy, derivatives and other qualified financial contracts are awarded special legal treatment exempting them from several provisions of the Bankruptcy Code, thereby creating a safe harbor.[54] First, derivatives creditors can net offsetting positions with the debtor, seize and liquidate collateral, and choose whether to close out and terminate positions right after bankruptcy without being subject to the automatic stay. Relatedly, creditors have broad rights to set off debts owed to the debtor against debts due from the debtor if a setoff provision has been included in the ISDA Master Agreement. Second, they are exempt from certain creditor liabilities related to pre-bankruptcy agreements such as fraudulent conveyance liability (arising from the debtor selling its own assets prior to bankruptcy for less than fair value) and preference rules (the need to return preferential payments received just before bankruptcy or to give back preferential collateral calls). The remainder of this section focuses on the first exemption relating to the procedures for termination, liquidation of collateral, netting, and setoff.

The termination procedure for creditors is described by an ISDA Master Agreement that lists the default events triggering termination. Specifically, contracts terminate automatically if the derivatives contract has an automatic early termination clause or, alternatively, the nondefaulting party has the choice (but not the obligation) to terminate by giving written notice to the defaulting party. Naturally, the nondefaulting party has an incentive not to terminate the contract when it is out-of-the-money; moreover, in such cases, it has the right to suspend periodic payments to the defaulting party under the Master Agreement. Termination of a Master Agreement terminates all derivatives transactions under that agreement. The Master Agreement is supplemented or amended by a schedule that (among other things) states whether or not the derivatives transactions are supported by a guarantor or other credit support provider. If so, a default by a credit support provider will constitute a default event under the Master Agreement.

With early termination under a Master Agreement, parties can seize any collateral posted pursuant to the agreement. A derivatives transaction may include a credit support annex, which is a security agreement that describes any collateral pledged in the derivatives transactions. Typically, liquid collateral (such as U.S. Treasury securities or agency securities) is posted (Ricotta 2011). Collateral is "marked to market" and the amount due to or from a party (its "exposure") is calculated periodically. Either one side or both sides to a transaction may post collateral. The credit support annex may also permit a party to hypothecate collateral posted and delivered by the other party.

The valuation framework implicitly envisions a liquid market such that the nondefaulting party closes out its open positions at market rates and then establishes replacement hedges to offset expected price changes (Das 2012). Accordingly, valuation of contracts requires determining the exact timing of valuation, the method used, and the calculation agent carrying out the valuation. Under the 1992 Master Agreement, parties can choose between the market quotation method and the loss method. The market quotation method allows nondefaulting parties any unpaid amount plus replacement transactions valued based on quotes from at least three reference market-makers; the loss method entitles the nondefaulting party to "an amount that party reasonably determines in good faith to be its total losses" from the terminated transactions. The 2002 Master Agreement uses the close-out amount approach, which combines elements of the quotation and loss methods.[55]

[53] ISDA is an industry trade association that has developed two documents that are fundamental to any OTC derivatives transaction: the 1992 ISDA Master Agreement and the 2002 ISDA Master Agreement. Multiple derivatives transactions may be documented under a single Master Agreement that contains alternative provisions to be selected by the two signatories.

[54] More formally, "safe harbor provisions" are provisions in the U.S. Bankruptcy Code ensuring that derivatives contracts and other QFCs are enforced according to their terms by creditors even after the debtor files for bankruptcy, subject to certain exceptions under the code. Bliss and Kaufman (2006) and Roe (2011) discuss the desirability and rationale of safe harbor provisions.

[55] Similar to the quotation method, the close-out amount approach entitles the nondefaulting party to any unpaid amounts. Similar to the loss method, it also allows a "close-out amount" equal to the replacement costs of the terminated trades where the determining party may "use [any] commercially reasonable procedures in order to produce a commercially reasonable result."

## Appendix D: The Settlement of OTC Derivatives Contracts in Bankruptcy (Continued)

Once contract values are established, close-out netting is used to determine the net settlement amount. Close-out netting involves the calculation of gains or losses for each party upon termination of a derivatives contract, repeating the calculation for all of the derivatives transactions involving the two parties and then offsetting the resulting amounts. After applying any setoff rights and the value of collateral posted, the procedure yields a single payment from one party to the other. If a party has multiple derivatives transactions with different affiliates of a firm, then netting requires written agreements with the affiliates. If no such agreements exist, then the ability to net depends on the local law of the jurisdiction (in particular, the applicable insolvency law), which often prohibits multilateral setoffs (for example, derivatives counterparty A sets off an amount it owes to Lehman affiliate B against an amount Lehman affiliate C owes to derivatives counterparty A).

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Joseph H. Sommer

# Why Bail-In? And How!

- Financial firm insolvency is very different in kind than the insolvency of ordinary firms.
- The key distinction is that only financial firms are dominated by "financial liabilities"—liabilities whose value is greater than the net present value of their associated income streams.
- The "bail-in" insolvency process respects this distinction, converting the claims of the parent company's creditors to equity while paying the subsidiaries' creditors on time and in full.
- Bail-in impairs only the nonfinancial liabilities in the parent and preserves the financial liabilities in the subsidiaries. It therefore preserves the firm's liquidity and risk-shifting abilities.
- For systemically important financial firms, bail-in averts systemic risk.

## 1. Introduction

Bank resolution is a big topic these days.[1] ("Resolution" is a term of art, meaning something like "insolvency process.") This is especially true for megabanks—large international financial conglomerates.[2] Most bank regulators are unhappy with standard insolvency law, such as the Bankruptcy Code (Code). They often favor a novel process. The generic term is "bail-in."[3] The Federal Deposit Insurance Corporation (FDIC) has its own version, called "single point of entry."

This raises two questions. Why should bank regulators dislike standard insolvency law? And why should bail-in make them happy? This article answers these questions.

[1] *E.g.*, citations contained *infra* notes 3, 4 (second paragraph), 8, 28, 34, 48, 56, 61, 65.

[2] Throughout this discussion, I shall use the terms "megabank," "large financial firm," or "large international financial conglomerate" as if they all meant the same thing. I do not use the jargon term "SIFI," the acronym for "systemically important financial institution." This article does not need a systemic risk boogeyman, although it helps.

[3] D. Wilson Ervin, a banker at Credit Suisse, invented the concept. Paul Calello & Wilson Ervin, *From Bail-Out to Bail-In*, The Economist 95 (Jan. 28, 2010). Mr. Ervin told me that he conceived the idea around September 2008.

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The author thanks Barry Adler, Thomas Baxter, Wilson Ervin, Mark Flannery, Charles Gray, Joyce Hansen, HaeRan Kim, Lisa Kraidin, James McAndrews, Hamid Mehran, Donald Morgan, Brian Peters, Michael Schussler, and David Skeel. The views expressed in this article are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

My answers are not quick ones. The theory for a quick answer is not there. Few bankruptcy scholars or practitioners know about financial firm insolvency. Unlike bankruptcy, the secondary legal literature on financial firm insolvency is sparse.[4] Not everybody has read it, and besides, I have a few notions of my own.

The first section of this article therefore discusses megabank insolvency. Ordinary bankruptcy law makes many tacit assumptions as to what a generic firm should be. Many of these assumptions are invalid—or even inverted—for financial firms. The second section defines and discusses bail-in. The third section defines, discusses, and dismisses the alternatives to bail-in.

With this teaser, let us get started.

[4] I know of one excellent, if ancient, monograph. Hirsch Braver, Liquidation of Financial Institutions (1936). It remains useful for a few technical issues; *cf.* Office of the Comptroller of the Currency, Instructions to National Bank Receivers (1932). There are three useful modern monographs: David A. Skeel, The New Financial Deal: Understanding the Dodd-Frank Act and Its (Unintended) Consequences (2011); Bankruptcy Not Bailout: A Special Chapter 14 (Kenneth E. Scott & John B. Taylor, eds., 2012) ("*Hoover Institution*"); Eva Hüpkes, The Legal Aspects of Bank Insolvency: A Comparative Analysis of Western Europe, the United States and Canada (Kluwer 2000). The law review literature is sparse between the Depression and the 2008 crisis. Robert R. Bliss & George G. Kaufman, *U.S. Corporate and Bank Insolvency Regimes: A Comparison and Evaluation*, 2 Va. L. & Bus. Rev. 143 (2007); Thomas C. Baxter, Joyce M. Hansen & Joseph H. Sommer, *Two Cheers for Territoriality*, 78 Am. Bankr. L.J. 57 (2004); David A. Skeel, *The Law and Finance of Bank and Insurance Insolvency*, 76 Tex. L. Rev. 723 (1998); Peter B. Swire, *Bank Insolvency Law Now that It Matters Again*, 42 Duke L.J. 469 (1992); William R. Buck, Jr., Comment, *Bank Insolvency and Depositor Setoff,* 51 U. Chi. L. Rev. 188 (1984). *See also, e.g.*, Group of Thirty, International Insolvencies in the Financial Sector 84 (1998); G-10 Contact Group on the Legal and Institutional Underpinnings of the International Financial System: Insolvency Arrangements and Contract Enforceability (September 2002) at http://www.bis.org/publ/gten06.htm.

Recently, the topic has become more trendy: *e.g.*, Skeel, *supra; Hoover Institute*, *supra*; Douglas G. Baird & Edward R. Morrison, *Dodd-Frank for Bankruptcy Lawyers*, 19 Am. Bankr. Inst. L. Rev. 287 (2011); David A. Skeel & Thomas H. Jackson, *Transaction Consistency and the New Finance in Bankruptcy,* 112 Colum. L. Rev. 152 (2012); Peter Conti-Brown, *Elective Shareholder Liability*, 64 Stan. L. Rev. 409 (2012); Randall D. Guynn, *Are Bailouts Inevitable?*, 29 Yale J. Reg. 121 (2012); Adam J. Levitin, *In Defense of Bailouts*, 99 Geo L.J. 435 (2011); John R. Bovenzi, Randall D. Guynn & Thomas H. Jackson, Too Big to Fail: The Path to a Solution (Bipartisan Policy Center 2013); Thomas F. Huertas, *Safe to Fail*, 28 Butterworth's J. of Int'l Banking & Fin. L. 407 (2013); Paul Tucker, *Resolution and Future of Finance* (May 20, 2013) (available at http://www.bis.org/review/r130606a.pdf?frames=0 (last visited June 12, 2013); High-Level Expert Group on Reforming the Structure of the E.U. Banking Sector (available at http://ec.europa.eu/internal_market/bank/docs/high-level_expert_group/report_en.pdf) (last visited September 26, 2013).

## 2. Why Megabanks Are Different

Megabanks are more than big banks. They are more complex; they are more interlocked; they are more global. They also have a peculiar corporate structure and—most importantly—peculiar liabilities. They are atypical firms. As we shall see, they need atypical insolvency law.

This section does four things. It starts with the balance sheet of megabanks. All financial firms have peculiar balance sheets. Megabanks are more peculiar yet. Megabanks are highly leveraged. Their liabilities are generally financial products, often very liquid. Finally, megabanks are conglomerates, with close connections among component entities.

After these balance-sheet concerns, we then look at the business of megabanking. Several traits stand out: personnel, interconnections, and a global reach. These all affect megabank insolvency.

We then look at the nature of bank supervision—including megabank supervision. Supervision is tightly tied to insolvency, much as corporate finance is tied to corporate insolvency. The incentives of local supervisors are a powerful force in cross-border megabank insolvency.

Add all these together, and we have our conclusion: Megabank insolvency is different from that of other businesses.

### 2.1 The Peculiar Balance Sheet of Megabanks

We begin by looking at the balance sheet of large financial firms. A "financial firm," for our purposes, has a high degree of leverage. It also has something I call "financial liabilities." Megabanks also have a conglomerate structure.

We begin with the two traits that megabanks share with other financial firms: leverage and financial liabilities.

#### *Leverage*

Almost all financial firms are highly levered. Debt-equity ratios of 1:1 are typical for ordinary firms: the widget maker of the textbook. Financial firms' debt-equity ratios are much higher: about 15:1-30:1 for banks and securities firms,[5] and somewhat less for insurers. This leverage has some implications.

[5] Sebnem Kalemli-Ozcan, Bent Sorensen & Sevcan Yesiltas, *Leverage Across Firms, Banks, and Countries*, 88 J. Int'l Econ. 284 (2012).

First, financial firms maintain good credit despite their high leverage. Before the recent crisis, banks typically got ratings around A- to AA.[6] This need do no violence to the basic tenets of corporate finance. Financial firm assets are typically much safer (*i.e.*, lower in variance) than the assets of general business firms. They must be. The classical bank asset is somebody else's debt. Debt is paid before profit. A firm that specializes in holding debt will have less risk than firms that must pay the debt.

However, megabanks hold many assets other than simple debt. Some of these other assets are risky indeed. To reduce the variance of these assets, megabanks use diversification and hedging schemes. Diversification and imperfect hedging, of course, rely on historical behavior. Beyond a few standard deviations, history is bunk—so-called "tail risk." Megabanks are inherently sensitive to tail risk in their models, more so than less sophisticated firms. We have seen this several times in the past few decades: Askin Capital, Long-Term Capital Management, and AIG come to mind. None of these firms had bank charters, but our definition of "megabank" needs no charter.

Second, high leverage is hard to measure. In a highly levered firm, the value of assets is close to the value of liabilities. A small error in measurement can lead to a large error in reported leverage. Measurement is harder in the insurance industry, where the (contingent) liabilities of claims are probably more difficult to measure than asset values. But it is bad enough in banking, and amplified by the greater leverage in the banking industry. This is especially true for megabanks with substantial contingent liabilities in the form of derivatives contracts. Similarly, a small change in the variance of bank assets can lead to a large change in bank risk.

This has some unpleasant implications for governance. As Jensen and Meckling have told us, overleveraged firms may gamble with their creditors' money.[7] But the leverage and risk of banks is difficult to measure. A small increase in either is hard to verify, and banks traditionally had weak creditors, anyway. This is both a good argument for capital regulation (smaller risk substitutions are more effective in leveraged firms), and for supervision (a creditors' agent argument independent of deposit insurance).

Third, leverage is hard to define, even if it is measurable. The notion of leverage distinguishes between some liabilities called "capital" and other liabilities. This distinction may still exist in corporate law, but corporate finance theory views it as mere superstition.[8] There are only classes of risk, with different classes of control appropriate to the risk class. Nonetheless, financial regulators think that it is important to sharply distinguish some kinds of liabilities from others. They do not draw the line at equity. They will also consider some kinds of subordinated debt and preferred stock to be capital. Other kinds of debt—even long-term debt—do not so qualify.

The regulators are right, and the theory is wrong. Not all liabilities are created equal, like beads on a linear string of risk. As we shall see, some liabilities—financial liabilities—are indeed different in kind.

### *Financial Liabilities*

Financial liabilities are a key concept in this article—*the* key concept of this article. Since induction trumps deduction, a list should precede my definition. Financial liabilities are those that only financial firms are in the business of incurring. They include things like bank deposits, derivative contracts, insurance policies, and repos. Corporate debt or trade credits are not financial liabilities. This is also true of the corporate debt or trade credit of financial firms.

With our intuition set, we should now define the term. We need a definition that makes a difference in insolvency. Two such definitions come to mind.

Perhaps the best definition of a financial liability is one whose value is impaired by the insolvency process. Yes, insolvency does nothing if it does not affect liabilities. But I mean this in a certain special sense, one evoked by an old bankruptcy lawyers' joke: "not only does the food taste awful, but the portions are too small." This joke is funny because it is true. The portions *must* be too small: insolvency must impair liabilities. Somebody will not get what they bargained for. And the food tastes awful: bankruptcy destroys value. But value destruction is not an inherent trait. An ideal insolvency process can impair liabilities quickly, smoothly, and with no collateral damage. But the Bankruptcy Code, although pretty good, is not an ideal process.

We usually think in terms of destroyed asset value—deadweight losses, such as administrative costs, lost going-concern value, and so on. Value *is* destroyed on the asset side, and modern insolvency law mitigates this destruction. But

[6] Frank Packer & Nikola Tarashev, *Rating Methodologies for Banks*, BIS Quarterly Review 39, 41, 49 (June 2011) (citing Fitch and Moody's ratings). A notch or two of these ratings consisted of government support, but they are still investment grade. *Id.* at 50.

[7] Michael Jensen & William Meckling, *Theory of the Firm: Managerial Behavior, Agency Costs, and Capital Structure*, 3 J. Fin. Econ. 305 (1976).

[8] To be fair, some corporate finance theorists are beginning to see the wisdom to this superstition, at least where systemic risk is concerned. Oliver Hart & Luigi Zingales, *A New Capital Regulation for Large Financial Institutions*, 13 Am. L. & Econ. Rev. 453, 455-54 (2011). But as we shall see, the issue is a more general one than systemic risk.

some special liabilities—financial liabilities—may also lose value in the insolvency process, beyond any value measured by the net present value of the claim. They, too, suffer a deadweight loss.

Financial liabilities are more than claims to a future stream of income. Yes, they are that, but they are something else, too. Some of them, such as bank deposits, are also sources of liquidity. Others—derivatives or insurance policies—shift risk. These liabilities are also credit instruments. But unlike, say, corporate bonds, their credit nature is incidental to—but inherent in—their liquidity or risk-shifting functions. Liquidity and risk shifting are valuable in themselves—valuable beyond the face value of the financial liability. This is not a conjecture. It is a revealed preference. Insurance policies cost more than their net present value. Liquid debts pay less well than illiquid ones.

This has potent implications in insolvency. If financial liabilities have value that goes beyond their face value, the extra cost of impairing them in insolvency is itself a deadweight loss, exceeding the cost of impairing other liabilities. This cost includes impaired liquidity or risk shifting, as well as an impaired payment stream. This cost is substantial, and it can be enormous if it takes the form of systemic risk.[9]

Good insolvency law would protect these liabilities: preserve their liquidity or risk-shifting functions. This would be at the cost of other liabilities: the familiar Modigliani-Miller seesaw. However, this seesaw has no fixed pivot: priority creates value. The other liabilities are mere streams of income, with no other function. The cost of impairing them is less than the cost of impairing financial liabilities. This leads to the central policy implication of this article: *Financial liabilities deserve priority treatment in insolvency law.* Such priority exists today, ordinal and often temporal. Financial liabilities are often paid first in line and often first in time, before any payments to other creditors. We return to this point below, after a detour through a few of these financial liabilities.

A checking account is a financial liability. People hold these accounts because they are liquid. A delayed insolvency distribution is an illiquid distribution. An illiquid distribution is costly. For an individual, these costs may include bad credit reports, eviction, or delayed medical care. For a firm, these costs may include strained relations with creditors, or even its own insolvency. For a megabank, the costs can extend to chain-reaction illiquidity and insolvency: systemic risk. In a typical bank insolvency, checking accounts are typically paid in full with no delay.

[9] *See infra* text accompanying note 23.

Bank deposits are not the only financial liability. Insurance policies are another. Consider a term life policy as an example, with an insolvent insurer. To healthy policyholders, the policy is worth little, because it is easy to replace. But consider a person who purchased the policy at a low cost when healthy, has subsequently developed cancer, and has a right to renew. What does it mean for an insolvency distribution to treat all policyholders equally? A quick *pro rata* distribution would be a disaster for the sick policyholder, who will not be able to replace the policy on the market. A future claims estimation process could be a nightmare of litigation. Insurance insolvencies, therefore, are often the opposite of bank insolvencies: very slow, so that all claims may come to fruition. Policyholders are first in line, even if the line moves slowly.

Brokerage accounts are financial liabilities, much like bank deposits. We usually think of them as direct property rights of the customer, with the broker acting as a kind of bailee. But the property law of securities, contained in Uniform Commercial Code (UCC) Article 8, shows that they are generally relationships between the broker and customer, rather than a direct property right of the customer against the issuer.[10] Again, the liquidity of these securities is important. Issuers structure debt as a security rather than a direct loan to enhance its liquidity, either in the distribution process or the secondary market. The Security Investors Protection Act (SIPA) insolvency, as well as Subchapter III of Chapter 7 of the Code, further enhance this liquidity. They rapidly transfer the customer securities of insolvent brokers to another party that can comply with customer orders.

The protected contracts of the Federal Deposit Insurance Act (FDI Act) and Bankruptcy Code can also be financial liabilities. (These liabilities are characteristic of megabanks.) Derivative contracts are intended to shift risk. Insolvency impairs this function. Many securities contracts have a similar function. Many of these transactions hedge portfolios of market risk. Repo creates liquidity.

In other words, financial contracts are contracts in which credit risk is incidental. The creditor in such contracts is not primarily an investor: paying money now to get more later. Instead, it wants liquidity, or insurance, or other kind of risk shifting. It is the *creditor* that is different, not the debtor. To a financial firm, the proceeds of a financial liability are a form of credit, used like any other credit. This suggests a second definition of a financial liability: a *product* of a firm, sold to

[10] Some of the more important pieces of secondary literature: James Steven Rogers, *Policy Perspectives on Revised U.C.C. Article 8*, 43 U.C.L.A. L. Rev. 1432 (1996); Kenneth C. Kettering, *Repledge Deconstructed*, 61 U. Pitt. L. Rev. 45 (1999); Steven L. Schwarcz, *Intermediary Risk in a Global Economy*, 50 Duke L.J. 1541 (2001).

customers. This definition pretty much overlaps with the first. It is less analytically pleasing, because it does odd things like exclude interdealer derivatives contracts. But it explains much, works well, and is easy on the intuition.

This notion of a financial liability as a product has implications for insolvency law, apart from priorities. Insolvency law assumes that firms often need a breathing spell from their creditors, so that they can pick themselves up, continue operating, and start reorganizing. It therefore places all claims in a collective procedure and places a moratorium on efforts to collect assets. However, financial products are operations of the financial firm. Freezing performance on a financial product, whether by automatic stay or treatment as a claim, is akin to prohibiting a carmaker in Chapter 11 from making and selling cars, or an airline from selling tickets, buying jet fuel, and flying planes.[11]

Since a financial liability is a product, it contains some goodwill. It is worth more to the issuer than the mere proceeds of other liabilities. Nobody thinks of customer loyalty in the bond market, but it is quite common in the insurance market, or the retail market for bank deposits. In other words, some financial liabilities—*e.g.*, bank deposits or insurance policies—can be firm-specific. They are more valuable if kept with the firm's business than paid off in an insolvency distribution. Therefore, purchasers will assume these liabilities for a discount. They need less than one dollar of assets to assume a dollar's worth of these liabilities.

This turns a standard bankruptcy argument inside out. Bankruptcy scholars argue that reorganizations are generally more efficient than liquidations because reorganizations preserve the value of firm-specific assets.[12] Financial firms may have fewer firm-specific assets than other firms. But they have firm-specific liabilities. These liabilities also require reorganization of the firm—but no alteration of these liabilities. Other liabilities would bear the brunt.

This article uses the concept of financial liabilities to *define* financial firms. This excludes many firms that have financial assets: *e.g.*, leasing, factoring, lending, or mortgage companies. These firms raise their funds from banks and on the bond market, like any other ordinary business firm. They do not issue financial liabilities. They are not financial firms, for our purposes.

Our definition of financial firms might be narrow, but it accords with U.S. law. The law defines banks by their unique power to issue one financial liability: the deposit. (This power is legally necessary, if not always sufficient.[13]) The Bankruptcy Code treats leasing, factoring, lending, or mortgage companies as ordinary industrial firms. The Code can succeed with these firms, as it did with CIT Group. It only excludes those firms defined by financial liabilities: banks and insurers.

When the Code sees something like a financial liability, it typically feels protective. Financial contracts such as swaps and repos are exempt from the stay and most avoidance provisions. Subchapter III of Chapter 7 transfers customer security positions rapidly, again free of the stay and with limited avoidances. Trade credit is a special case. It is not a financial liability—it is worth no more to the creditor than its net present value. However, paying the trade credit in full is often worth more to the estate than any loss to other creditors, since an angry trade creditor can refuse to deal. So the Code creates a twenty-day priority and a forty-five-day quasi-priority in the form of a right of reclamation.[14]

[11] To express this in more abstract language, firms have both operations and financing. The task of reorganization is to rearrange the claims of financiers, without disturbing operations. However, operations require continuing financing. Insolvency law must separate the two somehow. The Code does this with the automatic stay and post-petition lending. The automatic stay keeps the erstwhile financiers away from the operations; post-petition lending funds ongoing operations. This decomposition is impossible for a financial firm, if there is no distinction between financing and products. Bail-in works by segregating the financial products (and thus the operations) from the nonproduct financing. This segregation requires an insolvency priority for the financial products. The segregation only needs to be good enough, not perfect. Even the Dodd-Frank Act (see Section 3.3 below) has a one-day stay on financial contracts.

[12] A "liquidation" sells the assets of the firm and distributes the sales proceeds down the priority ladder of creditors. A "reorganization" leaves the assets alone, and readjusts the liabilities by eliminating or reducing junior claims, converting senior claims to junior ones, and lengthening some surviving senior claims. Chapter 11 of the Bankruptcy Code employs both liquidation (usually of bulk business) and reorganizations. *See infra* text accompanying note 68.

Liquidation and reorganization are not the only insolvency law techniques. Bank and insurance insolvency law allows for a transfer of liabilities to a solvent party, compensating the transferee with assets. This is the "bridge bank" and "purchase and assumption" transaction of the FDI Act or the "bridge company" of the Dodd-Frank legislation. As we shall see below, a bridge company can be tantamount to a reorganization. *See infra* text accompanying notes 55-56.

[13] **Necessary and sufficient:** 12 U.S.C. § 378(a)(1). **Necessary but not sufficient**: 12 U.S.C. § 1841(c)(1)(B) (also needs commercial lending); 12 U.S.C. § 1813(a)(2) (also needs incorporation).

[14] **Financial contract provisions:** 11 U.S.C. §§ 362(b)(6), (7), (17), (27), 546(e)-(g), 555-56, 559-61; **Subchapter III:** 11 U.S.C. §§ 741-52; **Sales priority:** 11 U.S.C. § 503(b)(9); **Right of reclamation:** 11 U.S.C. § 546(c).

Bankruptcy practice expands on these statutory hints with so-called "critical vendor orders." These orders, awarded at the beginning of the process, grant ordinal and temporal priority to select liabilities. These orders originally protected suppliers, for the reasons discussed above. They now often cover consumers who have paid but have not received value: *e.g.*, warranties or airline tickets.[15] (Since modern critical vendor orders often support non-vendors, I henceforth use an acronym: CVO.) Consumer CVOs preserve the reputation of the firm to its customers: an apparent requisite of successful reorganization.

CVO treatment also applies to true financial liabilities, at least those few liabilities of Code entities that are not already exempted as repo or derivative contracts. Customer securities and commodities positions are financial liabilities. The Code demands their rapid transfer, and regulatory segregation principles usually give them priority. Casinos are financial firms; casino chips are financial liabilities; they pass free of the stay with administrative priority.[16] I know of only one other Code entity with financial liabilities: money transmitters. The liabilities are the payments in transit: funded, but not paid. The Code does not recognize these liabilities as special. State law works around the Code, by pairing these liabilities to segregated assets:[17] a statutory trust.

However, most megabanks have an enormous volume of financial liabilities: far greater than their other liabilities. They do not pair these liabilities to specified assets. The argument for CVOs only works if the favored liabilities are paired with segregated assets, or are few.[18] Therefore, the CVO approach will not work for megabanks.

The difference between financial firms and others, then, is one of degree, rather than kind. Financial liabilities dominate the balance sheet of financial firms. Other firms may have some peculiar liabilities. But they do not have enough of them to interfere with formal Code doctrine. CVOs are nonstatutory and limited in scope. Therefore, financial firms require an explicit priority for financial liabilities: one absent from the Code.

[15] The oddest CVO may have been *In re* Marvel Entertainment Group, 209 B.R. 832 (D.Del. 1997) (comic books paid for but not delivered to children). The leading case on CVOs is clearly *In re* Kmart, 359 F.3d 866 (7th Cir. 2004). Judge Easterbrook suggested a statutory basis for this and proposed an economic rationale. *Id.* at 872-73. He argued that the CVO priority is justified when it increases the value of the estate to the other creditors.

[16] *In re* TCI 2 Holdings LLC, 428 B.R. 117, 180 (Bkrtcy. D.N.J. 2010).

[17] Uniform Money Services Act § 701(c) (2004). *Cf.* Ronald Mann, *The Rise of State Bankruptcy-Directed Legislation*, 25 Cardozo L. Rev. 1805 (2004).

[18] *See supra* note 15 and accompanying text. A sufficiently large volume of CVO priorities cannot make the other creditors better off.

### *Conglomeration*

Megabanks are seldom—if ever—single entities. Instead, they are typically conglomerates. The parent is typically a bank or a holding company (in U.S. law, the latter.) Some of the subsidiaries have financial liabilities: banks, insurers, securities dealers, derivatives dealers, or the like. Other subsidiaries do not: mortgage banks, venture capital firms, asset holding companies, various kinds of middlemen, or the like. There are also special purpose vehicles (SPVs), which purport to be bankruptcy-remote, but often operate with megabank resources. Except for the bank and perhaps a reinsurer, there is little cross-border branching: each country (or at least each major country) gets its own set of subsidiaries.

Most of these affiliates are centrally controlled, sharing risk management, personnel, business, reputation, and operations. They also lend to each other. Typically, the parent and bank are the main sources of interaffiliate credit, because they are the most creditworthy entities. The bank is creditworthy because regulators limit its interaffiliate credit exposures.[19] Some other affiliates have their own credit, as standalone business units or SPVs. But most do not. The credit of most megabank entities depends on that of the organization. And conversely. Except for the insurance industry, parent financial firms seldom let their affiliates become insolvent, even when there is no question of legal exposure. This is at least as old as the salad oil swindle of 1963, in which American Express rescued its warehouse company. And we saw it in 2007-08, when parent firms rescued their shadow banks, despite a clear legal separation between them.

The net result is an organization that is hard to decompose in insolvency, even if interaffiliate books were perfect. ("[I]mperfection in intercompany accounting is assuredly not atypical in large, complex company structures."[20]) Insolvency law treats the legal entity as the basic unit upon which it operates. Insolvency law acknowledges that affiliation usually calls for unified administration, but otherwise treats the separate entities with great respect.

[19] *See* 12 U.S.C. §§ 371c & 371c-1; E.U. Conglomerate Directive: Directive 2002/87/EC of the European Parliament and of the Council of 16 December 2002 on the supplementary supervision of credit institutions, insurance undertakings, and investment firms in a financial conglomerate and amending Council Directives 73/239/EEC, 79/267/EEC, 92/49/EEC, 92/96/EEC, 93/6/EEC and 93/22/EEC, and Directives 98/78/EC and 2000/12/EC of the European Parliament and of the Council 2003 O.J. (L 35/1).

[20] *In re* Owens-Corning, 419 F.3d 195, 215 (3d Cir. 2005) (Ambro, J.)

Yet megabanks continue to use these affiliated structures, for several reasons.[21] First, regulators sometimes force them to. A good example of this is the separation between banking and securities underwriting/dealing. This is near mandatory in U.S. law,[22] but rare in Europe. Second (although first in the hearts of corporate lawyers) is tax avoidance. Tax avoidance does not increase welfare; credit impairment decreases welfare. Third, securitization relies on separate entities. Fourth, insurance insolvency law is incompatible with other insolvency law. This requires that the insurance business of a firm be in a separate subsidiary. Fifth, insurance companies do not care as much about credit as they care about tail risk. For them, separate subsidiaries reduce tail risk at a reasonable cost to credit. Other reasons doubtless exist—some good and some bad.

Entity proliferation certainly complicates insolvency law. But good or bad, it is a fact. Megabanks are complex and highly interconnected conglomerates. Any megabank resolution scheme must deal with this.

## 2.2 The Peculiar Ecology of Megabanks

We now turn to a few attributes of megabanks that do not show on their balance sheets, yet do affect their insolvency. First, megabanks have little specific human capital. High-paid individuals and teams can run from the megabank almost as quickly as deposits can. Second, megabanks are interconnected. Third, most megabanks are international, spread across many legal regimes.

### *The Human Factor*

All banks are subject to a run on their liabilities. Megabanks are subject to a run on their personnel.

Most megabanks contain many high-paid sales and trading personnel who are not management: investment bankers, traders, quantitative analysts. The work that they do is directly linked to the profitability of the firm, so the profit of a business unit or subunit is a reasonable proxy for their performance—and thus their pay. Because these personnel face outward, the top performers have a reputation throughout the industry. This reputation adheres to them (or their team), more than it does the bank that employs them. In other words, they have very little firm-specific human capital: much like superstar athletes or scholars.

Since these personnel have weak ties to their firms, they can easily leave for another megabank. Megabanks are aware of this, and seek to hold their stars with deferred pay packages. However, these packages contain credit or market risk, and are less credible if a megabank appears weak. Hence, if a megabank appears weak, its successful high-paid teams tend to go elsewhere. This run on human capital can parallel a run on more conventional parts of the balance sheet.

### *Interconnectedness and Systemic Risk*

Megabanks are highly interconnected. This implies that a weakness in one megabank can become a weakness in all. The mechanism is unimportant. It could be a pure panic attack, with bad news for one bank imputed to all. Or perhaps a markdown of an asset class by one bank triggers markdowns by all. Or an industry-wide hedging model goes south. Or perhaps one megabank's liabilities are others' assets. Or perhaps a clearinghouse goes bad, blocking liquidity. Leverage and liquidity stress seem to be important.

To make matters worse, the asset side also becomes illiquid in times of general stress. (I make no claims of causal direction here.) Therefore, asset liquidity dries up precisely when a megabank most needs this liquidity. Tradable assets are not naturally liquid; they are only liquid because of legal rules and market conventions. Market liquidity is at best factitious. In times of stress, it may become fictitious.

Megabanks, like any other bank, are subject to runs on their liabilities. Bank transaction deposits are liquid by design: always susceptible to a run.[23] Some megabank liabilities, such as commercial paper or repo, expire very quickly and are also liquid. Bank derivative liabilities are ordinarily illiquid, because derivative contracts commonly remain outstanding for years at a time. However, this illiquidity is illusory; most derivative contracts have hair-trigger closeout provisions, and also demand constant collateral calls. When the bank is under

[21] Thomas C. Baxter, Jr. & Joseph H. Sommer, *Breaking Up Is Hard to Do: An Essay on Cross-Border Challenges in Resolving Financial Groups*, in Systemic Financial Crises: Resolving Large Bank Insolvencies 175 (Federal Reserve Bank of Chicago 2005); Richard Herring & Jacopo Marcassi, *The Corporate Structure of International Financial Conglomerates: Complexity and Its Implications for Safety and Soundness*, in The Oxford Handbook of Banking (Allen N. Berg, Philip Molyneux & John O. S. Wilson, eds.) (Oxford 2012).

[22] The few remaining shards of the Glass-Steagall Act still restrict the equities activities of national banks. But perhaps more significant these days are the Securities and Exchange Commission's capital requirements, which would be prohibitive if applied to a bank's balance sheet.

[23] Douglas W. Diamond & Philip H. Dybvig, *Bank Runs, Deposit Insurance, and Liquidity*, 91 J. Pol. Econ. 401 (1983).

stress, the closeout provisions loom large, and the collateral calls generally create greater demands on liquidity.

The mechanism is not important: only the results. Banks are interconnected. Chain-reaction illiquidity or insolvency is possible: the systemic risk boogeyman. Systemic risk events are not common, and seldom trace back to a single cause. But they are frightening. We need not know the etiology of systemic risk—its consequences are enough.

With all this being said, systemic risk events are not the norm, even for megabank insolvency. Megabanks can usually ride out times of financial stress: for example, the 1997 Asian financial crisis, or the 1987 stock market break. Conversely, financial firms often collapse in isolation, even large firms. They still go down quickly, but they go down smoothly. Enron is one example; others are Barings Bank, Drexel Burnham Lambert, Refco, MF Global, and Amaranth Advisors. Some of these firms' failures created stress (Drexel, Barings); others did not (Refco, Enron, Amaranth, MF Global.) These firms mostly went down in relatively good times, often from some kind of fraud. Systemic risk is reserved for times of extreme market stress. But systemic risk inheres in the balance sheets and business practices of megabanks.

### *Internationality*

As a stylized fact, most megabanks are international.There are, of course, some exceptions, but internationality is the norm.

The insolvency of international firms is more complex than that of domestic firms. Cross-border insolvency may entail multiple and competing insolvency administrations of a firm. Each administrator uses its own law to conduct the proceeding (*lex concursus*), although it usually defers to the relevant local law governing assets and liabilities. *Lex concursus* includes process, avoidances, priorities, conflicts of law, and any stays. Setoff and netting may be *lex concursus*, or may be local law.

The basic unit of responsibility is the entity. The emerging norm is that of a central administrator, with other jurisdictions in a supporting role. These other jurisdictions conduct "ancillary proceedings" that assist the main proceeding. In a liquidation, the ancillary proceeding collects assets and distributes them to the central receiver for distribution. In a reorganization, the ancillary jurisdiction enforces the stay and does whatever asset collections are necessary. This cooperation requires a consensus on roles. Who runs the central proceeding? Who assumes the ancillary role? This consensus is codified in an international instrument: a model law.[24]

But this norm is limited to entity insolvency. Cooperation on conglomerates is more informal, and not nearly as effective, since the entity is the basic unit of insolvency law. Jurisdictions are not likely to cede their primacy on their local entities. However, most cross-border conglomerate insolvencies still work themselves out, albeit awkwardly and inefficiently. There are some incentives for cooperation. The assets of ordinary firms are typically firm-specific: the justification for the automatic stay. Local liquidations will destroy value, and the automatic stay buys time for cooperation. Industrial insolvencies are common, and large firms are spread over the globe. This supports a norm of reciprocity. A jurisdiction may agree to a subordinate role now, in return for a central role later.

The incentives for cooperation are far weaker in financial firm insolvencies. Financial insolvencies (especially major ones) are more rare, and asset specificity less intense. As we shall see below, parochial regulators weaken these incentives even more. Not only are incentives for cooperation weaker: cooperation is more difficult. To preserve liquidity and confidence, megabank resolutions must be very fast. Certain parts of them are over with almost before they start. And furthermore, megabank insolvencies give very little warning. Cooperation, then, must be *ex ante*. For sovereigns, this is much more difficult than *ex post* cooperation. It involves ceding sovereignty, rather than extending comity.

There is a final problem. International banks, unlike most international firms, tend to use branches rather than subsidiaries. (The bank is typically branched; the rest of the megabank is typically compartmentalized by national subsidiary.) This tends to complicate insolvency law. There is no international consensus on the insolvency of cross-border bank entities.[25] Indeed, the Model Law has an express carve-out for bank insolvency. Some jurisdictions (such as the United States) treat branches as if they were separate local juridical entities. Most claim to subject them to conventional ancillary proceedings—at least in theory.

[24] UNCITRAL Model Law on Cross-Border Insolvency, 36 I.L.M. 1386 (1997). The United States adopted this model law in 2005 as Chapter 15 of the Bankruptcy Code.

[25] *See infra* notes 31-35 and accompanying text.

## 2.3 Prudential Supervision

It is impossible to understand financial insolvency law without understanding something about bank supervision. Here we talk about two things: the role of supervisors in ordinary times, and their role and behavior in the neighborhood of insolvency.

### *What Do Supervisors Do?*

Most office workers have a difficult time explaining their jobs to their children. Financial supervisors have it worse—they have a difficult time explaining their job to adults. Here I will try to explain it to you—at least enough to understand their role in financial insolvency.

Any discussion of financial supervision must begin with the distinction between supervision and financial regulation. This distinction is often a fine one, because the same agencies often do both. So let me clarify my terms. Henceforth, I will use "supervision" and "regulation" as if they were distinct categories. A "supervisor" is a person or agency who performs supervision. "Regulator" is an ambiguous term, at least in natural language. I shall respect nature, and use it to refer to the persons or agencies that supervise and/or regulate, with the function left to context.

Financial regulation applies conventional regulatory techniques to financial firms. These techniques are part of the rule-of-law enterprise. A regulator promulgates and enforces rules, and often issues licenses. Rule promulgation is a mixture of policy, prudence, and authority: a mini-legislative function. The product is a rule that has force of law. Licensing can be a more discretionary activity. Nevertheless, it involves some kind of process defined by legal rules and generally subject to judicial review.

Supervision, in contrast, fills a gap somewhere between business and law. Supervisors are invested with legal powers: the power to collect information and typically some enforcement power.[26] But law enforcement is only secondary to what they do. Instead, they try to ensure that a financial firm is well run: with good operations, good risk management, good compliance, good management, and a good business plan. This task resembles many other roles, but not the same as any of them. One could view supervisors as agents of the financial firm's creditors, with a bias toward safe over profitable operation. (Remember that the creditors of financial firms are typically disperse and weak.) Or maybe supervisors resemble agents of top management, ensuring compliance with internal policies. Or perhaps a kind of auditor: an independent line of reporting to the board of directors, assessing the effectiveness of top management. Or perhaps supervisors are the bankers' answer to the agricultural extension service: ensuring that the best practices of good banks spread to the others.

We have two take-home lessons here. The first is that supervisors know quite a bit about banks, which suggests a role in insolvency law. The second is that supervisors traditionally felt protective of the creditors of the firms they supervised. Nowadays, they also seek to protect the financial system as a whole.

### *How Do Supervisors Behave in the Zone of Insolvency?*

As a general rule of corporate finance, the creditors of a firm become increasingly powerful as a firm approaches insolvency.[27] However, financial firms are different, because they do not have powerful creditors. The creditors of banks and insurers are widely dispersed, and not in the business of lending money. (This is inherent in the definition of "financial liability.") They have no covenants that can enable a governance role. Derivatives creditors are less widely dispersed and are professionals. However, derivatives credit exposures are typically collateralized and enjoy favorable insolvency treatment. Derivatives creditors therefore have little incentive to govern.[28]

The firm's supervisor typically steps into the gap and is the contingent control party. It becomes more active as the firm's prospects decline: something formalized in the "Prompt Corrective Action" system, linked to the bank's capital position.[29] In the United States, the supervisor is not the creditor of the bank, unless it is the FDIC, which is subrogated to depositors' claims. But the supervisor, in whatever jurisdiction, plays the traditional strong creditor role: exerting increasing control over weaker banks. If not a strong creditor itself, the supervisor might be the strong agent of the weak creditors.

Supervisors' active role with weak financial firms extends to the insolvency of financial firms. Almost invariably, the supervisor has the right to initiate the insolvency procedure.

[26] For the legal status of the examination function, see Cuomo v. Clearing House Ass'n, 557 U.S. 519 (2009).

[27] Oliver Hart, Firms, Contracts, and Financial Structure (1995).

[28] *Cf.* Mark J. Roe, *The Derivatives Players' Payment Priorities as Financial Crisis Accelerator*, 63 Stan. L. Rev. 539 (2011).

[29] 12 U.S.C. §§ 1831o, 5366.

This pattern is an international one, at least for banks.[30] The right of initiation tends to be exclusive in the United States, but is superimposed on ordinary process elsewhere.

In the United States, the role of supervisors goes even further, to the administration of insolvency. They are logical choices for this role. As supervisors, they know about the firm and know the firm's business. However, supervisory administration is not universal. In U.S. banking law, the FDIC, uninsured bank regulators, and state insurance supervisors all administer insolvencies. Securities firm insolvencies are typically administered by the Securities Investor Protection Corporation: an agency with no supervisory role. Overseas, supervisory administration is even less common.

This strong creditor role creates problems for international supervision. Supervisors are national actors, with national incentives. As Ernest Patrikis once put it:[31]

> When faced with the prospect of bankruptcy at a multinational bank, it is the solemn duty of each bank supervisor to do all that can possibly be done to ensure that the adverse financial effects fall on no customer or counterparty of the bank. But failing that, they should fall in another jurisdiction.

Because supervisors are national, they take a partial view: particularly host-country supervisors. They want to protect customers of the host entity and are not inclined to sacrifice their wards to global interests. This affects their supervision of troubled firms and insolvency law. Effective supervisors prefer to supervise and liquidate their local branches as if these branches were separate juridical entities. The branches of effective supervisors will pay their creditors (defined by territory, not nationality) in full. This preference may be inefficient (at least *ex post*), and even unfair, according to the equal treatment norm. But strong local supervisors are more interested in the welfare of the creditors of their firms than they are interested in a globally efficient proceeding.

This policy is codified into U.S. banking law, which treats the insolvent local branches of foreign banks as if they were separate juridical entities.[32] International insolvency standards acknowledge this approach. The UNCITRAL Model Law—which favors integrated proceedings—exempts financial entities.[33] Even where not codified in law, it is often part of practice. The United Kingdom is ordinarily a devout believer in cooperative insolvency. This belief did not apply to the insolvency of the Icelandic banks (which had U.K. branches) or the administration of the London brokerage of Lehman Brothers. The E.U. Recovery and Resolution Directive aspires to collective action within the European Union. However, it retains a local resolution option for local supervisors who dislike collective action.[34]

This policy interferes with megabank insolvency. As stated above, megabanks—despite their complex structure and international operations—are tightly integrated firms. But when megabanks get weak, supervisors work for the creditors of the entities they supervise. Aggressive local supervisors will move assets to their jurisdictions or liabilities from their jurisdiction, thus making home country resolution more difficult.[35] Home and host-country supervisors become less cooperative, precisely when cooperation is most needed. If it comes down to insolvency, they may become territorial. These foreign jurisdictions, if successful in grabbing enough assets, have no incentive to do anything but liquidate, destroying value.

## 2.4 Summary

Things look grim for megabank insolvency. As complex international conglomerate firms, megabanks seem doomed to piecemeal competitive procedures: the worst kind. Their key personnel are likely to run, along with their liquid liabilities. Both assets and financial liabilities are likely to be impaired by any insolvency process—assuming that they can be sorted out across affiliate lines. Small asset impairments in these highly leveraged organizations translate to large equity impairments. All this without even bothering to invoke the boogeymen of interconnectedness and systemic risk!

Fortunately, the cavalry is coming.

[30] Hüpkes, *supra* note 4, at 80. Hüpkes' study was limited to the United States, Canada, and E.U. jurisdictions, but I believe that the conclusion applies almost anywhere.

[31] Group of Thirty, International Insolvencies in the Financial Sector 84 (1998).

[32] *See* 12 U.S.C. § 3106(j); N.Y. Banking L. § 606. The federal and other state statutes are modeled after the New York statute.

[33] 36 I.L.M., *supra* note 24, at 1389 art. 1(2).

[34] *See* Article 83(6), 83a(4) (local E.U. authorities may go their own way if they articulate a reasoned dissent to their fellow E.U. authorities.) This right is even more explicit with non-E.U. insolvency authorities. *See* Articles 86-87. This document is still in preparation. A recent draft can be found at http://register.consilium.europa.eu/pdf/en/13/st11/st11148-re01.en13.pdf (last visited Aug. 26, 2013.)

[35] Baxter *et al.*, *supra* note 4, at 77.

## 3. Bail-In

It is time to answer the two questions I posed at the beginning. Why do bank regulators like bail-in? And why do they dislike other modes of resolution? We start with bail-in: the topic of this section.

To analyze bail-in, we must describe it. But which bail-in to describe? Bail-in is a work in progress, not tested law like the Code. The FDIC is working on its "single point of entry" concept. But the FDIC has not released all the details yet, so I will take the do-it-yourself approach. The first subsection is an idealized description of one possible bail-in scheme, inspired by the theory of Section 2 and some imagination. The second subsection puts this description in a broader context and engenders a bit more theory. Finally, I will look at the FDIC's current plans.

### 3.1 The Mechanics of Bail-In

Bail-in is a stripped-down form of reorganization[36] working at warp speed. As we have seen, financial liabilities lose additional value if reorganized to other debt. But other liabilities only lose net present value: let us call them "bonded debt." Bail-in subordinates bonded debt and reorganizes only it into equity—mostly overnight. If there is enough bonded debt, the financial liabilities are untouched: ordinal and temporal priority. The bail-in process should create a well-capitalized firm the next morning, before the financial liabilities have had a chance to run. The hope is that this process works as smoothly as a recapitalization with government money—with no government money at risk. The bonded debt bails out the financial liabilities: hence the sobriquet "bail-in."

I have just been a bit too glib. Debt subordination is an old trick in financial insolvency law,[37] but it is not enough. "Subordination" is an entity concept. Megabanks are conglomerates, not unitary entities. How, then, to instantly reorganize the nonfinancial debt of conglomerates, without touching the financial debt? Such debt might exist in many entities, in many jurisdictions. The creditors might be affiliates. Overnight reorganization of such debt requires a tremendous amount of information and jurisdictional coordination. This task is an impossible one.

Fortunately, this is not the task of bail-in. By a stroke of luck, the Bank Holding Company Act encourages the parent entity of a financial firm to be pretty much a pure holding company.[38] *This means that the parent entity does not rely on financial liabilities*. Furthermore, the parent is the cheapest source of funding in the organization. Therefore, the parent can downstream this cheap debt to the subsidiaries.[39] *This means that the third-party liabilities of the subsidiaries are mostly financial.* Because of limited liability, the debt of the parent is "structurally subordinated" to the debt of its subsidiaries. The creditors of a solvent subsidiary are paid in full, even if the parent is insolvent. And finally, a parent reorganization involves only one entity. Only one jurisdiction is responsible for the parent's insolvency: one set of rules, one set of acts, and one set of incentives. International insolvency law works better for single entities than conglomerates.

This all looks a bit too pat. The problem of megabank insolvency is too hard, and bail-in seems too easy. Let us slow down and look at the details of bail-in, starting with its sequence.

#### *The Sequence*

Bail-in begins before it begins. The regulator must prepare for the bail-in well in advance. There are two pre-initiation processes: fast and slow. The slow process is one of discourse with clearinghouses and foreign regulators. The goal is not agreement, but the formation of reciprocal expectations. The clearinghouses and foreign regulators expect the parent regulator to rescue all relevant subsidiaries, at the expense of the parent. The parent's regulator expects cooperation in return. These expectations are not mutual obligations. There are no obligations until the parent regulator decides to rescue the subsidiaries. Only then do the reciprocal expectations crystallize into reciprocal obligations.

[36] *See supra* note 12.

[37] Insurance policies are priority debts in insurance law. Bank insolvency law has inconsistent priority rules. *Compare* Jennings v. U.S. Fidel. & Guar. Co., 294 U.S. 216 (1935) (priority debts abhorrent to the National Bank Act); 12 U.S.C § 5390(b) (priorities in Dodd-Frank Act which do not privilege financial liabilities) *with* 12 U.S.C. § 1821(d)(11) (depositor priority); UCC § 4-216 (priority for checks in collection); Merrill Lynch Mortgage Capital, Inc. v. Federal Deposit Insurance Corp., 293 F.Supp.2d 98 (D.D.C. 2003) (priority for special deposits).

[38] 12 U.S.C. § 1841 *et seq*. The holding company can do anything that its nonbank subsidiaries can do, so financial liabilities are possible. However, there is no need to keep these liabilities in the parent. They are not very common in practice and can be moved out of the parent without much cost. This trick—limiting parents to nonfinancial liabilities—does not work for all jurisdictions, some of which have the bank as a top-tier parent. Such jurisdictions must rely on explicit subordination, whether by priority or contract.

[39] The bank subsidiary is an exception to this, since it, too, is a cheap source of funding. However, Sections 23A and 23B of the Federal Reserve Act restrict the bank's ability to fund its affiliates. 12 U.S.C. §§ 371c, 371c-1.

The fast process is fast indeed: days or even hours, if necessary. At this point, we shall call the official actor the "receiver," likely the regulator in another guise. The receiver must assess the situation as best it can and make two key decisions: whether to support the subsidiaries, and the amount of the debt haircut at the parent level. The receiver will probably want to recapitalize all subsidiaries. (There are complexities to this, discussed below.)

Initiation has four immediate consequences. First, the receiver's second decision becomes action. The receiver selects parent debt. In doing so, it climbs up the liability stack as far as it needs: certainly equity and preferred stock, then subordinated debt on up to senior debt, if needed. Each class but one is either untouched or fully selected. One class may be partially selected: the one sandwiched between the untouched and fully converted classes. Any unselected debt is paid according to contract. The selected debt becomes new equity, to be distributed later. The result is a parent with much less debt, and substantial equity. The proper debt-equity conversion is the most difficult decision that the regulator must make. Too small a conversion, and the reorganization will not be credible. An overlarge conversion unnecessarily disrupts creditor expectations. (The risks are asymmetric.)

The second consequence of initiation is that the receiver can (but need not) exercise classical receiver powers for some time. It may replace management (if necessary), do some early transactions, and possibly alter the governance of the firm. The active part of the receivership could be over as soon as reliable private governance is in place: a few weeks. Or it could persist longer.

The third consequence of initiation is an automatic anti-*ipso facto* provision that invalidates cross-default clauses keyed to the parent. Since the subsidiaries will likely be solvent in bail-in (see below), any invocation of these cross-default clauses would be opportunistic behavior of counterparties. Enforcement of this stay requires some measure of cross-border cooperation: either through harmonized insolvency law, or changes in industry-standard documentation, or changes in regulation.

The fourth consequence of initiation is the recapitalization of the subsidiaries, probably by debt relief. The parent can afford to relieve its subsidiaries' debt, because it has very little debt service itself. Presto! All affiliates that relied on parental funding are now reasonably capitalized. There will probably not be much private liquidity in times of stress, even though the bail-in creates an extremely well capitalized megabank. However, government liquidity to the parent will serve temporarily and can also recapitalize any subsidiaries that did not rely on parental credit. There is not much risk in lending to the now-well-capitalized parent.

The fast work is all done. Only one operation on the balance sheet remains, but this takes some time. Who gets the new equity? It is operationally easy to relegate debt to equity—just name a number. This number can be arbitrary, if the process respects debt priority. True, the relegated debt holders lose their old debt. But they are compensated in new equity. As long as debt priority is respected, the aggregate value of the new equity should have precisely the same value as the old debt aggregate. This is true notwithstanding the amount of relegated debt.

The problem, of course, is that only the *aggregate* value is preserved. There will likely be several classes of claimant, each insisting that it is entitled to plenty of new equity. These claims are harder to resolve. Any resolution would require some rules and a few months of time. They may require the imprimatur of an Article III court, or at least plenary review by an Article III court.[40] The entire process of equity distribution would have to do the following:

**Handle claims.** Most of this is fast and mechanical, as the claims will typically be those of bondholders. Therefore, the process is simply that of identifying bondholders and their assignees.

**Compute new equity to the claimants.** This is not mechanical. Even the simplest form is complex: valuation of the firm, and equity distribution following the priority ladder of claims. The Code follows another path: a negotiation process that culminates in a plan. Such a process gives more voice to claimants and thus may be more legitimate than a judicial valuation. However, it encourages strategic claimant behavior, runs the risk of delay, and requires judicial review.[41] Note that a bail-in negotiation process would be more limited than the one in the Code. The Code negotiation process chooses which debt to impair, as well as the conversion of impaired debt to equity. In contrast, bail-in impairs parent debt at the very beginning of the process, to create confidence at the subsidiary level.

**Distribute new equity to the claimants.** This is relatively mechanical, but time-consuming. The distribution itself is fast enough, but the antecedent securities law disclosures take time.

This process could be compressed into a few months, with appropriate procedures. Time is significant, but not of the essence. This process has a limited role: who gets

[40] United States v. Raddatz, 447 U.S. 667 (1980).

[41] There is a third way: giving junior classes an option to buy out the senior classes at face value. *See, e.g.*, Lucian Bebchuk, *A New Approach to Corporate Reorganizations*, 101 Harv. L. Rev. 775 (1988); Philippe Aghion, Oliver Hart & John Moore, *The Economics of Bankruptcy Reform*, 8 J.L. Econ. & Org. 523 (1992). However, this approach presumes a working capital market, which is unlikely during a financial crisis.

Table 1
## Timeline of the Integrated Bail-In Process

| Prior Steps | | Bail-In | | | Restructuring |
|---|---|---|---|---|---|
| Years | Days | Overnight | Days to Weeks | Months | Long Term |
| *Talk to*: Foreign regulators, clearinghouses | Value firm | Debt to equity | Liquidity support | Restructure business | Restructure business |
| | *Deal with*: Foreign regulators, clearinghouses | Subsidiary debt swap | New governance | Access to public liquidity | Add parent debt or shrink bank |
| | | Receiver takes over | | New securities registration | Pay dividends |
| | | *Ipso facto* relief | | New securities distribution | |
| | | Foreign regulator approval | | Receivership ends | |

Source: Tabular summary of text.

how many shares in the reborn enterprise. This role is especially limited because the market for corporate control of financial firms is a tightly regulated one that favors widely distributed shareholdings.

This is the only slow part of bail-in. The rest is fast. Financial liabilities are unaffected, and the firm's operations are unscathed.

The distribution of equity is the end of the legal process, but not the end. The reorganized bank will have a strong balance sheet, but may not have a strong business. The megabank probably became troubled in the first place because its operations were insufficiently profitable, or perhaps too risky. The megabank will have to shed its bad operations. This is not a primary task for the bail-in, which apart from installing new management and maybe governance, works mostly on the balance sheet. Rather, it is a task for the restructuring stage, although there will be some overlap with the earlier process. A timeline of the integrated bail-in process is shown in Table 1.

Bail-in requires two things to succeed in full. First, there must be enough debt at the parent to credibly fill the consolidated capital shortfall, and the receiver must be willing to haircut it accordingly. This requires regulation, as discussed below. Second, bail-in must inspire confidence. For this, adequate capital is necessary, but not sufficient. A sufficient liquidity backstop is also necessary, as is the cooperation of foreign regulators. But even these are not sufficient. An adequately capitalized firm might still not engender enough confidence to survive as a going concern.

However, even such a failure would be a success. The firm will still survive as an orderly liquidating organization, if not as a business unit. The liquidity backstop assures that it will not need to dump its assets on the market. Such a failure will internalize credit risk on the bondholders, and not destroy asset or liability values.

### *The Guarantee Problem*

Guarantees pose a technical problem for bail-in. Guarantees, for our purposes, include anything that pierces the corporate veil of affiliates: straight guarantees, collateral, or keep-well agreements, for instance. The guarantee can run from parent to subsidiary, or cross-stream, or even upstream. This definition does not include guarantees of unaffiliated organizations.

Guarantees preclude the receiver's option to abandon a subsidiary. A guaranteed subsidiary is welded to its guarantor. This sounds like little loss; bail-in will usually recapitalize all the subsidiaries. However, this is the *ex post* fallacy: ignoring incentives. The option of abandoning a subsidiary is credit risk for its creditors and regulators. This risk is an incentive to monitor subsidiaries.[42] An ideal bail-in would be time-inconsistent: *ex ante* putting the subsidiaries at risk and *ex post* bailing them out. Time-inconsistent

[42] *Cf.* Baxter *et al.*, *supra* note 4 (context of branching: the rationale for territorial branch liquidations); Roe, *supra* note 28 (derivatives).

policies do not work in a frictionless world. But frictions exist aplenty: notably uncertainty about regulatory action and the credit risk aversion of financial product counterparties.

If the receiver does not have the *ex post* option to abandon a subsidiary, the parent regulator has no *ex ante* bargaining position with foreign regulators. In other words, foreign regulators will have less incentive to cooperate with parent regulators, because they know that their local subsidiary will leave no creditor behind. This is not an insolvency problem. Instead, it is a regulatory problem, encouraging local regulators—who have local knowledge and power—to free ride off the parent regulator, who does not.

This analysis of guarantees is incomplete, and at most establishes a *prima facie* case. But it is enough to serve my purpose. Guarantees are a significant issue in bail-in, and one without an easy solution.

If regulation of guarantees is useful, the bail-in process itself can regulate, by subordinating parental guarantees. A subordinated guarantee remains fully effective against a healthy parent. It therefore assures subsidiary creditors that the healthy parent will not walk away from the subsidiary. But subordinated guarantees do not protect the subsidiaries of an insolvent parent. Therefore, subordinated guarantees preserve the receiver's freedom of action in the event of insolvency.

### *The Regulations*

Bail-in assumes a bank supervisory process, *e.g.*, monitoring a weakening business and restructuring the bailed-in firm. Bail-in also requires some adjunct regulation. Fortunately, this regulation is neither extensive in scope nor difficult to draft:

**Mandatory debt.** Bail-in requires an adequate level of parental debt: enough to recapitalize the largest foreseeable shortfall. Market forces may not provide enough of such debt, since firms may prefer to issue liabilities through the subsidiaries, as profitable financial products. This argues for minimum mandatory debt at the parental level.[43] A mandatory debt regulation is easy to draft and comply with. The amount of debt could key off Basel risk-weighted methodology or the value of the financial liabilities, held by third parties with the subsidiaries.

**Cross-affiliate guarantee.** The insolvency process can subordinate parental guarantees, but it cannot affect cross-affiliate guarantees, because bail-in will put few, if any, subsidiaries into insolvency. A holding company might be tempted to use these guarantees to deny the receiver the ability to abandon a particular subsidiary.[44] Similar to guarantees are other close relationships, such as service agreements, cross-stream debt, common names, and the like.

This problem is not a fatal one, but it is not easy to fix in insolvency law. It suggests a regulatory approach.

**Claims trading.** Valuation is one of the slower parts of bail-in. During its pendency, the ultimate value of the claims will be uncertain. This valuation uncertainty is likely to create an active market in claims, along with the invariable portfolio repositioning of debt-holders who may not (want to) hold equity. There is nothing wrong with this; it is part of every modern Code reorganization.

However, this trading is likely to concentrate the claims, which will concentrate the ultimate equity holdings. U.S. bank regulation is chary of concentrated equity holdings. A concentrated equity holder might itself become a bank holding company, which is illegal without a license.[45] There will probably be some need to reconcile the claims trading process with the ownership limitations of the Bank Holding Company Act.

**Parent liabilities.** Bail-in works best when the parent has no financial liabilities. This might imply some reinterpretation of the Bank Holding Company Act, to prohibit the few financial liabilities that a modern holding company parent might have. It might go a bit further. Some nonfinancial liabilities are typically subject to a CVO (*e.g.*, trade credit) or a bankruptcy priority, such as employee compensation. From the perspective of bail-in, the best holding company is a pure shell, without any operations or even a building lease or telephone bill.

## 3.2 The Meaning of Bail-In

Now that we have discussed the mechanics of bail-in, it is time to put this technique into context, with three brief essays. I shall first discuss why this technique works. I then discuss the implications of bail-in for the notion of bank capital. I conclude with a few words on the limits of this technique.

[43] Such mandatory parent debt is current regulatory policy, although not yet implemented. http://federalreserve.gov/newsevents/speech/tarullo20131018a.htm (last visited November 12, 2013.) For a more sophisticated argument, see James McAndrews, Donald P. Morgan, João Santos & Tanju Yorulmazer, *What Makes Large Bank Failures So Messy and What to Do about It?*, 20 FRBNY Econ. Pol. Rev., 229 (2014).

[44] *See supra* text accompanying note 42.

[45] 12 U.S.C. §§ 1844(a), 1847.

Table 2

## Balance Sheet Data of Selected Large Banks in 2006

| | Consolidated Liabilities (L) (Trillions of dollars) | Equity (E) (Trillions of dollars) | Long Liabilities (LL) (Trillions of dollars) | E/L (Percent) | LL/E (Percent) | LL/L (Percent) | (LL+E)/L (Percent) |
|---|---|---|---|---|---|---|---|
| JPMorgan Chase | 1.24 | 116 | 145 | 9.4 | 1.25 | 11.7 | 21.0 |
| Lehman Brothers | 0.53 | 18 | 82 | 3.4 | 4.55 | 15.5 | 18.8 |
| Citibank | 1.88 | 119 | 290 | 6.3 | 2.44 | 10.1 | 16.4 |
| Goldman Sachs | 0.80 | 34 | 126 | 4.2 | 3.71 | 15.8 | 20.0 |

Source: Securities and Exchange Commission Form 10-K consolidated balance sheets filed in 2007.

Notes: The long-term debt is consolidated, and thus may count long-term third-party debt at the subsidiaries. However, most of this subsidiary debt (if it exists) can be cheaply moved to the parent, so it is useful for bail-in. I would dearly love to argue that Table 2 proves that the 2006 levels of long-term debt were sufficient to avert the disaster of 2008, if only bail-in had been around. I am not certain that this is true.

### *Why Bail-In Works*

Parent-level bail-in is quick and simple, compared with the alternatives. Since everything happens at the parent level, the complexity of the conglomerate matters little, if subsidiaries are safe and everybody cooperates. Parent-level bail-in is strongest at the crisis stage—the beginning. Compared with the alternatives, it economizes on information, planning, and implementation when time is short and the stakes are high. The early stages of bail-in are operationally tractable, even with the time constraints. The debt haircut may be a difficult judgment call, but is operationally easy. The subsidiary debt forgiveness and liquidity provision are conceptually simple, and operationally straightforward. With some luck, they can restore confidence in the firm, preserving its going-concern value. At worst, bail-in creates an orderly liquidation.

International cooperation is the most complex of the early steps. But fortunately, the scope of the cooperation is limited. The foreign regulator must keep its subsidiaries out of local insolvency proceedings, perhaps provide liquidity, and discourage declarations of default. Clearinghouses must not close their members out. Fortunately, bail-in aligns the cross-border incentives, at least if all the subsidiaries are safe. For the foreign regulators, bail-in shifts all the pain to the home country, at least if we assume that foreign regulators care no more about their bondholders than they do about domestic bondholders in nonfinancial firms. The home country also wants bail-in, because it is likeliest to preserve the financial firm.

The process creates few perverse incentives, because the parent creditors cannot expect the public to assume their credit risk. It does not concentrate the industry further. It may encourage a shift of liabilities to the subsidiary. But the fix for this is easy: mandatory debt at the parent level. It may encourage inappropriate downstream and cross-stream guarantees, but there are fixes to this, too.[46] There will be some tail risk. But this is not a significant problem. There is plenty of bail-in ammunition in most large banks' balance sheets, and the banks can afford it. As Table 2 shows, there is nothing unnatural about the kind of balance sheet that supports bail-in. Most large banks in 2006 had substantially more long-term liabilities than equity capital. And these liabilities *understate* the bail-in-able debt, because the parent also had substantial short-term liabilities.

### *The New Meaning of Capital*

Our core insight is that only financial firms have financial liabilities. Bail-in succeeds because it subordinates and separates the nonfinancial liabilities from the financial liabilities. This transforms our understanding of bank capital.

Capital regulation presupposes that junior liabilities should protect senior liabilities. This makes no sense in ordinary corporate finance theory, because nobody needs protection. Every voluntary investor assumes its risk, compensated by the pricing and contractual terms it bargained for.

[46] *See supra* text accompanying notes 42-44.

Why protect it from its bargain? (We ignore nonadjusting creditors and strategic behavior.) But this article does not use ordinary corporate finance theory. This article extends corporate finance theory to include financial products as well as ordinary debt, held for investment. Holders of financial products lose more in insolvency than the net present value of the difference between their claim and their share. An efficient contract gives them priority regardless of their bargain, averting deadweight loss.

Bail-in transforms the meaning of capital. In bail-in, parental debt does exactly the same thing as equity: it protects financial liabilities from a degradation of value. If this is the function of capital, we may conclude that *with bail-in, all nonfinancial liabilities are capital*! It also means that in a bail-in regime, megabanks currently hold much more capital than we thought they did.[47] But with poor insolvency law, there is no access to it.

Not all capital is created equal. But it is hard to say which forms of capital are better. Debt might provide better protection than equity. It is easier to measure. It disciplines management,[48] especially if continuously issued. From a supervisor's perspective, it provides superior information to equity. The price of debt reflects only downside risk: the supervisor's main concern. Finally, a debt-heavy structure ensures plenty of bail-in ammunition.[49]

Proponents of equity structures have their argument, too. Inadequate equity encourages excessive risk-taking.[50] Also, low-equity structures enter insolvency more often than high-equity structures. Insolvency is costly. The cost of insolvency argues for more equity—a lower probability of default.

The term structure of parent debt also makes a difference. Short tenors are more sensitive than long tenors, because the primary market constantly assesses them. Alternatively, long-term debt protects a firm from transient market sentiment. Banks arguably need such protection more than commercial firms, because they do not have commercial paper backstops. Then again, banks have a fair amount of liquid assets; hence less need for something like a commercial paper backstop.

I do not seek to optimize parental debt and equity. It is enough to say that they both serve as capital in a workable bail-in regime.

### *Bail-In and Systemic Risk*

I cannot stress the point enough: the case for bail-in does not need the systemic risk boogeyman. The boogeyman is real and scary enough, but also a rare beast. Bail-in works well for isolated megabank insolvencies, which are far more common.[51] If there is enough debt in the parent, the worst result is pretty good: an orderly liquidation that does not impair financial liabilities, dissipate asset values, or put public funds at risk. And bail-in has a good chance of preserving the firm as a going concern.

Bail-in should also mitigate systemic risk. I have been agnostic on the causes and mechanisms of systemic risk,[52] but liquidity and leverage have a lot to do with it. Bail-in eliminates the leverage problem: the bonded debt of the parent protects the subsidiaries' creditors. Liquidity support is credible. If the government can print money and does not assume substantial credit risk (bonded debt again), public liquidity has no real cost, even before public benefits are considered. Furthermore, bail-in can work as quickly as systemic risk can materialize. Since the early stages of bail-in are administratively simple, it also scales well. It can work on many firms at the same time, if necessary.

Bail-in will probably create its own stresses. A bailed-in firm will likely mark many of its assets down. These asset markdowns might force other firms to do the same, adding to the systemic risk of multiple bail-ins. However, I believe that this particular risk may be a chimera. Bail-in is scalable. It is a reorganization, needing no outside resources, apart from liquidity and regulatory attention. These resources are not scarce, at least in the United States, as we have seen in 2008. A contrarian could even argue that multiple bail-ins are less stressful than single ones. Bail-in may be stigmatizing, but multiple bail-in stigmatizes an industry, not a firm. This may decrease the risk of soft failure. Counterparties can avoid a stigmatized firm, but have a harder time avoiding a stigmatized industry.

[47] *See* Table 2: compare E/L column to (LL+E)/L column. This is directly contrary to the Admati-Hellwig hypothesis: that the low levels of Basel Tier I capital imply that banks are severely undercapitalized. Anat Admati & Martin Hellwig, The Bankers' New Clothes: What's Wrong with Banking and What to Do about It (2013). If bail-in works as I expect it to, their apparently radical recommendation of 20-30 percent equity is pretty close to a plea for the *status quo*. The Admati-Hellwig thesis tacitly assumes that these debt liabilities are irrelevant: *i.e.*, bail-in does not work.

[48] Michael C. Jensen, *Agency Cost of Free Cash Flow, Corporate Finance, and Takeovers*, 76 Am. Econ. Rev. 323 (1986).

[49] Some of these arguments are made more analytically in McAndrews *et al.*, *supra* note 43.

[50] *See supra* note 7.

[51] For a short list, *see supra* Section 2.2.

[52] *See supra* text accompanying note 23.

### *Limits on Bail-In*

Bail-in has at least five limits: maybe a sixth if you are worried about multiple bail-ins. Here we discuss the five.

First, bail-ins can only marshal limited resources: the nonfinancial liabilities of the parent. This would have been plenty for the crisis of 2008. But it is not enough for any imaginable crisis. Since megabanks are in the business of financial liabilities, they can afford to issue only so many nonfinancial liabilities. For a sufficiently large shock, systemic risk will remain. Nor will breaking up megabanks eliminate the systemic risk problem, even with bail-in. The failure of a small bank may not endanger the system. But systemic dangers—such as asset collapses—will systemically endanger even small banks.

This is reminiscent of the catastrophic risk problem of the insurance industry. Capital markets, no matter how ingeniously organized, can only handle so much risk. Leviathan must always lurk at the far end of the risk tail. All we can do is stretch the tail a little longer, further away from our workaday world.

Bail-in must also muster another resource: governmental liquidity. With enough parental liabilities to bear the risk, governmental liquidity is a free good, at least in principle—but maybe not always in practice. Liquidity is only free if the government debt market is deep enough. This is almost certainly true in jurisdictions like the United States, where financial panics increase government liquidity, as investors rush to public debt. But, as Iceland has shown, it is possible for a jurisdiction to be smaller than its banks. Bail-in might have operational problems in such a jurisdiction.

Third, as discussed above, bail-in has a soft failure mode. Counterparties may not have enough confidence in the firm to stick with it, even if they know they will be repaid in full. If so, bail-in ceases to be a reorganization, and becomes a kind of controlled wind-down. Such a failure is a successful one: this bug is really a feature. Financial creditors get paid in full, at the expense of nonfinancial creditors. This both averts systemic risk and imposes market discipline on nonfinancial creditors. But it does destroy the business.

The fourth limit does not exist in principle, but may be a significant problem in practice. Megabanks are international firms. Bail-in requires a fair degree of *ex ante* legal harmonization and *ex post* cooperation. This is no problem in principle: both the *ex ante* and *ex post* incentives are strong, as argued above. But legal harmonization derogates from sovereignty. The history of insolvency treaties has not been a good one. *Ex post* cooperation has had some success, but cooperation is hardest in times of panic. As a political matter, can a home-country receiver promise to make good on a massive hole in a foreign subsidiary? As an economic matter, can it afford not to? Can a host-country official (be seen to) rely on the kindness of strangers?

There are, however, some grounds for optimism. Since most of the action takes place at the parent, the necessary harmonization is narrow in scope. I can only think of two major issues (there may be more.) Creditors of the parent may seek to enforce their claims against parental assets overseas—the stock and upstream debt of the subsidiaries. And we have already mentioned, in Section 3.1, that bail-in requires that jurisdictions not enforce *ipso facto* cross-default clauses. The first problem was solved—or at least addressed—over a decade ago by recognition of main and ancillary proceedings.[53] If a bail-in follows the established rules of the road, the parent creditors will have no recourse outside the main proceeding. The *ipso facto* problem might also be tractable. Legal harmonization might require super-sovereignty, but banking law contains super-sovereign forces. The Basel process, for instance, encouraged enforcement of *ipso facto* clauses in derivatives contracts. The ISDA model agreement could remove or modify these clauses, and ISDA seems to have done so.

There is one other limit to the bail-in concept. It is limited to financial firms. Bail-in cannot replace the Code. Bail-in buys speed at the cost of flexibility. This speed is needed for the financial liabilities that define financial firms, but other liabilities can survive the automatic stay. Bail-in presupposes a certain corporate structure. It also presupposes prudentially regulated firms, and requires a capital regulatory scheme. It is a specialist: good for the peculiar world of financial firms, but not exportable elsewhere.

## 3.3 The FDIC and Bail-In

Title II of the Dodd-Frank Act empowers the FDIC to resolve financial conglomerates.[54] The FDIC formally adopted the single point of entry (SPOE) approach to implement Title II in a December 2013 release that is currently out for comment.[55] This release does not contain all the details, such as: the details of the valuation and equity distribution, or the criteria for recapitalizing subsidiaries. But the outline is good enough. SPOE is a form of bail-in at the parent. Instead of

[53] *See supra* text accompanying note 24. *But see supra* notes 32-34.

[54] 12 U.S.C. § 5381 *et seq.*

[55] "Resolution of Systemically Important Financial Institutions: The Single Point of Entry Strategy," 78 Fed. Reg. 76614 (Dec. 18, 2013).

working directly on the parent entity, it uses an intermediate "bridge company." [56] The FDIC will transfer all or most of the assets of the holding company parent to a bridge company, retaining many or all of the parent liabilities in the estate. It will then issue the stock of the bridge company to estate claimants in satisfaction of their claims. This liquidating distribution in kind is almost identical to a classical reorganization, although it entails a *de novo* entity.

Their approach should work, if there is enough debt in the parent. (This task is the Federal Reserve's.) Bail-in requires liquidity support, but the Dodd-Frank Act provides it, through the FDIC and the Treasury.

SPOE relies on Title II, and Title II is drafted as an insolvency process of last resort. The entity must be on the eve of insolvency (defined broadly), the insolvency must have systemic consequences, and there must be no good alternative to Title II resolution. The procedural barriers are high, as well: a recommendation by the Board of Governors of the Federal Reserve System and another agency; a determination by the Secretary of the Treasury (in consultation with the President), and either approval by a district court or the acquiescence of the firm's board of directors.

This hard trigger has its downside. Bail-in works well, even when systemic risk is not on the table. With the appropriate parental capital structure, bail-in improves the balance sheet, preserves going-concern value, does not result in concentration, and displaces poor management. Bail-in is not an inherently desperate measure. It should not be reserved for desperate times.

The hard trigger is not only too narrow; it also harms the bail-in process. The hard trigger means that there will be no SPOE practice emerging from experience in low-stakes cases. This is troublesome. "The life of the law has not been logic; it has been experience."[57] (Chapter 11 is a good illustration of this maxim, as is the administration of the FDI Act.[58]) The Title II hard trigger does not allow for experience. The FDIC will have to get it right the first time, with high stakes and no latitude for error. Fortunately, however, bail-in is a simple and robust idea. We may never get the experience with SPOE that we have with Chapter 11. But we will not need as much of it.

There is a second problem, complementary to the first. People are more confident with well-tested procedures. Bail-in may not require confidence to provide an orderly liquidation or avert systemic risk: enough capital and liquidity support should do the trick. However, it does require confidence to preserve the bailed-in entity as a business concern. Such confidence relies on practice and custom: "an instinctive confidence based on use and years."[59] This is the same confidence by which customers buy airline tickets from airlines in Chapter 11.

## 4. Alternatives to Bail-In

This section answers the other question posed at the beginning: why are regulators unhappy with the alternatives to bail-in? It examines three alternatives: fast asset sales, Chapter 11, and private law. It concludes that they are all worse than bail-in. Some may not work at all.

None of these comparative arguments requires systemic risk. Bail-in is better for any megabank failure—even localized failures.

### 4.1 Fast Asset Sales

The asset sale proposal of Melaschenko and Reynolds[60] looks attractive. It takes place at the parent level. All the assets and some of the liabilities of the parent go into a temporary holding company, which operates for a few months, until a buyer emerges. The proceeds of the sale pay off the creditors, much like the sale of a business in bankruptcy.

The proposal looks much like bail-in, and should be about as quick. It has the further virtue of placing a market value on the firm. It may even work. But even if it works, it will work worse than bail-in. It assumes too much: a competitive market for corporate control, and no antitrust problems. Bail-in suffers from neither problem. Let us review the bidding, starting with the market for corporate control.

#### *Market for Corporate Control*

In a perfect market for corporate control, the sale price would be the best measure of firm value. Real-world markets for corporate control are not perfect, but they are far better than the forced asset sale of a megabank.

[56] *See supra* note 12.

[57] Oliver Wendell Holmes, Jr., The Common Law 1 (1881).

[58] David A. Skeel, Jr. Debt's Dominion: A History of Bankruptcy Law in America (2003). A similar history of bank insolvency has not been published.

[59] Walter Bagehot, Lombard Street: A Description of the Money Market 33 (Richard D. Irwin 1972) (1873).

[60] Paul Melaschenko & Noel Reynolds, *A Template for Recapitalising Too-Big-to-Fail Banks*, BIS Quarterly Rev. 25 (June 2013).

To begin with, the market would be thin. Thanks to the Bank Holding Company Act, bidders would be few. Only megabanks—or organizations willing to become megabanks—can buy megabanks. Not all of them would necessarily be bidding. In times of financial panic, many banks might prefer to avoid the action. And the best offer would not necessarily win. It may come from the weakest bidder.

The market would be thinner because it would likely be lumpy: of the whole bank. Units could be sold, in principle, just the same way that any functioning megabank could sell a business unit. But in practice, things are a bit more difficult, because the buyer is not certain that the seller would remain as a going concern. (Sales of business units usually feature warranties and service contracts.) And the more pieces that are sold, the more skittish the financial liability holders of the unsold pieces would be, and the less the unsold pieces would be worth.

The assets would also be a bit lemony, as well as lumpy. It takes a lot of due diligence to purchase a very large bank. This is especially true for a megabank known to have weak business units—especially in a time of financial panic when asset prices are unmoored from asset values.

Not only are the assets lemony and lumpy, they are also volatile. There will be some time between bidding and closing. This is time that the subsidiary's creditors could decide that they do not like the bidder, and disappear, taking the value of the firm with it. The same is true for others. A temporary entity with a "for-sale" sign around its neck might have more problems retaining customers and key employees.

An impaired market for corporate control is still a market for corporate control. If the regulator is determined to sell the megabank cheaply, some buyer will probably emerge—maybe even in a financial panic. The buyer will probably get a very good deal. This is precisely the problem. The creditors would do better in bail-in, which does not require a functioning market for corporate control.

### *Competition*

Despite their problems, we know that fast asset sales or mergers of megabanks can work if the acquiring megabank is strong and/or if the acquisition is assisted. We have seen them work in 2008. JPMorgan Chase Bank acquired Bear Stearns and Washington Mutual Bank. Wells Fargo Bank acquired Wachovia Bank. Bank of America acquired Merrill Lynch. These are successes; they averted target insolvency. Transaction flow was smooth; financial liabilities were unimpaired. The Washington Mutual transaction created some angry creditors of the parent (which was not sold), but the parent had no financial liabilities.

But they are only partial successes. Each sale replaced a sick megabank with a bigger megabank. This is poor competition policy.[61] There are not that many megabanks: the industry is concentrated. Only a megabank can acquire another megabank, so mergers concentrate the industry further.

Bail-in is clearly superior in this regard. A successful bail-in has only a marginal effect on competition; an unsuccessful bail-in only eliminates a competitor, without creating a bigger one.

## 4.2 The Bankruptcy Code

Bail-in is a form of reorganization. The Chapter 11 reorganization is the jewel in the crown of the Code. Why can't megabanks just use Chapter 11, on a parent-only basis? A parent-only Chapter 11 would be similar to bail-in: protecting the financial liabilities at the expense of the parent's bonded debt.

This question has a consensus answer: "Chapter 11 will not work." This is true even though Chapter 11 is better than SPOE in some respects. It has a much lower initiation trigger than Title II,[62] and it does not require a separate bridge entity.[63] Despite some early support for unvarnished Chapter 11,[64] most Code proponents now say that Chapter 11 needs some improvements.[65] This is a good place to examine the weaknesses of Chapter 11 in financial insolvency. We start with a very brief introduction to Chapter 11. We then discuss the flaws of Chapter 11.

[61] This is so at least in the eyes of Congress. *See* 12 U.S.C. §§ 1852, 5363 (limiting acquisitions of large financial firms.)

[62] *See supra* text accompanying notes 56-59.

[63] *See supra* text accompanying notes 55-56.

[64] *E.g.*, Kenneth Ayotte & David A. Skeel, *Bankruptcy or Bailouts?*, 35 J. Corp. L. 469 (2009); Stephen J. Lubben, *Systemic Risk and Chapter 11*, 82 Temp. L. Rev. 433 (2009); Skeel, *supra* note 4; Baird & Morrison, *supra* note 4 (more-or-less equating Code to FDI Act process).

[65] *See Hoover Institution*, *supra* note 4 ("Chapter 14"); Bovenzi, Guynn & Jackson, *supra* note 4.

### *A Quick Tour of Chapter 11*

I implore readers with any knowledge of the Chapter 11 process to skip this short section. I wrote it only for a hypothetical reader who is new to the topic and does not know how grossly I simplify.

The Chapter 11 process begins with a petition filed in court, generally by the debtor. No judicial action is needed; filing alone is effective and creates an "estate" in the entity that filed. After filing, the incumbent management typically continues to operate the estate, although a court may select other management. Management serves as a fiduciary for the estate, supervised by the courts. As fiduciary for the estate, it is responsible only for the estate, not third parties such as employees or financial counterparties of subsidiaries.

Filing creates an immediate stay on all debt-collection efforts. Nevertheless, debtors typically need liquidity for their continuing operations, and financial firms definitely need liquidity. The Code lets a post-petition debtor borrow on a priority basis: so-called "DIP financing."[66] At this stage, the Chapter 11 process bifurcates. In one path, the court—at the behest of management or the creditors—sells the bulk of the business as an operating concern. This so-called "Section 363" path is favored these days, because it is much faster (weeks to months) than the alternative path: a true reorganization.[67] The reorganization seeks the same end-state as a bail-in: a new capital structure. However, its process is completely different.

A Chapter 11 reorganization is a negotiating process. To oversimplify, creditors form committees of similar claims. The debtor and committees negotiate among themselves and come up with a "plan" that reorganizes the liabilities of the firm in a more sustainable fashion: transforming senior debt into junior classes (or even equity), and short-term debt into long-term debt. This often takes a year or more. Dissenters complain to the court. If the court deems the plan fair, it "confirms" the plan, over the dissenters' objections. If not, the negotiation cycles again. Upon confirmation, the firm is reorganized, with a more sustainable capital structure.

Note that this negotiation process conflates two processes distinct in bail-in: the relegation of old debt, and the distribution of new instruments. In bail-in, the first process occurs at the beginning. The second process occurs at the end, with the valuation of the firm. In Chapter 11, both processes occur synchronously, with the plan confirmation at the end.

[66] "DIP" is an acronym for "debtor in possession": *i.e.*, the incumbent management, which usually continues operating the firm, subject to judicial supervision. "DIP financing" is a term of art; it applies to any post-petition financing, regardless of who is running the firm.

[67] *See supra* note 12 for more on reorganizations.

### *Problems of Chapter 11: A Checklist*

This section is a list of Chapter 11 elements that may impede a megabank resolution. Again, we assume a parent-only Chapter 11, much like bail-in, but using the Code. Chapter 11 reform advocates have noted and addressed some of these elements, but not all. Some of these elements are easy to fix, at least conceptually. But some go to the very structure of Chapter 11.

This list could be a useful checklist for Chapter 11 reform advocates.

**Adjudication and compensation**. Chapter 11 has no concept of *ex post* compensation; it relies on *ex ante* adjudication. This must be so—a court has no fund with which to compensate claimants for its errors. But this also limits the speed of the process. If compensation is impossible, any significant decision must be adjudicated, which entails due process. Bankruptcy courts can be very quick—for courts. But the faster they act, the less legitimate their process—a point that emerged from the Chrysler and General Motors (GM) reorganizations. And the faster they must act, the more meaningless the appellate review, in which the appellate court is asked to unscramble an omelet prepared by the bankruptcy court. In contrast, Dodd-Frank contemplates errors and provides for their *ex post* compensation.[68] This places far less strain on due process.

**Bank Holding Company Act.** Claims trading is common in modern bankruptcy practice. Active investors seek a stake in the firm that will give them the best possible position in negotiations. Typically, this position translates to a controlling equity stake. However, the Bank Holding Company Act limits control. Claims trading without regulatory approval, then, may lead to illegal control. This problem exists in bail-in as well as Chapter 11.

**Capital regulation.** Chapter 11 does not regulate the *ex ante* capital structure of an enterprise. It reorganizes the capital structure it is given. As we have seen, this is not enough: the parent needs enough bonded debt to bail out all the financial liabilities. A regulatory fix is necessary.

**Capital structure (shape).** Chapter 11 tends to produce a thin capital structure *ex post*: an outcome of the negotiation process. The capital structure may also have some optionality. Neither is reassuring to creditors at the subsidiary level who can run during the pendency of the process. And both may be the subject of regulatory displeasure.

**Capital structure (timing).** Chapter 11 produces a capital structure at the end of the process, not the beginning. Even if this capital is adequate, it may be too late. Financial creditors

[68] 12 U.S.C. § 5390(d)(2)(B). For the quantum of compensation, see *infra* text accompanying notes 70-72.

need the most assurance at the beginning of the process. They are more likely to run if they do not immediately see a hefty capital cushion. There is a bit of time-inconsistency here; more ordinary amounts of capital may placate these creditors at the end of the process. But this time-inconsistency does not connote a logical inconsistency. Asset values are more questionable at the beginning: imperfect information.

It is worth noting that the successful bankruptcy reorganization of CIT did not suffer from this timing problem. CIT was an insolvent lending company with a very solvent bank subsidiary (segregated and insured, to boot.) The lending company was funded like an ordinary industrial corporation, with bonded debt. The only protected financial liabilities at the bank subsidiary did not run; the nonfinancial liabilities were trapped in the process and could not run. This provided enough time for Chapter 11 to work on the nonfinancial liabilities.

**Derivatives and repo closeout.** Chapter 11 permits unrestricted closeout of derivatives and repo transactions. All Chapter 11 advocates have recognized this problem and have proposed fixes. In the context of a parent-level bail-in, this problem is in the cross-default clause of the subsidiaries' contracts, discussed above. The solution for Chapter 11 would be the same as that for bail-in: a stay on derivative closeouts triggered by parental filing.

**Governance.** Chapter 11 has a complex governance structure, not suited to fast resolution. For consequential decisions, everybody has a say, with the court's word as the final one. This works because the automatic stay buys the necessary time. But the automatic stay buys no time in a financial insolvency, and the most consequential decisions are on the first day. The first day is the day to flash the most money: "shock-and-awe" DIP financing must be in place. The financial creditors will run on the first day, unless they are assured by subsidiary recapitalization and a thick layer of reorganized parent equity. Clearinghouses and foreign regulators also need assurance on the first day—preferably earlier. There is no way the court can do this all on the first day and provide ordinary bankruptcy due process.

**Initiation.** As a practical matter, the debtor initiates Chapter 11. Since unsecured creditors traditionally receive low recoveries, it is hard to avoid concluding that Chapter 11 begins later than it should. Most Chapter 11 reform advocates have proposed a regulatory role in initiation, to supplement the debtor's role.

**Liquidity.** Chapter 11 has no public liquidity provider. Normally, the private sector suffices; DIP loans are profitable. However, megabanks need far more liquidity than most industrial firms. Also, megabank insolvency often occurs during a financial panic, when liquidity lending dries up. Most Chapter 11 reform advocates have discussed a public liquidity provider, generally assigning it the role of a DIP lender. But DIP lenders generally play a very strong role in a Chapter 11 process, which contradicts the general belief among these advocates that the executive branch should have limited discretionary power in Code bankruptcies. The governmental DIP role was controversial in the GM and Chrysler bankruptcies and should be more so in a megabank bankruptcy.

**Planning.** Bankruptcy planning is part of modern Chapter 11 practice: creditors need notice, and the court must approve the ordinary operations and DIP financing of the debtor. Much of this planning is not necessary for a financial reorganization at the parent level. The operations are contained in the subsidiaries, unaffected by the parent's filing. However, financial firms require one unique form of planning that does not lend itself well to Chapter 11. They must extend and obtain many pairs of credible conditional reciprocal promises: that the parent will recapitalize its subsidiaries and in consideration, that the subsidiaries' regulators and clearinghouses will let them live. Bankruptcy judges are generally realistic and businesslike, but no judge can engage in extended secret *ex parte* communications in advance of a filing.

**Limits of structural subordination.** Bail-in only operates on the parent. Bail-in protects the subsidiaries' creditors with structural subordination: only the parent liability holders bear losses. This is true regardless of the implementation of bail-in: the FDIC's SPOE approach, or Chapter 11. This protection is complete if only the parent is insolvent. Structural subordination does not necessarily protect the creditors of insolvent subsidiaries. It can only work if the insolvent parent recapitalizes the insolvent subsidiary.

This is more difficult to do in Chapter 11 than in something like SPOE, even if there is adequate parental debt. The problem lies in two key elements of Code ideology. First, the Code looks no further than the welfare of the insolvent entity. This ignores externalities—including those related to affiliates or systemic risk. Second, the Code views the welfare of the entity as consisting solely of maximum recovery for creditors, consistent with the Code's priority scheme.[69] Therefore, Code ideology demands that any recapitalization of a subsidiary by an insolvent parent must benefit the creditors of the parent. This is easy if the subsidiary is solvent. Every dollar that flows from the parent's creditors to the solvent subsidiary will increase the value of the subsidiary by at least a dollar.

[69] This is the logic of Judge Easterbrook's defense of CVO priority. *See supra* note 15. He argues that CVO priority is justified *only* if it enhances the aggregate recovery of the creditors not given the CVO priority.

But justification is harder if the subsidiary is insolvent. Any value that the parent injects into the subsidiary will first go to the creditors of the subsidiary, not the equity of the subsidiary. Such a capital injection will only benefit the parent if we make some special assumptions.

These special assumptions can be plausible. But they are contestable, and they must convince a bankruptcy judge. Judges may be willing to fudge close cases, mumbling "going-concern value," or the like. But many judges fully buy into the ideology and might not want to fudge. And there are limits on what even heterodox judges can do. The chief of these limits is time. The subsidiaries must be recapitalized on the first day of the process. Can a judge do this with any semblance of due process? And putting due process aside, can the judge possibly have enough information or time to make a sound decision?[70]

Consider, for example, a megabank with one deeply indebted, but highly systemic, subsidiary and a number of other subsidiaries that are doing well. If the parent has not guaranteed this subsidiary, a bankruptcy judge would have a hard time recapitalizing it. Or consider the contrary case: a foreign non-systemic subsidiary with a very uncooperative supervisor. The home country supervisor might want to let it go: to encourage cooperation in the future. A bankruptcy court might not. Or as a final case, consider the Section 363 sale of a major subsidiary to another large financial firm. This may be in the best interest of the creditors, but might create an excessively large firm.

No bail-in scheme can ignore the plight of the parent's creditors. The Constitution requires some solicitude: creditors must do at least as well as they would in liquidation.[71] Dodd-Frank and the FDI Act meet this standard, if not the higher standard of the Code. This guarantee is denominated in monetary terms, so the FDIC can act now and compensate later, if necessary.

[70] Judge Peck, who presided over the Lehman case, was very frank on the difficulties of adjudicating the first few days. *In re* Lehman Brothers Holdings, 445 B.R. 143 (Bkrtcy S.D.N.Y. 2011).

[71] Neblett v. Carpenter, 305 U.S. 297 (1938); *cf.* Doty v. Love, 295 U.S. 64 (1935). The Code has a similar standard for distributions among classes of creditors. 11 U.S.C. § 1129(a)(7)(A)(ii). However, the Code maximizes the value of the entity as a whole.

## 4.3 Private Law

The Dodd-Frank Act mandated consideration of contingent convertible debt as a source of bank capital: perhaps a substitute for equity. Can this idea be extended? Is contingent convertible debt a plausible private-law substitute for bail-in? This would resemble Professor Adler's "chameleon equity" proposal for corporate restructuring, which converts old debt to new equity upon a trigger event.[72]

A private law insolvency process would require a contractual formula for debt conversion. In a megabank, there is no time to wait for arbitration or adjudication. It is difficult to imagine a trigger that does not contain either basis or manipulation risk: possibly both. Management can control reported capital levels; market participants can affect bond prices. Both indexes also contain basis risk. Capital levels vary with the macroeconomy: bond prices with the term structure of interest rates.

Furthermore, the amount of convertible debt would have to be large: as large as the amount of bail-in debt. And this debt would have to convert to something. The something could be equity. If so, the dilution will be very large: probably exceeding standard shareholder protections entrenched in the corporate certificate of the parent. This problem goes away if the something is nothing: a fixed-income instrument *junior* to equity. But what creditor would trust a debtor with this kind of incentive to default?

Finally, contractual bail-in is still bail-in. It is hard to see how it would work without public law: a stay on *ipso facto* provisions, official-sector liquidity support, international negotiations among public officials and clearinghouses, and the like.

[72] *Cf.* Barry Adler, *Financial and Political Theories of American Corporate Bankruptcy*, 45 Stan. L. Rev. 311 (1993).

James McAndrews, Donald P. Morgan, João A. C. Santos, and Tanju Yorulmazer

# What Makes Large Bank Failures So Messy and What Should Be Done about It?

- The failures of large banks are not only costly—they destroy asset value and consume legal resources—but also destabilizing, in that they spill over to other financial institutions and cause more widespread instability.
- The messiness of these failures can be traced in part to large banks' reliance on uninsured financial liabilities (UFLs). UFLs include uninsured foreign and domestic deposits, repurchase agreements (repos), commercial paper, and trading derivative liabilities.
- To ease the problem of large banks' disorderly failures, regulators might require the banks to issue a certain amount of long-term "bail-in-able" debt, or "at-risk" debt that converts to equity in resolution.
- The stabilizing effects of an at-risk debt requirement cannot be achieved by simply requiring more equity; bail-in-able debt and equity are not perfect substitutes in providing financial stability if the resolution authority is slow to close the bank.

## 1. Introduction

This article uses "messy" repeatedly, so we should be clear at the outset what we mean by this term. Simply put, we mean that the failures of large banks are costly—in terms of destruction of asset value arising from fire sales—and also destabilizing—meaning their failure can threaten the operation of financial markets generally. We maintain that messy failures, so defined, are unique to large, complex, and interconnected banking firms. A small bank failure is costly, in terms of lost local output (Ashcraft 2005), but it does not threaten the smooth functioning of the financial system at large. Thus, small bank failures are costly, but not destabilizing. The failure of a large nonfinancial firm can also be costly, but it is not usually considered destabilizing; when the bankruptcy of General Motors Company was considered, most of the discussion was about lost jobs, not the stability of the automobile sector.

We contend that the reliance of large banks on *uninsured financial liabilities* is a key reason why their failures are so messy. We define uninsured financial liabilities (UFL) according to Sommer (2014) as liabilities that are issued specifically by financial firms, that is, uninsured foreign and domestic deposits, repurchase agreements (repos),

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The authors thank Beverly Hirtle and Joseph Sommer for helpful comments. Minh Phan provided excellent research assistance. The views expressed in this article are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

commercial paper, and trading derivative liabilities.[1] These liabilities are special for two reasons. First, unlike a regular debt liability of a nonfinancial firm, uninsured financial liabilities confer money-like or liquidity services that may be impaired or destroyed in bankruptcy. This is one reason why the failure of financial firms is especially costly or messy. Another reason is that uninsured financial liabilities are *runnable*. Runs on the large firms relying heavily on UFL (or financial liabilities that are not fully collateralized) trigger fire sales that inflict losses not just on the firm in question, but also on other firms with similar portfolios of assets. That is what we mean by destabilizing—it is the threat of systemic consequences associated with the failure of a very large bank.

Our claim that the liabilities of financial firms are the defining feature that makes failures messy is not incompatible with the view that illiquid asset holdings or organizational/global complexity contributes to messy failures. While illiquid assets and organizational complexity are undoubtedly important, we suggest that large banks' liability structure is the defining feature that leads to messy failures. Simplifying a bit, uninsured financial liabilities are those liabilities that are runnable. When a financial firm experiences a run or fears a run in some part of its organization, it can trigger a fire sale of its assets as well as runs by holders of runnable liabilities in other parts of the firm or in other firms. So, in our view, the risk of a run is the element that catalyzes the fire sales and other rapid and destabilizing effects of a failure. The run creates a messy situation because as the holders of runnable liabilities run, they steal time from all other decisionmakers to respond in an orderly manner. When the firm fails, those holders of UFL that have not run lose twice, in the sense that they may ultimately receive a pro rata share of the asset values, which typically involves a loss, but they also will have lost the services they had counted on—for example, having a deposit that they would normally use to provide liquidity at a moment's notice to make purchases or investments.

We present some direct evidence in support of our hypothesis that uninsured financial liabilities contribute to messy failures. Using data on all failed banks and thrifts (herein "banks") resolved by the Federal Deposit Insurance Corporation (FDIC) from 1985 to 2011, we first show that banks more reliant on UFL in the year before their failure experience larger contractions in UFL in the ensuing year. This simple fact is consistent with the notion that UFL holders are prone to run. We then show that the estimated cost of failures to the FDIC is increasing in the amount of UFL on a bank's balance sheet in the year before failure. We take that as evidence for our premise that greater reliance on UFL leads to runs and fire sales of assets, which make failure costlier.

Having discussed what we think makes large bank failures so messy, we then turn to the question of what to do about it. Following Calello and Ervin (2010), European Commission (2012), Tarullo (2013), and others, we advocate that BHCs be required to issue a certain amount of long-term "bail-in-able" debt or, as we prefer, "at-risk" debt that converts to equity in resolution (we call it "at-risk" because the debt is at risk of being converted to equity). If issued in sufficient quantities, the at-risk debt requirement immunizes UFL holders from losses and thus reduces their incentive to run.[2] An at-risk debt requirement would also have helpful incentive effects as it would tend to discourage the over-issuance of UFL (although not so bluntly as an outright ceiling) that Stein (2012) highlights in the context of short-term debt.

One of the central contributions of this article is to counter the argument that the stabilizing effects of an at-risk debt requirement could be achieved by simply requiring more equity, thus obviating the need to impose a new requirement for this class of liabilities. According to that view, requiring $x$ units of equity and $x$ units of at-risk debt is no different, in stability terms, than requiring $2x$ in equity. To investigate the claim requires one to consider how the resolution authority behaves—that is, when it will shut down the firm. Using a simple model, we show that at-risk debt and equity are not strictly substitutes, assuming (plausibly, we think) that the resolution authority is slow to close a failing institution. The resolution authority in our model is "slow" in the sense that it will shut down and resolve a firm only once its (book) equity capital is exhausted. Granting that assumption, we show that holders of uninsured financial liabilities are less likely to run on a bank that has $x$ in long-term debt and $x$ in equity than a bank that has $2x$ in equity; resolution turns out to be more frequent under the at-risk debt requirement, but also more orderly. The at-risk debt functions as "capital in resolution" that serves to stall runs by holders of uninsured liabilities.

[1] Commercial paper issued by large bank holding companies (BHCs) is distinguished from nonfinancial company commercial paper in that the large BHCs tend to "make markets" in their own commercial paper, standing ready to buy it back under most circumstances. This feature makes commercial paper effectively demandable debt.

[2] We envision that the bail-in would happen in resolution under the FDIC's proposed single point of entry (SPOE) receivership. Under SPOE, the FDIC would take over the holding company and transfer its assets to a bridge financial holding company. The bridge bank would be capitalized by bailing in the subordinated and unsecured term debt held in the receivership. By taking over at the holding company level, the operating subsidiaries (for example, the bank) could continue with business as usual. Since the bridge bank would be well capitalized (and have adequate liquidity provided by the Orderly Liquidation Fund housed in the U.S. Treasury), uninsured liability holders should have little incentive to run.

Where we may differ from other proponents of an at-risk debt requirement is that we advocate scaling the requirement by the amount of uninsured financial liabilities held by the (consolidated) entity. The logic for this scaling is derived directly from our model of messy failures. First, the at-risk debt, scaled to the amount of UFL, will provide a buffer in resolution to protect holders of financial liabilities, forestalling runs by them. Forestalling those runs will reduce the messiness of the firm's failure. Consequently, designing the requirement to stop runs by the holders of UFL is as important to a successful requirement as is the buffering role of providing capital in resolution. Finally, by imposing such a requirement scaled to the amount of uninsured financial liabilities, and because issuing at-risk debt is expected to be costly to the firm, the requirement can provide the firms with incentives to reduce their reliance on UFL, which would improve the overall stability of funding by targeting the weak link in the large banks' funding models: uninsured financial liabilities. Stein (2012) argues that banks produce externalities when they issue short-term, money-like liabilities, which can consist of both insured liabilities and the uninsured financial liabilities that we are focused on. Tying an at-risk debt requirement to those liabilities would force firms to internalize those externalities to some extent.

In contrast with those who, in seeking to end the too-big-to-fail problem, suggest "breaking up the banks" or reimposing more stringent separation of commercial and investment banking as mandated in the Glass-Steagall Act of 1933, we offer a seemingly less radical but equally consequential change. We suggest that it is the liability side of today's large financial firms that should be restructured: The uninsured financial liabilities should be separated from the equity capital by an amount of long-term (at-risk) debt. To issue more UFL, the firm would be required in time to issue additional long-term (at-risk) debt. This structure of the liabilities of a large financial firm would assist in protecting the firm against runs, provide capital in resolution, and produce incentives for those firms to avoid excessive reliance on runnable liabilities. These benefits are not without costs, nor would they fully ensure against messy failures (topics we discuss later), but they would improve the chances that failures would be avoided in the first place and, if encountered, be of a more manageable scale.

The next section makes some preliminary points about the problem of "messy" bank failures. Section 3 presents evidence that UFL holders at failing banks are prone to run and that those runs add to the cost of resolving those failures. Section 4 advocates and provides analytics in support of a long-term (at-risk) debt requirement as a way to deal with the problem of messy bank failures. Section 5 provides a general discussion of our results. Section 6 summarizes our findings.

## 2. Preliminaries

Why are bank failures more disruptive than those of nonfinancial firms? As Sommer (2014) explains, bank failures are different because banks issue money as liabilities.[3] One can think of "money production" as one of the most important services provided by banks. While textbooks often define banks as intermediaries that gather the savings of households and lend to productive enterprises, most economic models of banks emphasize the point that banks issue deposits, or other money-like liabilities (Diamond and Dybvig 1983 and Gorton and Pennacchi 1990), and that the demandable deposits issued by banks are the source of messy failures of banks when the depositors run.

More recently, banks have expanded their organizational forms and activities (see Avraham, Selvaggi, and Vickery [2012]). As reviewed by Gorton and Metrick (2010), the rise of "shadow banking" has led to innovative forms of liabilities, such as repos, that are the functional equivalent of what used to be provided only by deposits.[4] Gorton and Metrick (2010) argue that repos are therefore a type of money because they are liquid, functionally demandable at par due to their largely overnight tenor, and able to function as an overnight store of value. Similarly, other forms of uninsured financial liabilities, such as commercial paper issued by banks, are also demandable at par for large customers that request the financial firm to "buy back" its paper. As a result, a large amount of big financial firms' funding is made up of uninsured financial liabilities, which provide the monetary services of demandability at par and apparent safety. They are consequently runnable.

It is important to note that U.S. and much international law recognizes the unique characteristics of some uninsured financial liabilities and specifically excludes them from the stay that bankruptcy imposes on creditors. For many repo contracts, and for most derivative contracts, the creditors can exercise their right of close-out and sell collateral immediately. This carve-out specifically recognizes that those claims

[3] Versions of this point have been made before. Friedman and Schwartz (1963) famously argued that the Great Depression was aggravated by bank failures that contracted the supply of bank liabilities—that is, money. Corrigan (1982) made a similar point, although more narrowly, in his famous paper "Are Banks Special?"

[4] To be sure, repo finance has been around for decades, but its use has grown exponentially.

on the firm are "special" and that the law in many cases allows holders of those claims to exit their claim (by selling collateral) rather than having to petition the bankruptcy court for it. In addition, the special resolution regime for banks and deposit insurance also recognizes the social value of preserving the main financial liabilities of a bank—its deposits—even in the event of the bank's failure.

Most bank deposits in the United States are insured by the FDIC.[5] Because insured depositors are relatively unaffected by the failure, a bank has the capacity to issue additional deposits even if it is economically insolvent, in the sense that the market value of its liabilities exceeds that of its assets. Consequently, a bank is typically put into resolution by its supervisor. In the United States, the FDIC resolves failed U.S. banks. For most of these failed banks, the capital structure is relatively simple, consisting primarily of insured deposits along with equity, but often with an additional portion of deposits that are uninsured. The firm is resolved in one of several ways, often by transferring deposits and an equivalent amount of assets to another bank in such a way that depositors maintain full access to their deposit accounts without interruption.

Our thesis is that bank failures are messy because holders of uninsured financial liabilities can and do run to avoid the consequences of failure. Financial liabilities are often redeemable on demand at par, or subject to frequent rollover. As financial liability holders run, the bank must borrow to replace the funding it loses to the run, or sell assets quickly. The asset sales can lead to deeply discounted prices (that is, fire sales), (further) imperiling the solvency of the bank and imposing costs on unaffiliated parties. In addition, because other financial institutions demand uninsured financial liabilities from banks because of their money-like properties, the failure of the issuing bank can bankrupt the institutions holding their liabilities (apart from fire sales). The leading example, of course, is the money market fund Reserve Primary Fund; after Lehman Brothers filed for bankruptcy, that fund "broke the buck" after Lehman Brothers filed for bankruptcy because it was holding $535 million of Lehman's commercial paper.[6]

To be clear, we are not saying that reliance on UFL is the only feature that makes bank failures costly. We know from Ashcraft (2005) that even small bank failures are costly in terms of forgone output. His findings could reflect that bank failures destroy the private information that banks develop about their borrowers so that erstwhile borrowers become credit constrained after the failure. Our position is that larger banks' reliance on uninsured financial liabilities is what makes their failures *messy*—that is, both costly and destabilizing to other banks and the financial system. In other words, small bank failures are "merely" costly, but large, UFL-dependent bank failures are messy.

## 3. Testing Our Thesis

Recall our thesis that uninsured financial liabilities contribute to messy (costly and destabilizing) large bank failures for two reasons. First, the money-like services provided by those liabilities are destroyed in the event of failure. Second, UFL are runnable, which can lead to fire sales of assets that not only destroy value at the failing institution, but can also have spillover costs on other institutions with similar asset holdings. This section provides some evidence on both points. First we show that UFL holders at failed banks are prone to run. Then we provide evidence that greater reliance on such liabilities leads to messier—that is, costlier—failures.[7]

Chart 1 plots the various components of UFL—uninsured domestic deposits, foreign deposits, repos, commercial paper, and derivative liabilities—by BHC asset decile. In general, UFL increases with BHC size, primarily because of increasing reliance on uninsured deposits. For BHCs in the 90th percentile, the class comprising megabanks, there is a sharp increase in the share of liabilities accounted for by UFL. The jump reflects increased reliance on virtually every component of UFL except uninsured domestic deposits. This chart neatly makes the point that if, as we maintain, reliance on UFL makes for messy bank failures, then we would expect large bank failures to be especially messy.

To test the hypothesis that UFL holders are prone to run when a bank is in distress, we turned to the FDIC database on failed banks. The data include 1,619 instances of failed banks or thrifts ("banks") between 1985 and 2011. Summary statistics for the banks, including those for a number of variables we use in a subsequent regression, are reported in Table 1. The statistics are measured at the quarter of failure, unless otherwise indicated. The average assets of the failed banks over this period (at the quarter of failure) totaled only about $275 million, so these are not the large banks that most interest us. Nevertheless, the data represent a useful laboratory to test our ideas.

[5] According to Federal Financial Institutions Examination Council, *Consolidated Reports of Condition and Income*, insured deposits made up 61 percent of all domestic deposits in the fourth quarter of 2012.

[6] The Reserve Primary Fund was also holding $250 million of medium-term notes. See http://www.reuters.com/article/2010/04/14/reservefund-lehman-idUSN1416157520100414.

[7] Since we are studying smaller bank failures here, we do not test for evidence that UFL is associated with more financial instability.

To test the run hypothesis, we estimated the following regression:

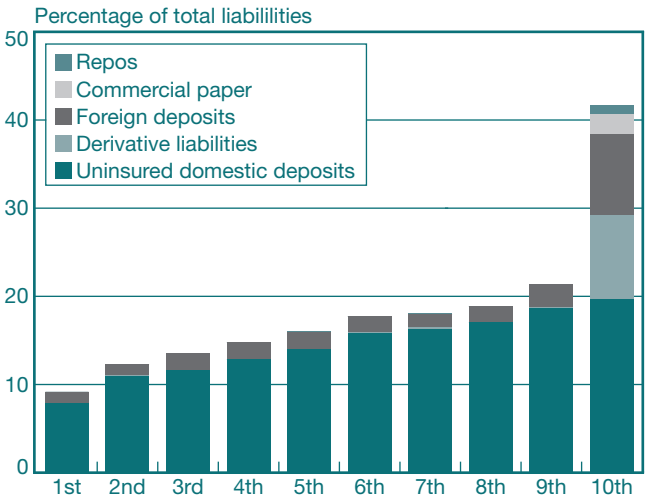
$$\frac{UFL_{it} - UFL_{it-4}}{Assets_{it-4}} = a + \frac{\beta UFL_{it-4}}{Assets_{it-4}} + \lambda \log(Assets_{it-4}) + \varepsilon_{it-4}.$$

Our hypothesis is that $\beta < 0$, that is, failing banks or thrifts experience larger runoffs of UFL over the year before their failure, the larger their UFL holding the year before failure. Despite the *t* subscript, this is not a panel regression; we are simply regressing the scaled, four-quarter change in *UFL* on the *UFL* four quarters earlier for the set of 1,619 failed banks and thrifts. The regressions include fixed effects for the state in which the failure occurred and the type of insurance fund.[8]

[8] Before 1989, there were two federal deposit insurance funds, one administered by the FDIC, which insured deposits in commercial banks and state-chartered savings banks, and another administered by the Federal Savings and Loan Insurance Corporation (FSLIC), which insured deposits in savings associations with state or federal charters. In 1989, the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) specified that thereafter the FDIC would be the federal deposit insurer of all banks and savings associations and would administer both the FDIC fund, which was renamed the Bank Insurance Fund (BIF), and the replacement for the insolvent FSLIC fund, renamed the Savings Association Insurance Fund (SAIF). Although it was created in 1989, the SAIF was not responsible for savings association failures until 1996. From 1989 through 1995, savings association failures were the responsibility of the Resolution Trust Corporation (RTC). In February 2006, the Federal Deposit Insurance Reform Act of 2005 provided for the merger of the BIF and the SAIF into a single Deposit Insurance Fund (DIF). Necessary technical and conforming changes to the law were made under the Federal Deposit Insurance Reform Conforming Amendments Act of 2005. The merger of the funds was effective on March 31, 2006.

Chart 1

## Uninsured Financial Liabilities, Sorted by Asset Decile




Sources: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data); Federal Financial Institutions Examination Council, *Consolidated Reports of Condition and Income*.

Note: The chart plots the UFL components of U.S. bank holding companies (BHCs) as a percentage of total liabilities at different asset sizes. To construct this chart, we split the set of BHCs in 2012:Q4 into deciles, according to total asset size. We proxy BHC-level uninsured domestic deposits for a particular asset decile with bank-level uninsured domestic deposits for the same decile. All other line items are obtained from the Federal Reserve's Y-9C Form.

Table 1

## Summary Statistics Calculated for Failed Banks and Thrifts from 1985 to 2011

| Variables | Observation | Mean | Median | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| Log [estimated loss to FDIC] | 1,619 | 9.15 | 9.11 | 2.06 | 0.00 | 15.35 |
| Uninsured financial liabilities (thousands of dollars) — lag 4Q | 1,619 | 71,467.16 | 3,877.00 | 41,3971.59 | 0.00 | 8,233,800.00 |
| Uninsured financial liabilities / assets — lag 4Q | 1,619 | 0.11 | 0.08 | 0.11 | 0.00 | 0.84 |
| Log [uninsured financial liabilities / assets] — lag 4Q | 1,619 | 0.10 | 0.07 | 0.10 | 0.00 | 0.61 |
| GDP growth | 1,619 | 0.62 | 0.64 | 0.64 | -2.30 | 1.95 |
| Log [assets] | 1,619 | 10.98 | 10.73 | 1.53 | 7.46 | 17.05 |
| Assets (thousands of dollars) | 1,619 | 274,726.91 | 45,573.00 | 1,141,216.61 | 1,731.00 | 25,455,112.00 |
| Commercial real estate loans / assets | 1,619 | 0.21 | 0.15 | 0.18 | 0.00 | 0.78 |
| Real estate owned / assets | 1,619 | 0.05 | 0.04 | 0.05 | 0.00 | 0.53 |
| Loans past ninety days / assets | 1,619 | 0.02 | 0.01 | 0.03 | 0.00 | 0.28 |
| Total equity capital / assets | 1,619 | -0.01 | 0.00 | 0.06 | -0.48 | 0.52 |
| Asset growth | 1,619 | -12.35 | -14.84 | 21.80 | -63.43 | 359.58 |

Source: Federal Deposit Insurance Corporation.

Notes: All balance sheet variables are measured at the date of failure. Asset growth (yearly rate) is measured at the quarter of failure.

Table 2

## Is Higher UFL Associated with More UFL Runoff at Failed Banks?

| | Failed Banks | | Healthy Banks | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| UFL / assets — lag 4Q | -0.502*** | -0.507*** | -0.268*** | -0.287*** |
| | [0.037] | [0.059] | [0.061] | [0.092] |
| Log assets — lag 4Q | 0.002 | 0.008*** | 0.007** | 0.006 |
| | [0.002] | [0.003] | [0.003] | [0.006] |
| Constant | -0.005 | -0.073*** | -0.045 | -0.037 |
| | [0.018] | [0.025] | [0.029] | [0.046] |
| Observations | 1,619 | 1,619 | 1,619 | 1,619 |
| Adjusted R-squared | 0.334 | 0.361 | 0.084 | 0.083 |
| Fund FE | | YES | NA | |
| State FE | | YES | NO | YES |

Source: Authors' calculations.

Notes: The table reports ordinary least squares (OLS) regression and robust standard errors (clustered by time and state) in parentheses. The dependent variable is the change in UFL over the previous year, scaled by assets four quarters before failure. For a placebo test, we tested whether the relationship between lagged UFL and the change in UFL holds for a matched sampled of healthy banks. Healthy banks were matched by state, entity type, assets (within 25 percent of matching failed banks), and date. Robust standard errors are presented in brackets.

*** $p < 0.01$
** $p < 0.05$
* $p < 0.1$

The results are reported in Table 2, models 1 and 2. Consistent with the hypothesis, we observe $\beta < 0$, with the estimate significant at the 1 percent level. The point estimate in model 2 (with all the fixed effects) implies that a failing bank or thrift with the mean ratio of $UFL_{t-4}/Assets_{t-4}$ (11 percent) experiences a runoff of 5.5 percent of assets. We can express the run in dollar terms if we assume that the bank with mean $UFL_{t-4}/Assets_{t-4}$ also has mean assets ($275 million). In that case, the bank would experience a run of $0.055 \times \$275 = \$15$ million. Note from the summary statistics (Table 1) that failing banks did experience substantial asset contractions in the year before their failure.[9]

To see if our run regressions were simply picking up regression toward the mean, we also estimated placebo regressions for a set of matched nonfailing (healthy) banks. The healthy banks were matched by state, entity type (bank or thrift), asset size, and date.[10] In fact, we do observe a significant relationship between the lagged level of UFL and the change in UFL, suggesting that some regression toward the mean may explain some of the link between lagged UFL and UFL runoff observed for models 1 and 2. Note, however, that the coefficient on lagged UFL in models 1 and 2 is substantially larger for failed banks—almost twice as large, in fact. Using a Chow test, we can reject at below the 1 percent level that the coefficient on lagged UFL for failed banks in model 1 equals the corresponding coefficient for healthy banks in model 3.[11] We take the extra sensitivity of the change in UFL to lagged UFL for failed banks as evidence that failing banks do experience runs by holders of UFL.

The greater tendency for UFL to run off from failed banks is apparent in the histograms plotted in Chart 2 and Chart 3. The histogram for the failed banks is skewed negative while the histogram for the healthy, matched banks is more symmetrically distributed around zero. The skewness statistic for failed banks is -0.939. The statistic for healthy banks is -0.004.

Now we present some regression evidence consistent with the hypothesis that higher UFL is associated with costlier

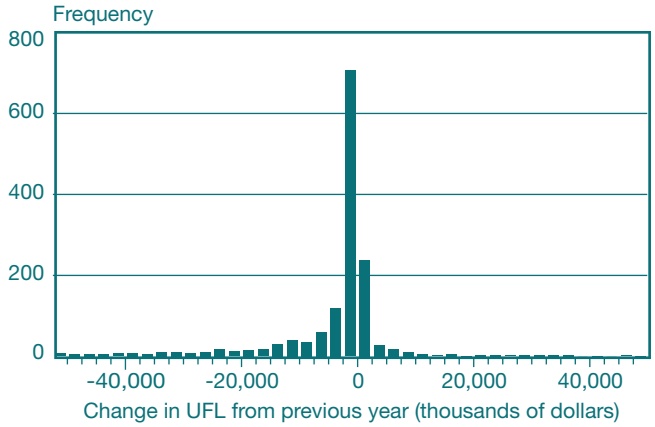
[9] Our premise is that a run on UFL triggered a contraction. However, we cannot rule out the opposite causality—that is, that assets were contracting so the UFL was allowed to run off.

[10] The healthy banks were considered a match by assets if their assets were within 25 percent of the failed bank.

[11] We cannot do a Chow test for models 2 and 4 because the fixed effects differ.

Chart 2

Failed Banks

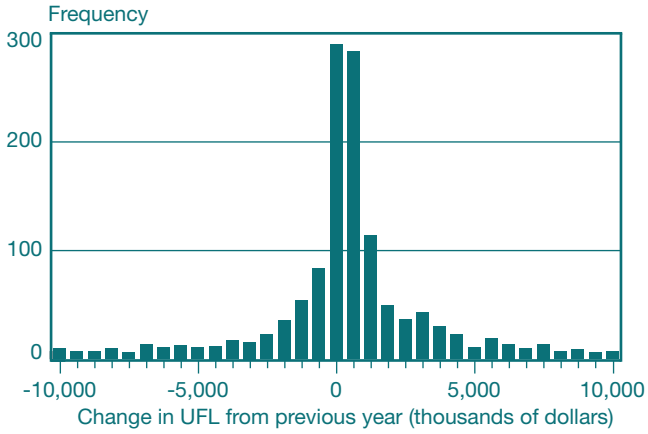



Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data); Federal Financial Institutions Examination Council, *Consolidated Reports of Condition and Income*.

Note: The chart plots the UFL components of U.S. bank holding companies (BHCs) as a percentage of total liabilities at different asset sizes. To construct this chart, we split the set of BHCs in 2012:Q4 into deciles, according to total asset size. We proxy BHC-level uninsured domestic deposits for a particular asset decile with bank-level uninsured domestic deposits for the same decile. All other line items are obtained from the FR Y-9C.

Chart 3

Healthy Banks




Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data); Federal Financial Institutions Examination Council, *Consolidated Reports of Condition and Income*.

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failures. As before, we use the FDIC's data on bank failures, except now we focus on estimated losses (to the FDIC) associated with bank and thrift failures; the estimated loss is the difference between the amount disbursed from the insurance fund and the amount estimated to be ultimately recovered from liquidation of the receivership estate.[12] According to our hypothesis, failing banks with more UFL in the period leading up to their failure are more likely to have to "fire sale" assets, and the attendant liquidation costs should be expected to increase the costs of the failure to the deposit insurer.

Our regression model is

$$\log\left(\frac{\text{Losses}_{it}}{\text{Assets}_{it}}\right) = \alpha + \beta\log\left(\frac{UFL_{it-4}}{Assets_{it-4}}\right) + \lambda' Controls_{it} + \varepsilon_{it}.$$

On the right-hand side, we lag UFL by four quarters for consistency with the run regression results.[13] For controls we use the same set of variables shown by Schaeck (2008) to influence FDIC losses on failures. We also include fixed effects for the state where the failure occurred, the transaction type (failure or assistance), and the type of insurance fund. We report ordinary least squares (OLS) estimates and Tobit estimates (since the dependent variable is truncated at zero). We predict $\beta > 0$.

Columns 1 and 2 of Table 3 reveal a positive and significant (at the 5 percent level) relationship between the costs of failure and the level of UFL four quarters earlier, that is, the failures of banks with more UFL are costlier. Given that the distribution of UFL is so heavily skewed toward larger institutions, we tried splitting the sample and estimating the model separately for failed institutions with assets below the median for the sample ($45.6 million) and institutions with assets above the median. Splitting the sample reveals an interesting difference: The positive relationship between the cost of failure and the amount of UFL holds only for the larger failed banks in the sample; for the smaller banks, there is also a positive relationship, but it is not significant. The OLS coefficient estimate in model 3 implies that a 10 percent (roughly one standard deviation) increase in the ratio of

[12] See the FDIC's data on failed banks at http://www2.fdic.gov/hsob/SelectRpt.asp?EntryTyp=30.

[13] Assets on the left-hand side are measured at the quarter of failure.

Table 3

## Is Higher UFL Associated with Costlier Banks?

| | All Banks | | Assets > Median | | Assets < Median | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | OLS | TOBIT | OLS | TOBIT | OLS | TOBIT |
| Log UFL / assets – lag 4Q | 1.010** | 1.005** | 1.449*** | 1.455*** | 0.663 | 0.650 |
| | [0.429] | [0.428] | [0.491] | [0.481] | [0.834] | [0.817] |
| GDP growth | -0.118** | -0.119** | -0.065 | -0.065 | -0.114 | -0.116 |
| | [0.050] | [0.050] | [0.060] | [0.059] | [0.082] | [0.081] |
| Log assets | 0.755*** | 0.755*** | 0.748*** | 0.747*** | 0.990*** | 0.992*** |
| | [0.056] | [0.056] | [0.085] | [0.083] | [0.084] | [0.083] |
| Commercial real estate loans / assets | 0.949*** | 0.955*** | 1.516*** | 1.533*** | 0.214 | 0.216 |
| | [0.328] | [0.327] | [0.440] | [0.433] | [0.410] | [0.401] |
| Real estate owned / assets | 4.929*** | 4.952*** | 6.710*** | 6.768*** | 3.089*** | 3.097*** |
| | [0.587] | [0.585] | [1.104] | [1.088] | [0.646] | [0.632] |
| Loans past ninety days / assets | 6.256*** | 6.291*** | 7.297*** | 7.352*** | 4.846*** | 4.858*** |
| | [1.018] | [1.008] | [2.066] | [2.003] | [0.832] | [0.812] |
| Total equity capital / assets | 3.386*** | 3.398*** | -4.816*** | -4.831*** | -2.221*** | 2.231*** |
| | [0.659] | [0.652] | [1.352] | [1.322] | [0.692] | [0.673] |
| Asset growth | 0.004** | 0.004** | 0.006** | 0.006** | 0.002 | 0.002 |
| | [0.002] | [0.002] | [0.003] | [0.003] | [0.002] | [0.002] |
| Constant | -0.009 | -0.021 | -0.673 | -0.684 | -2.052** | -2.078** |
| | [0.543] | [0.540] | [0.942] | [0.917] | [0.846] | [0.833] |
| Observations | 1,619 | 1,619 | 809 | 809 | 810 | 810 |
| Adjusted R-squared | 0.611 | | 0.512 | | 0.379 | |
| Fund FE | YES | YES | YES | YES | YES | YES |
| State FE | YES | YES | YES | YES | YES | YES |

Source: Authors' calculations.

Notes: The table reports regression estimates and robust standard errors (in parentheses). The dependent variable is the estimated cost of failure to the FDIC per assets. Coefficients are estimated over the indicated number of failures over the period 1985 to 2011.

UFL to assets is associated with a 15 percent increase in the ratio of estimated costs to assets. This should be viewed as a lower bound of the costs associated with UFL because our dependent variable does not capture the effect of fire sales on the solvency of other banks. Note also that the cost of failure is significantly increasing in the log of assets; failures of larger banks are messier.

## 4. What to Do about the Problem of Messy Failures?

Having argued and provided some evidence that reliance on uninsured financial liabilities is one reason why large bank failures are so messy, we now turn to the question of what to do about it. We cannot simply argue that banks should eschew the use of such liabilities because the liquidity they create is socially valuable. Instead, we join the chorus of those calling for a long-term debt requirement, where the debt is bail-in-able—that is, it converts to equity in resolution.

Given that the debt is at risk of being converted to equity, we prefer the term at-risk debt. We have three points to make regarding the potential benefits of an at-risk (or subordinated) debt requirement based on the amount of a bank holding company's financial liabilities.

The first point, which we spend some time on, is to counter what is perhaps the most important possible objection to an at-risk debt requirement. Stated simply, the objection is that equity and at-risk debt are substitutes in terms of providing financial stability. For example, suppose that the BHC has $1 trillion in risk-weighted assets and a $75 billion Tier 1 common equity requirement; furthermore, consider an at-risk debt requirement of an additional $75 billion. Then one might object, why not make the Tier 1 common equity requirement equal to $150 billion? In that case, the bank's UFL will be roughly equally protected against shocks to asset values, and the BHC will not be put into resolution as frequently.[14] Therefore, the at-risk debt requirement is superfluous relative to an equity requirement that is higher by the exact amount of the at-risk debt requirement.

Treating equity and at-risk debt as equally costly (that is, not granting any benefits to the tax deductibility of interest expense on debt), one still has to consider three issues before concluding that the protection achieved by an at-risk debt requirement can be duplicated by a larger equity requirement. One has to specify 1) the rule by which the resolution authority puts the BHC into resolution, 2) the process by which losses accrue, and 3) the incentives of the bank to issue uninsured financial liabilities.

First, because long-term debt and equity are generally more expensive forms of funding for a financial firm, we assume that, without the requirement to issue at-risk debt, the BHC would issue UFL to the extent feasible, up to its required equity.[15] Second, we assume—and this is critical—that the resolution authority puts the BHC into resolution only after it has experienced losses in excess of its equity.[16] Finally, we assume that the loss-generating process is a relatively "smooth" one, so that there are no large jumps to default; instead, the BHC transits through relatively small losses to larger losses (this process could be a random walk, but the size of incremental losses, if not continuous, is small; alternatively, and more realistically, it could be a process with significant serial correlation). With these three assumptions, we now demonstrate that a larger equity requirement is not equivalent to an equity requirement plus an at-risk debt requirement.

Consider a BHC with a large equity requirement ($150 billion in our example) versus one with both equity and at-risk debt requirements (a $75 billion equity requirement and a $75 billion at-risk debt requirement). We assume, for this exercise, that both BHCs have issued the same amount of UFL and they both have the same asset composition. Now, when the firm has the high equity requirement, all of its remaining liabilities are in the form of UFL. As the firm experiences losses that grow from 13 to 14 to 15 percent of its risk-weighted assets, the holders of the UFL realize that they have no further "buffer" that would limit their exposure if losses grow from those levels.[17] Knowing, furthermore, that the resolution authority will not put the BHC into resolution until losses exceed 15 percent of risk-weighted assets, the holders of the UFL will likely run on the BHC. As the run creates fire sales by the BHC, imposing losses on other parties, the resolution of the firm will be messy, and the government may feel the need to bail out the BHC's UFL holders to forestall the run.

In contrast, consider the BHC with both the equity and the debt requirement. In this case, losses of half the previous size will exhaust the BHC's equity. When losses rise from 5 to 6 to 7.5 percent of risk-weighted assets, the holders of the UFL realize that the firm has losses that equal its equity and that it will likely be put into resolution. However, they also recognize that the $75 billion of at-risk debt provides a source of "capital in resolution" that, in the event of the firm's resolution, provides a buffer against further losses from eroding the value of the firm's UFL. Consequently, the UFL holders have little reason to run. As a result, the resolution authority could put the BHC into resolution without triggering a run, allowing a greater chance for an

[14] We are ignoring the fact that if the protection takes the form of equity, the bank will pay higher taxes out of cash flow. This may reduce the retained wealth available for UFL protection.

[15] Equity is more expensive than debt generally because interest is tax deductible. Long-term debt is usually considered more expensive than short-term debt because of the greater uncertainty associated with the longer maturity. In addition, the higher cost of long-term debt may not be offset by lower costs of other liabilities of the firm, in violation of the Modigliani-Miller framework; if there are agency problems (conflicts of interest between shareholders and creditors), creditors may prefer lending with a "short leash"—that is, short-term. Pushing them away from their natural habitat will require a maturity premium that makes long-term debt more expensive.

[16] This assumption is not implausible; in the bank failure data we studied earlier, only two out of 1,619 failures did not entail losses to the FDIC. Prompt corrective action implies in principle that the FDIC should close banks before capital is depleted and the FDIC is exposed to losses. However, as just noted, losses to the FDIC are the rule in FDIC failures. Nonetheless, our assumption can be weakened. What is required is that 1) there are dead-weight costs to resolution that will deplete assets available to pay out to holders of UFL, and 2) the timing of the resolution is uncertain, so that by the time it occurs there is a sufficient probability applied to the outcome that UFL holders will not be made whole in the course of the resolution or that payouts to them will be delayed.

[17] The losses and equity values discussed in this section are all in book terms.

orderly resolution (holding fixed the potential signaling effects on other firms). So if society were to *substitute* long-term at-risk debt for equity, one would expect more frequent failures of firms, but these failures would be less likely to be accompanied by runs on the firm—that is, they would be less likely to be messy. By contrast, if long-term at-risk debt were deployed in *addition* to the minimum regulatory equity capital requirement, then, all else equal, losses that deplete capital would be no more frequent but would be less messy.

In summary, the difference between "loss bearing" capacity in which one is expressed solely as an equity requirement and the other is split between an equity requirement and an at-risk debt requirement is this: An at-risk debt requirement results in more frequent resolutions of BHCs, but these resolutions are more orderly. Essentially, under our assumptions, a requirement consisting solely of equity results in little expected protection for the holders of UFL in those extreme events in which equity is exhausted, resulting in runs on the firm. This, in turn, reduces the chances that resolution can be accomplished in an orderly way, putting greater pressure on the government to bail out the UFL of the firm.

We can make the same point about the benefits of an at-risk debt requirement more generally using some algebra. Consider a model with three dates, $t = 0,1,2$, and a representative bank with the following balance sheet:

| Assets | Liabilities |
|---|---|
| $A$ | $UFL$ |
| | $LD$ |
| | $E$ |

The bank has assets worth $A$, which it funds with $UFL$, long-term debt, $LD$, and equity, $E$.[18] $UFL$ can be redeemed at $t = 1$. Long-term debt can be redeemed only at the last date $t = 2$. All liability-side variables are valued as of date $t = 2$. LD is at risk, or bail-in-able, because it is junior to UFL. That is, in the event of default, long-term debtholders are paid only after UFL debtholders have been reimbursed in full.

We assume that the return on the bank's assets is random and that the bank can suffer losses at dates 1 and 2. In particular, we assume two states of the world: The good state occurs with probability $1 - a$, and the bad state occurs with probability $a$. If the good state of the world occurs, the bank does not suffer any losses, and the value of its assets is $A$ at $t = 2$. If the bad state of the world occurs, the bank suffers losses $L_1$ at $t = 1$. Further, if the bad state of the world occurs, with probability $1 - \beta$, the bank does not suffer any further losses at $t = 2$, in which case the value of its assets is $A - L_1$, but with probability $\beta$, the bank suffers additional losses $L_2$ at $t = 2$, in which case the value of its assets is $A - L_1 - L_2$ at $t = 2$.

We now consider two alternative funding structures for the bank in our model:

*Case I (all equity)*: The bank holds no long-term debt, only equity. The bank's balance sheet thus has the following form:

| Assets | Liabilities |
|---|---|
| $A$ | $UFL$ |
| | $LD_1 = 0$ |
| | $E_1$ |

*Case II (equity and long-term debt)*: The bank holds some long-term debt and some equity, where the sum of the two is equal to the equity the bank holds in Case I (all equity). Hence, the bank's balance sheet has the following form:

| Assets | Liabilities |
|---|---|
| $A$ | $UFL$ |
| | $LD_2 = E_1 - E_2$ |
| | $E_2 < E_1$ |

We assume that the bank makes the following promises to its UFL creditors: If they withdraw their funds at $t = 1$, they will receive 1 unit; and if they choose to roll over their claims and withdraw their debt at $t = 2$, they will receive the return of $r_s > 1$ at $t = 2$. In order to see UFL creditors' rollover incentives, consider the following scenario: Suppose that $A - L_1 - L_2 < UFL < A - L_1$. Under these conditions, in the bad state of the world, if the bank experiences further losses, it does not have enough funds to pay UFL creditors in full at $t = 2$, whereas the bank can pay them in full at $t = 2$ if it does not experience any further losses. In Case I (all equity) the bank has positive equity $E_1 - L_1 > 0$ at $t = 1$. Suppose that $E_2 < L_1$ so that, under Case II (equity and long-term debt), the bank has negative equity at $t = 1$ in the bad state. Note that, if the probability of the bank experiencing additional losses at $t = 2$ ($\beta$) is sufficiently high, UFL creditors will be concerned about the solvency of the bank and decide not to roll over their claims, resulting in a run on the bank.

[18] Note the absence of insured deposits; we show in the appendix that the case for an at-risk debt requirement is even stronger when the bank has insured deposits because insured depositors are senior to UFL creditors and therefore the latter are more likely to run.

We model UFL creditors' rollover decision at $t = 1$ as follows: If a UFL creditor withdraws, he receives 1 unit. If he rolls it over, he expects to receive

$$\beta\left(\frac{A - L_1 - L_2}{UFL}\right) + (1 - \beta)r_s,$$

since with probability $1 - \beta$, the bank does not experience additional losses and an UFL creditor receives the promised amount $r_s$, and with probability $\beta$, the bank experiences additional losses and the creditor receives a pro rata share of the bank's return at $t = 2$ with other UFL creditors. Long-term creditors receive nothing because, by assumption, they hold a junior claim. Hence, the UFL holders will withdraw as long as

$$\beta\left(\frac{A - L_1 - L_2}{UFL}\right) + (1 - \beta)r_s < 1, \quad (1)$$

that is, when $\beta$ is sufficiently high:

$$\beta > \frac{r_s - 1}{r_s - \frac{A - L_1 - L_2}{UFL}} = \beta^{\star}.[19]$$

Hence, for $\beta > \beta^{\star}$, it is optimal for UFL creditors not to roll over their claims, and, consequently, in the bad state, there will be a run on the bank at $t = 1$ unless the regulator intervenes. Note that in the benchmark case, where there is no intervention by a regulator, long-term at-risk debt and equity provide the same level of buffer for losses; they are substitutes.[20] Next, we modify the benchmark case to show how long-term debt and equity can have different effects once regulatory intervention is possible.

Suppose that a regulator intervenes if, and only if, the bank has negative equity.[21] We assume the regulator can make this decision before UFL creditors decide whether they will roll over their debt (say, at $t = 1/2$).

Then, at $t = 1/2$ in Case I, where the bank has all equity, the bank has a positive equity of $E_1 - L_1 > 0$, so that the regulator leaves the bank open. However, for $\beta > \beta^{\star}$, the probability of further losses is large enough that UFL creditors do not roll over, resulting in a run on the bank.[22]

To contrast, consider Case II, where the bank has some equity and some long-term debt. Since in the bad state of the world the bank's equity is already wiped out ($E_2 - L_1 < 0$), the regulator has to intervene. The long-term debt (by providing, in the event of resolution, a loss absorber in front of the uninsured financial liabilities) allows the regulator to take the "right" action (when it follows a rule of intervening when the capital has been wiped out).

The analysis above suggests that an at-risk debt requirement can add to the stability of a BHC by preventing runs by UFL creditors. It should be noted that more frequent (but more orderly) resolutions would be expected only if an at-risk debt requirement were put in place at the expense of a lower equity requirement. However, if the at-risk debt requirement were met by substituting UFL with long-term debt, then there would be no expectation of more frequent resolutions.

Next, we show that the amount of long-term debt should be increasing in the amount of UFL the bank uses for the same level of the threshold value $\beta^{\star}$. To perform the analysis, we fix the equity of the bank at $\overline{E}$ and change *UFL* and *LD*. In particular, for the same level of $\beta^{\star}$, we obtain

$$d\beta^{\star} = \frac{\partial\beta^{\star}}{\partial UFL}\, dUFL + \frac{\partial\beta^{\star}}{\partial LD}\, dLD = 0.$$

Using $\beta^{\star} = \frac{r_s - 1}{r_s - \frac{A - L_1 - L_2}{UFL}}$ and the balance sheet identity $A = UFL + LD + \overline{E}$, we can show that

$$sign\left(\frac{\partial\beta^{\star}}{\partial UFL}\right) = sign\left(-(r_s - 1)(LD + \overline{E} - L_1 - L_2)\right),$$

which is negative, and

$$sign\left(\frac{\partial\beta^{\star}}{\partial UFL}\right) = sign\left(UFL(r_s - 1)\right), \text{ which is positive.}$$

Hence, we have $\frac{dLD}{dUFL} = \frac{\partial\beta^{\star}/\partial UFL}{\partial\beta^{\star}/\partial LD} > 0$.
If the bank wants to increase UFL, it needs to hold more long-term debt for the same level of bank stability (as measured by the likelihood of runs by UFL). We can perform the same analysis where we keep the equity of the bank fixed as a fraction of the bank's assets. In that case, we obtain similar results, but the required increase in long-term debt is less compared with the previous case. This is because when the bank's balance sheet expands due to an increase in UFL, its equity increases (while keeping the capital ratio constant). The increase in the bank's equity provides some cover for the holders of UFL, and the required increase in long-term debt can be less compared with the previous case.

[19] Note that we are assuming depositors are risk neutral. If they were risk averse, the threshold for running would differ.

[20] To see that explicitly, substitute the balance sheet identity $A = UFL_2 + LD_2 + E$ into (1).

[21] To be clear, the meaning here is book value of equity, not market value.

[22] One can argue that the regulator can intervene if it anticipates a run, even though the bank may have positive equity at the moment. We can extend the model and allow the value of $\beta$ to be uncertain, either high or low, and in expectation the bank can pay all wholesale creditors (or has positive equity) so that the regulator does not intervene. But once the high value of $\beta$ is realized, the run starts, and it is too late for the regulator to intervene to prevent it.

Recall that we had three points to make about the benefits of an at-risk debt requirement. We now turn to the second: the internalization of an externality. While banks produce a socially valuable, money-like service when they issue UFL, they may create too much of a good thing. As Stein (2012) and others have noted, there are externalities associated with the production of short-term debt; banks capture the social benefit of the production of short-term debt, but they do not always internalize its costs—namely, fire sales.[23] In the event of, or anticipation of, a crisis, banks are forced to "fire sale" assets to meet their short-term obligations, a move that can exacerbate the crisis by weakening the solvency of banks with similar assets. As Stein (2012, p. 2) explains, "banks may engage in excessive money creation, and may leave the financial system overly vulnerable to costly crisis."

Requiring banks to issue long-term at-risk debt in proportion to their financial liabilities can force banks to internalize the external costs associated with UFL issuance. The at-risk debt requirement forces banks to deviate from their privately optimal liability structure (because long-term debt is costlier than short-term debt), and, under our proposal, the required deviation is increasing in the amount of UFL. Thus, banks are inclined to be less reliant on UFL in their balance sheet choices.

The third potential benefit of an at-risk debt requirement is that debt can provide a useful signal of risk to supervisors. As Gropp, Vesala, and Vulpes (2006) point out, market indicators, such as spreads on debt, have the advantage of being more frequently observed and more forward-looking than accounting data. Bond spreads, in particular, have the advantage over equity prices in that spreads are not increasing in volatility as an institution nears default; bond spreads represent the downside perspective of supervisors and the FDIC. Gropp, Vesala, and Vulpes (2006) show that both subordinated bond spreads and equity prices help predict bank downgrades, but at different horizons. Both have marginal predictive power compared with bank accounting data.

## 5. Discussion

To reiterate, we have said that at-risk debt plays the role of capital in the resolution of a firm. We have said also that basing the at-risk debt requirement on the amount of UFL issued by a firm serves the purpose of providing additional capital in resolution for those firms whose failure would likely be the messiest (because of the high level of UFL among their liabilities). Given that long-term debt is costlier than short-term debt, the at-risk debt requirement would also provide an incentive for firms to reduce their reliance on UFLs.

Consider a large financial firm whose liabilities consist solely of insured deposits, with a large amount of equity. In our suggested rule for at-risk debt shown above, the firm would have a zero requirement of long-term debt. Is that reasonable? We would argue that it is reasonable because the liability structure of the firm would resemble a small bank whose failures are not typically messy (recall that all the firms we are discussing are subject to prudential regulation and supervision). Since insured deposit holders are not prone to run, the failure itself is unlikely to be extremely messy. In this case, the deposit insurer would provide the "capital" in resolution of the firm.

What would our proposal for basing an at-risk debt requirement on the amount of UFL issued by a firm imply about the amount of long-term debt large banks would have to issue? Calibrating the requirement is beyond the scope of this article, but conceptually we are proposing a rule of the form

$$LTD_i = aUFL_i.$$

Chart 4 plots the amount of UFL per assets as of the fourth quarter of 2012 for the set of twenty-two BHCs with more than $100 billion in assets. The chart shows considerable variation in reliance on UFL, so the amount of at-risk debt required, per dollar of assets, would vary accordingly across BHCs.

In practice, given the complexity of the large financial firms, it is difficult to measure precisely how much UFL a firm has issued, because for some liabilities it is not perfectly clear whether they are "financial" liabilities or exactly how runnable they are (for example, it may be unclear what proportion of its commercial paper a firm would buy back). Consequently, it may be preferable to base an at-risk debt requirement on the size of the firm as measured by either total assets or risk-weighted assets combined with the amount of UFL they issue, or make the requirement the greater of the two, such as a requirement expressed as

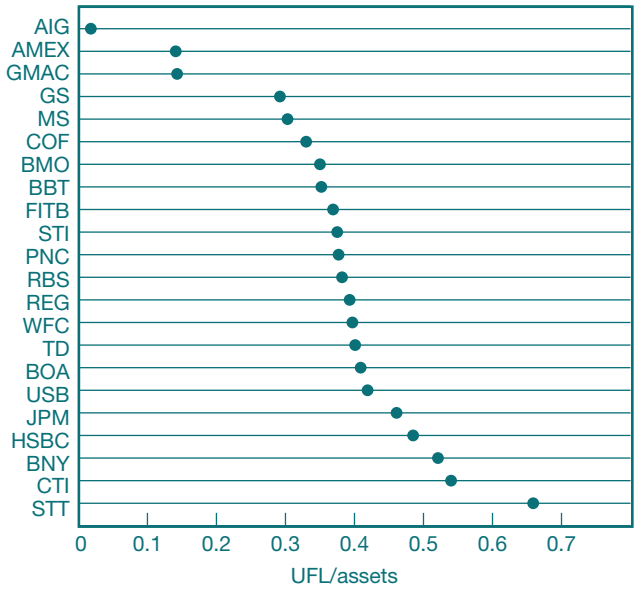
$$LDT_i = \min\{aUFL_i, bTotal\ Assets\}.$$

The parameters $a$ and $b$ can be chosen to make sure that, in the event of a firm's failure, the resolution authority

[23] The short-term debt emphasized in Stein (2012) seems very close to our concept of UFL. See also Gorton and Metrick (2010), Gorton and Pennacchi (1990), and Holmström and Tirole (1998, 2011).

Chart 4

UFL to Assets at the Largest BHCs




Source: Board of Governors of the Federal Reserve System, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data).

Note: The largest BHCs have total assets more than U.S.$100 billion, according to the FR Y-9C in 2014:Q4.

would have sufficient long-term at-risk debt on hand to provide capital that would cover a variety of scenarios regarding the firm's asset values.

The large firms we discuss are most often organized as a holding company with many subsidiaries. How would the at-risk debt requirement apply to a bank holding company? One possibility would be to measure, at each subsidiary, the amount of UFL that the subsidiary has issued to third parties. The holding company would then be required to issue at-risk debt in the amount of $a$ multiplied by the total UFL issued by all of the firm's subsidiaries. In turn, the subsidiaries could borrow from the holding company an amount of long-term debt equal to $a$ multiplied by the UFL issued by the subsidiary. This arrangement would be consistent with the single point of entry receivership approach to resolution that the FDIC has proposed.[24] Under that approach, the FDIC would take only the holding company into resolution, with the intention of maintaining the operating subsidiaries as going concerns. The at-risk debt of the holding company would be converted into equity of the bridge company. The bridge holding company could forgive the long-term debt of the separate subsidiaries, as needed, to provide them with additional capital.

[24] See http://www.fdic.gov/about/srac/2012/2012-01-25_resolution-strategy.pdf. Accessed August 22, 2013.

## 6. Conclusion

If the Lehman Brothers bankruptcy proved anything, it was that large bank failures are *messy*; they destroy value, they consume legal resources, and, not least, they spill over to other financial institutions and cause more widespread instability. This article has suggested a unifying framework for understanding why large bank failures are so messy. The reason for the messy failures, we have argued, is banks' heavy reliance on uninsured, money-like *financial liabilities*, such as uninsured deposits, repos, trading liabilities, commercial paper, and the like. The liquidity services of those liabilities get destroyed in failure, and the holders of those uninsured liabilities are prone to run as the bank approaches failure, which can cause fire sales. Both of these consequences make large bank failures messy.

We provide simple, direct evidence for our thesis. First, we show that failed banks that relied more on uninsured financial liabilities in the year prior to their failure experienced greater contractions in uninsured financial liabilities over the ensuing year. This finding is consistent with the hypothesis that holders of uninsured financial liabilities are prone to run. Second, we show that the cost of bank failures to the FDIC was increasing in the amount of uninsured financial liabilities in the year before the crisis. We take that finding as consistent with the premise that distressed banks' heavy reliance on uninsured financial liabilities subjects them to runs and fire sales, which increases the cost of the failure. That is, it makes the failure messier (although our regression does not capture the spillover to other institutions).

We join Calello and Ervin (2010), the European Commission (2012), Tarullo (2013), and others in recommending a long-term "at-risk" debt requirement as an additional measure to help cope with the problem of large banks' messy failures. Having such debt convertible to equity at failure provides a form of capital in resolution that can, in principle, stall runs by uninsured liability holders. Furthermore, sizing the requirement by the amount of uninsured financial liabilities, as we recommend, helps internalize the external costs (the risk of fire sales) of issuing money-like uninsured financial liabilities.

While we recommend an at-risk debt requirement as a way to deal with messy bank failures, we realize that such a requirement is not a panacea. First, it is not entirely clear how thick the market would be for at-risk, or "bail-in-able", debt; the peculiarities of pricing such an instrument could hamper

its development. Second, there is the potential for unstable market dynamics associated with an at-risk debt requirement. Even a small rumor about losses at a large bank could cause issuers' debt prices to collapse and make it difficult for the bank to issue new debt, which would potentially create a crisis for the firm. So the issuance dynamics must be carefully considered when requiring periodic issuance by a firm. Firms should not be put into resolution solely because of temporary disruptions in the market for their long-term debt. Finally, this proposal, like many others, does not prevent the buildup of systemic risk and the experience of contagion and contagious defaults among firms. Consequently, we think that this single approach, like all other approaches, cannot by itself eliminate the too-big-to-fail problem. Instead, we think this approach is an effective step in the right direction to limit the most damaging feature of too-big-to-fail financial firms: the fragility inherent in their reliance on uninsured financial liabilities.

To be clear, we are recommending an at-risk debt requirement as a supplement—not a substitute—for other macroprudential regulations, including equity capital requirements. In our discussion and argumentation, we needed to consider the argument of whether $2x$ in equity was as effective in limiting the messiness of large financial firms' failures as $x$ in equity and $x$ in long-term at-risk debt. However, we conclude that at-risk debt and equity are not substitutable. In particular, we do not suggest that at-risk long-term debt should serve to fulfill equity capital requirements, nor do we suggest that equity be allowed to fulfill the at-risk long-term debt requirement. Our view is that at-risk long-term debt should substitute for uninsured financial liabilities, not equity capital.

# Appendix

## Insured Deposits

Suppose now that the bank funds a portion of its assets with insured deposits, *ID*. In this case, the bank balance sheet has the following form:

| Assets | Liabilities |
|---|---|
| *A* | *ID* |
| | *UFL* |
| | *LD* |
| | *E* |

Further assume that *ID* is senior to all other creditors in bankruptcy. Suppose that $A - L_1 - L_2 < ID + UFL$ and $ID + UFL < A - L_1$. Hence, in the bad state of the world, if the bank experiences additional losses, it will not have enough funds to pay all insured depositors and the *UFL* creditors in full at $t = 2$, whereas it can pay them in full at $t = 2$ if it does not experience additional losses.

Assuming that *UFL* holders follow a rollover decision at $t = 1$ similar to that adopted in the benchmark case, they will withdraw if

$$\beta\left(\frac{A - L_1 - L_2 - ID}{UFL}\right) + (1 - \beta)r_s < 1,$$

that is, if $\beta$ is sufficiently high:

$$\beta > \frac{r_s - 1}{r_s - \frac{A - L_1 - L_2 - ID}{UFL}} = \beta' < \beta^*$$

Hence, for $\beta > \beta'$, it is optimal for UFL holders to withdraw at $t = 1$ in the bad state of the world, triggering a run on the bank (unless the regulator intervenes). Note that $\beta'$ is decreasing in *ID*.

In the presence of insured deposits, the run threshold for the probability of further losses is lower compared with the benchmark case, that is, $\beta > \beta'$. Hence, UFL creditors are more likely to run at $t = 1$ when the bank suffers losses of $L_1$. The reason is that the UFL creditors are junior to insured depositors in bankruptcy so that, compared with the benchmark case, *UFL* recover less in bankruptcy (and even less so when the bank has more insured deposits). As a result, early intervention by the regulator is even more important, and the conclusions of the benchmark case about the desirability of long-term debt are strengthened.

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Economic Policy Review



Library of Congress Card Number: 77-646559