The End of Market Discipline? Investor Expectations of Implicit State Guarantees*

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Abstract

We find that bondholders of major financial institutions have an expectation that the government will shield them from losses and, as a result, they do not accurately price risk. While bond credit spreads are sensitive to risk for most financial institutions, credit spreads lack risk sensitivity for the largest institutions. This expectation of public support constitutes a subsidy to large financial institutions, allowing them to borrow at government-subsidized rates. The implicit subsidy provided large institutions an annual funding cost advantage of approximately 28 basis points on average over the 1990-2010 period, peaking at more than 120 basis points in 2009. The total value of the subsidy amounted to about $20 billion per year, topping $100 billion in 2009. Passage of Dodd-Frank did not eliminate expectations of government support. The cost of this implicit insurance could be internalized by imposing a corrective tax. Requiring financial institutions to shoulder the full cost of their debt would help create a more stable and efficient financial system.

JEL Classifications: G21, G24, G28.

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I. Introduction

"If the crisis has taught a single lesson, it is that the too-big-to-fail problem must be resolved," declared U.S. Federal Reserve Chairman Ben Bernanke in 2010 when testifying before the U.S. Financial Crisis Inquiry Commission. We find that, despite efforts to end too-big-to-fail, the financial markets believe that the government will bail out major financial institutions in an emergency. The result is an implicit subsidy that allows these institutions to borrow at favorable rates.

The too-big-to-fail (TBTF) doctrine postulates that the government will not allow large financial institutions to fail if their failure would cause significant disruption to the financial system and economic activity. It is commonly claimed that, because of the TBTF doctrine, large financial institutions and their investors expect the government to back the debts of these institutions should they encounter financial difficulty. This expectation that the government will provide a bailout is referred to as an implicit guarantee; implicit because the authorities do not have any explicit, ex ante commitment to intervene.

Although it is often assumed that investors expect government bailouts for large financial institutions, few studies have attempted to provide evidence of that expectation, or to measure the funding subsidy that implicit government protection is alleged to offer. In this paper, we show that the implicit guarantee is priced by investors, and we quantify the value they place on it.

In the absence of an implicit government guarantee, market participants would evaluate a bank's financial condition and incorporate those assessments promptly into securities prices, demanding higher yields on uninsured debt in response to greater risk taking by the bank. However, for the market to discipline banks in this manner, debtholders must believe that they will bear the cost of a bank becoming insolvent or financially distressed. An implicit government guarantee dulls market discipline by reducing investors' incentive to monitor and price the risk taking of potential TBTF candidates. Anticipation of state support for major financial institutions could enable them to borrow at costs that do not reflect the risks otherwise inherent in their operations.

Nevertheless, some claim that Dodd-Frank ended TBTF expectations. Others argue that investors do not expect the government to implement TBTF policies, as there is no formal obligation to do so. The possibility of a bailout may exist in theory but not reliably in practice, and as a result, market participants do not price implicit guarantees. The government's long-standing policy of "constructive ambiguity" (Freixas 1999; Mishkin 1999) is designed to encourage that uncertainty. To prevent investors from pricing implicit support, authorities do not announce their willingness to support institutions they consider too big to fail. Rather, they prefer to be ambiguous about which institutions, if any, would receive support if they got into trouble. Ever since the Comptroller of the Currency named eleven banks "too big to fail" in 1984, authorities have walked a thin line between supporting large institutions and declaring that support was neither guaranteed nor to be expected, permitting institutions to fail when possible to emphasize the point. This has led authorities to take a seemingly random approach to intervention, for instance by saving AIG but not Lehman Brothers, in order to make it hard for investors to rely on a bailout.[1] Hence, it is an empirical question whether the implicit guarantee is considered credible by market participants and is therefore priced.

We find that expectations of state support are embedded in credit spreads on bonds issued by major U.S. financial institutions. We examine the relationship between the risk profiles of financial institutions and the credit spreads on their bonds. While a positive relationship exists between risk and spreads for medium and small institutions, the risk-to-spread relationship is not present for the largest institutions. In other words, bondholders of large financial institutions expect the government to shield them from the consequences of failure and, consequently, bond premiums do not fully reflect the institutions' risk taking. These results are robust to various bond-, firm- and macro-level controls. Expectations of state support reduce the cost of debt for these financial institutions. Because they pay a lower price for risk than other financial institutions, the perceived guarantee provides TBTF institutions with a funding advantage or subsidy.

The funding subsidy does not arise because large institutions are safer than smaller ones. We address potential endogeneity in the relationship between size and spreads by showing that large institutions are not less risky than smaller institutions. Our findings contradict the "charter value" hypothesis put forth by Bliss (2001 and 2004) and others. We find, instead, that large financial institutions are as risky or even riskier than their smaller counterparts. Nevertheless, the large financial institutions enjoy lower spreads.

[1] In a press briefing the day Lehman filed for bankruptcy, Treasury Secretary Paulson said: "Moral hazard is something I don't take lightly."

We alleviate endogeneity concerns further by examining rating agencies' expectations of state support. Certain rating agencies (such as Fitch) estimate a financial institution's standalone financial condition separate from its likelihood of receiving external support. Using these third-party estimates of risk and state support, we find that investors price the institution's likelihood of state support but not its standalone financial condition. In addition, we address endogeneity concerns by conducting an event study in order to examine shocks to investor expectations of support. We find that, following the government's rescue of Bear Stearns, larger financial institutions experienced greater reductions in spreads than smaller institutions experienced. Following the collapse of Lehman Brothers, larger financial institutions experienced greater increases in their spreads than smaller institutions experienced.

In addition to showing that investors in large financial institutions expect government support, we also estimate the value of that expectation. That is, we provide an estimate of the reduction in funding costs for TBTF financial institutions as a result of implied government support. While the direct cost of government bailouts is relatively straightforward to identify and quantify, the indirect cost arising from implicit government guarantees is more challenging to compute and has received less attention. We find that the implicit subsidy has provided large institutions an average funding cost advantage of approximately 28 basis points per year over the 1990-2010 period, peaking at more than 120 basis points in 2009. The total value of the subsidy amounted to about $20 billion per year on average over the twenty-year period, topping $100 billion in 2009.

These figures represent the price of implicit government insurance against default. They reveal what the value of the implicit guarantee would be if it were marked to market. This valuation can be used to compute a corrective tax or insurance premium to charge financial institutions in order to internalize the cost of the implicit guarantee. Internalizing the cost would better align risk with return for implicitly guaranteed institutions, producing a more stable and efficient financial system.

In the next section, we discuss the related literature. Section III describes the data and methodology we use in this study. Our main results appear in Section IV. Section V contains robustness tests. Section VI discusses policy implications and recommendations, and Section VII concludes.

II. Related Literature

A line of literature examines whether the market can provide discipline against bank risk taking (DeYoung et al. 2001; Jagtiani, Kaufman and Lemieux 2002; Jagtiani and Lemieux 2001; Allen, Jagtiani and Moser 2001; Morgan and Stiroh 2000 and 2001; Calomiris 1999; Levonian 2000; Federal Reserve Board 1999; and Flannery 1998). This literature examines whether there is a relationship between a bank's funding cost and its risk. Studies present some evidence that subordinated debt spreads reflect the issuing bank's financial condition and consequently propose that banks be mandated to issue subordinated debt. While these studies find that a bank's risk profile has some effect on spreads, the existence of risk-sensitive pricing does not necessarily mean that investors are not also pricing an implicit guarantee. These studies do not consider potential price distortions arising from conjectural government guarantees. For large institutions, the spread-to-risk relationship might diminish or break down if implicit guarantees are factored into market prices. In other words, these studies do not address TBTF.

In contrast to the extensive literature studying the spread-to-risk relationship in banking, a much smaller literature focuses on the role of implicit government guarantees in that relationship. These studies examine how the spread-to-risk relationship changes as investor perceptions of implicit government support changes. Their premise is that investors will price bank-specific risk to a lesser extent during times of perceived liberal application of TBTF policies, and will price bank-specific risk to a greater extent during times of perceived restricted application of TBTF policies. The empirical results, however, have been mixed.

Flannery and Sorescu (1996) examine yield spreads on subordinated debt of U.S. banks over the 1983-1991 period. Flannery and Sorescu believe that the perceived likelihood of a government guarantee declined over that period, which began with the public rescue of Continental Illinois in 1984 and ended with the passage of the FDIC Improvement Act (FDICIA) in 1991. They find that yield spreads were not risk sensitive at the start of the period, but came to reflect the specific risks of individual issuing banks at the end of the period, as conjectural government guarantees weakened. Sironi (2003) reaches a similar conclusion in his study of European banks during the 1991-2001 period. During this period, Sironi argues, implicit public guarantees diminished due to loss of monetary policy by national central banks and public budget constraints imposed by the European Union. Sironi uses yield spreads on subordinated debt at issuance to measure cost of debt and finds that spreads became relatively more sensitive to bank risk in the second part of the 1990s, as the perception of public guarantees diminished. In other words, these studies argue that as the implicit guarantee was diminished through policy and legislative changes, debt holders came to realize that they were no longer protected from losses and responded by more accurately pricing risk.

Other studies, however, reach different conclusions about the spread-risk relationship. These studies focus on the banks declared “too big to fail” by the Comptroller of the Currency in 1984, in order to differentiate TBTF banks from non-TBTF banks. Morgan and Stiroh (2005) determine that the spread-risk relationship was flatter for the named TBTF banks than it was for other banks. They find that this flat spread-risk relationship for the TBTF banks existed during the 1984 bailout of Continental Illinois and persisted into the 1990s, even after the passage of FDICIA, contrary to the findings of Flannery and Sorescu (1996). Similarly, Balasubramnian and Cyree (2011) suggest that the spread-risk relationship flattened for TBTF banks following the rescue of Long-Term Capital Management in 1998. In these studies, however, a TBTF institution is defined as one of the eleven banks named “too big to fail” by the Comptroller in 1984, a definition that is now almost 30 years old. Not only do these studies focus on a short list of banks from 1984, they also examine a short time frame. In contrast, we identify TBTF status by employing multiple measures of bank size and systemic risk contribution, and we examine a longer period of time (1990-2010). Our TBTF definition can be regularly updated over time and is a more relevant definition in today’s environment. While their definition of TBTF may suit the time period they analyze (the 1980s and 1990s), we analyze more recent data, including the financial crisis. We also undertake a more detailed analysis of the role TBTF status plays in the spread-risk relationship. In addition, we address endogeneity issues by performing multiple robustness tests. And we do more than ask whether implicit guarantees impact borrowing costs for TBTF institutions; we also provide a quantitative measure of the subsidy.

Although most research on implicit government guarantees has examined debt prices, some studies have looked at equity prices. These papers provide indirect evidence of a funding subsidy arising from implicit government support. While the immediate and most-valued beneficiaries of TBTF policies will be the debtholders, equity studies conjecture that implicit support will impact a bank’s stock price by reducing the bank’s cost of funds, thereby increasing profitability. Studies find a positive relationship between bank size and equity prices. O’Hara and Shaw (1990) find that positive wealth effects accrued to shareholders of the eleven banks named "too big to fail" by the Comptroller in 1984. Other studies suggest that shareholders benefit from mergers and acquisitions that result in a bank achieving TBTF status. Studies report that mergers undertaken by the largest banks increase market value for shareholders, while this is not the case for smaller banks, suggesting market prices reflect safety net subsidies for TBTF banks (e.g., Kane 2000). Hence, studies have focused on premiums paid in bank M&A activity, finding that greater premiums are paid in larger transactions, reflecting the benefits of safety net subsidies (Brewer and Jagtiani 2007; Molyneux, Schaeck and Zhou 2010).

Our paper is also related to a large literature that examines implicit guarantees and risk taking by banks. Although we focus on investors, implicit guarantees can also affect bank managers. The empirical literature on moral hazard generally concludes that banks increase their risk taking in the presence of government guarantees, as the guarantee provides protection against losses (Duchin and Sosyura 2012; Gropp, Hakenes and Schnabel 2010; Gropp, Gruendl and Guettler 2010; De Nicoló 2000; Hovakimian and Kane 2000; Boyd and Runkle 1993; Boyd and Gertler 1994; Demirguc-Kunt and Detragiache 2002, 2006) However, the evidence is far from unambiguous and some studies find that guarantees reduce risk taking (Kacperczyk and Schnabl 2011; Gropp and Vesala 2004; Cordella and Yeyati 2003), possibly resulting from increased charter values (Bliss 2001 and 2004; Keeley 1990) or greater regulatory oversight.

III. Data and Methodology

We collect data for financial firms with a two-digit Standard Industrial Classification (SIC) code of 60 to 64 (banks, broker-dealers, exchanges, and insurance companies), and 67 (other financial firms). Firm-level accounting and stock price information are obtained from COMPUSTAT and CRSP for the 1980–2010 time period.[2] Bond data come from three separate databases: the Lehman Brothers Fixed Income Database (Lehman) for the period 1980 to 1998, the National Association of Insurance Commissioners Database (NAIC) for the period 1998 to 2006, and the Trade Reporting and Compliance Engine (TRACE) system dataset from 2006 to 2010. We also use the Fixed Income Securities Database (FISD) for bond descriptions. Although the bond dataset starts in 1980, it has significantly greater coverage starting in 1990. In this paper, we focus on the 1990-2010 period.

[2] We obtained similar results using BANKSCOPE data.

Our sample includes all U.S.-issued bonds of financial institutions listed in the above datasets that satisfy a set of selection criteria commonly used in the corporate bond literature (see, for instance, Anginer and Yildizhan 2010 and Anginer and Warburton 2012). We exclude all bonds that are matrix-priced (rather than market-priced). We remove all bonds with equity or derivative features (i.e., callable, puttable, and convertible bonds), bonds with warrants, and bonds with floating interest rates. Finally, we eliminate all bonds that have less than one year to maturity. There are a number of extreme observations for the variables constructed from the bond datasets. To ensure that statistical results are not heavily influenced by outliers, we set all observations higher than the 99th percentile value of a given variable to the 99th percentile value. There is no potential survivorship bias in our sample, as we do not exclude bonds issued by firms that have gone bankrupt or bonds that have matured. In total, we have 567 unique financial institutions and 84,057 observations that have corresponding spread and financial information (Panel A of Table 1).

For each financial institution, we compute the beginning-of-month credit spread on its bonds (*spread*), defined as the difference between the yield on its bonds and that on the corresponding maturity-matched treasury bond. We are interested in systemically important financial institutions, as these firms will be the beneficiaries of potential TBTF interventions. Dodd-Frank emphasizes size in defining systemically important financial institutions. Although size is not the only characteristic that can make a financial institution systemically important, recent literature suggests that it is the most significant driver.[3] Adrian and Brunnermeier (2011), for instance, show that the systemic risk contribution of a given financial institution is driven significantly by the relative size of its assets. We employ multiple measures of firm size. One is the relative size of a financial institution (*size*), computed as its size (log of assets) in a given year divided by the average size of all financial institutions in that year. Another is whether a financial institution is in the top 90th percentile of financial institutions ranked by assets in a given year (*size90*). This measure is meant to capture very large institutions, which are likely to benefit most from TBTF policies. We also try defining a systemically important institution as one of the ten largest institutions in terms of size in a given year, and using an institution's contribution to systemic risk as in Adrian and Brunnermeier (2011).

[3] Other characteristics include interconnectedness, number of different lines of business, and complexity of operations. But these characteristics tend to be highly correlated with the size of a financial institution's balance sheet.

A number of different measures of risk have been used in the literature. In this study, we use distance to default (*mertondd*) as our primary risk measure. Distance to default is a measure of credit risk based on the structural credit risk model of Merton (1974). This approach treats the equity value of a firm as a call option on the firm's assets. Distance to default is the difference between the asset value of the firm and the face value of its debt, scaled by the standard deviation of the firm's asset value. The Merton distance-to-default measure has been shown to be a good predictor of defaults, outperforming accounting-based models (Campbell, Hilscher and Szilagyi 2008; Hillegeist et al. 2004). Although the Merton distance-to-default measure is more commonly used in bankruptcy prediction in the corporate sector, Merton (1977) points out the applicability of the contingent claims approach to pricing deposit insurance in the banking context. Anginer and Demirguc-Kunt (2011), Bongini, Laeven, and Majnoni (2002), Bartram, Brown and Hundt (2008) and others have used the Merton model to measure default probabilities of commercial banks.[4] We follow Campbell, Hilscher and Szilagyi (2008) and Hillegeist et al. (2004) in calculating Merton's distance to default. The details of the calculation are set forth in the Appendix. A higher distance-to-default number signals a lower probability of insolvency.[5]

Following Flannery and Sorescu (1996) and Sironi (2003), our controls include leverage, return on assets, time to maturity, issue size, market-to-book ratio, and issue rating. Leverage (*leverage*) is the ratio of total liabilities to total assets. Return on assets (*roa*) is the ratio of annual net income to year-end total assets. Time to maturity (*ttm*) is time to maturity (in years) of the issue. Issue size (*issuesize*) is the log of the size of the issue. Market-to-book ratio (*mb*) is the ratio of the market to the book value of total equity. Issue rating (*rating*) is the issue rating assigned by Standard & Poor's. We follow convention and use a numeric rating scale to convert ratings: 1 for AAA, …, 21 for CC. In addition, we include maturity mismatch (*mismatch*), defined as the ratio of short-term debt (minus cash) to total debt, as an additional control. We also include monthly macro factors (*mkt, term* and *def*). The construction of the variables is described in more detail in the Appendix.

Summary statistics appear in Table 1 (Panel B). Although it is larger financial institutions that issue public debt, we see significant dispersion in asset size. Table 1 also

[4] We verify our results using z-score in place of distance to default. Although z-score is more commonly used in the banking literature than Merton's distance-to-default measure, it does not exploit market prices like the Merton measure. In our analyses, we get substantially similar results using z-score in place of distance to default.

[5] Default probability for a firm is given by *N(-distance-to-default)*, where *N()* is the cumulative normal distribution.

includes a correlation matrix of variables (Panel C). There is a significant negative correlation between *size* and *spread*; larger financial institutions have lower credit spreads on their bonds.

IV. Results

In this section, we show first that bondholders of major financial institutions have expectations of receiving state support, providing a funding subsidy to these institutions. We then quantify the value of that subsidy on a yearly basis over the 1990-2010 time period.

1. Expectations of State Support

We begin by examining how the size of a financial institution affects the credit spread on its bonds. Following the empirical model in Campbell and Taksler (2003), we estimate the following regression using a panel with one observation for each bond-month pair:

$$\begin{aligned} Spread_{i,b,t} = & \propto + \beta^1 TBTF_{i,t} + \beta^2 Risk_{i,t} + \beta^3 Bond\ Controls_{i,b,t} + \beta^4 Firm\ Controls_{i,t} \\ & + \beta^5 Macro\ Controls_t + Firm\ FE + Year\ FE + \varepsilon_{i,b,t} \end{aligned} \quad (1)$$

In equation (1), the subscripts i, b, t indicate the financial firm, the bond, and the time (month), respectively, and the term FE denotes fixed effects. The dependent variable is the spread. To measure systemic importance of an institution (*TBTF*), we use multiple measures of an institution's size and systemic risk contribution, as discussed in Section III. We use Merton's distance to default (*mertondd*) as our measure of risk ($Risk_{i,t}$). We control for the following firm characteristics, $Firm\ Controls_{i,t}$: leverage (*leverage*), return on assets (*roa*), market-to-book ratio (*mb*), and maturity mismatch (*mismatch*). We control for the following bond characteristics, $Bond\ Controls_{i,b,t}$: the log value of the size of the issue (*issuesize),* the time to maturity of the bond (*ttm*) measured in years, the S&P issue rating (*rating*) [and the subordinated versus senior status of the bond (*sub*)]. We also control for the following monthly macro factors, $Macro\ Controls_t$: the market risk premium (*mkt*), the yield spread between long-term (10-year) treasury bonds and the short-term (three-month) treasuries (*term*) as a proxy for unexpected changes in the term structure, and the BAA-AAA corporate bond spread (*def*) as a proxy for default risk. The construction of the variables is described in the Appendix.

The results appear in Table 2. The table indicates a significant inverse relationship between spreads and systemic importance. In column 1, we use relative asset size (*size*) to identify systemic importance. We see that *size* has a negative effect on spreads. In column 2, we identify systemic importance as a financial institution in the top 90th percentile in terms of size (*size90*). The coefficient on the *size90* dummy variable is significant and negative, indicating that very large institutions have lower spreads. In column 3, we add dummy variables indicating an institution between the 60th and 90th percentiles (*size60*) and between the 30th and 60th percentiles (*size30*). The coefficients on *size60* and *size30* lack significance. These results suggest that the effect of size on spreads comes mostly from the very large financial institutions. We also try defining a systemically important institution using several alternative measures. In column 4, we define it as one of the ten largest institutions in terms of size in a given year (*size_top_10*). Results again show that TBTF status has a significant negative effect on spreads. Finally, following Adrian and Brunnermeier (2011), we use an institution's contribution to systemic risk (*covar*) to identify systemic importance. Lower values of *covar* indicate greater systemic risk contribution. Results in column 5 show a significant positive relationship between *covar* and *spread*.[6] That is, the greater an institution's contribution to systemic risk, the lower its spread. Overall, our results suggest a negative relationship between systemic importance and the cost of debt.

In terms of the other variables, there is a significant relationship between credit spreads and risk. The coefficient on distance to default (*mertondd*) is significant and negative in all specifications in Table 2. This result indicates that less-risky financial institutions (those with a greater distance to default) generally have lower spreads.

Does a financial institution's size affect this relationship between spreads and risk? To answer that question, we interact the size and risk variables, *size90* and *mertondd*. Results appear in Table 3. The coefficient on the interaction term is significant and positive. It indicates that the spread-risk relationship diminishes with TBTF status. For institutions that achieve systemically-important status, spreads are less sensitive to risk. The result is consistent with investors pricing an implicit government guarantee for the largest financial institutions. Moreover, the result is robust to different measures of risk. In place of *mertondd*, we employ z-score (*zscore*)[7] in column 2 and idiosyncratic volatility (*idiovol*)[8] in column 3. In both

[6] Following Adrian and Brunnermeier (2011), we do not include firm fixed effects in this regression as the *covar* measure is computed over the sample period for each firm.

[7] We compute z-score on a rolling basis as the sum of return on assets and equity ratio (ratio of book equity to total assets), averaged over four years, divided by the standard deviation of return on assets over four years (see Roy

specifications, the coefficient on the interaction term is significant and offsets the coefficient on the risk variable, indicating that the spread-risk relationship diminishes for the largest institutions.

These relationships can be seen in Figures 1 and 2. Figure 1 shows the relationship between the size of a financial institution and the credit spread on its bonds. It shows a negative relationship between size and spreads: larger institutions have lower spreads. Why do larger institutions have lower spreads? Are they less risky than smaller ones? Figure 2 plots the size of a financial institution against its risk (distance to default). There does not appear to be any observable relationship between size and risk. That is, Figure 2 suggests that larger institutions do not offer lower risk of large loses than smaller institutions.[9] Hence, the two figures, together, support the notion that large institutions have lower spreads because of implicit government guarantees. That is, large financial institutions enjoy lower spreads because of implicit government support, not because of their underlying risk profiles.

2. Quantification of the Implicit Subsidy

As the above results show, major financial institutions enjoy a funding subsidy as a result of implicit government support. In this subsection, we quantify the value of that subsidy. We provide an estimate of the reduction in funding costs for TBTF financial institutions as a result of implied government support.

We estimate the implicit subsidy on a yearly basis. To compute the annual subsidy, we run the following regression for each year:

$$\begin{aligned} Spread_{i,b,t} = &\propto + \beta^1 \times issuesize_{i,b,t} + \beta^2 \times ttm_{i,b,t} + \beta^3 leverage_{i,t} + \beta^4 roa_{i,t} + \beta^5 mb_{i,t} \\ &+ \beta^6 mismatch_{i,t} + \beta^7 mertondd_{i,t} + \beta^8 def_t + \beta^9 term_t + \beta^{10} mkt_t \\ &+ \beta^{11} size90_{i,t} + \varepsilon_{i,b,t} \end{aligned} \tag{2}$$

1952). The z-score measures the number of standard deviations that a financial institution's rate of return on assets can fall in a single period before it becomes insolvent. A higher z-score signals a lower probability of insolvency. A z-score is calculated only if we have accounting information for at least four years.

[8] *Idiovol* is annualized stock return volatility, computed as the standard deviation of fiscal year daily excess stock returns from a Fama-French three-factor model, multiplied by the square root of 252. Idiosyncratic volatility has been shown to be a significant driver of credit spreads (Campbell and Taksler 2003).

[9] It is important to note that the implicit guarantee does not prevent a financial institution from suffering significant losses, including having its equity wiped out and approaching the default boundary on its debt, before the implicit guarantee becomes explicit. Both distance to default and z-score capture these losses and, therefore, do not reflect the implicit guarantee itself.

where our variable of interest, *size90*, indicates a firm in the top 90th percentile of firms by assets. The coefficient on *size90* represents the subsidy accruing to large financial institutions as a result of implicit government insurance. The estimated subsidy is plotted, by year, in Figure 3. It depicts the estimated subsidy over the twenty-year period from 1990-2010.

The implicit subsidy provided large financial institutions a funding cost advantage of approximately 28 basis points per year, on average, over the twenty-year period. The subsidy skyrocketed to over 120 basis points in 2009.

We also quantify the dollar value of the annual subsidy. We multiply the annual reduction in funding costs by total uninsured liabilities (in US$ millions) to arrive at the yearly dollar value of the subsidy, reported on the left axis of Figure 3.[10] The dollar value of the subsidy amounted to $20 billion per year, on average. The value of the subsidy peaked in 2009 at over $100 billion.

Despite the magnitude of the implicit subsidy, few studies have attempted to quantify it. Those studies that have attempted a quantification do not focus on the U.S. and instead examine a sample of banks worldwide (Ueda and di Mauro 2011; Rime 2005; Soussa 2000). Ueda and di Mauro (2011) estimate a 60 basis point subsidy existed in 2007 for banks worldwide and an 80 basis point subsidy existed in 2009. Studying the pre-crisis period, Rime (2005) finds a subsidy of 10 to 20 basis points for stronger banks and 20 to 80 basis points for weaker banks. These studies, however, use credit ratings to proxy for funding costs. That is, they measure reductions in funding costs only indirectly, by studying differences in credit ratings, not directly as we do using financial market price data. Market prices reflect the expectations of actual investors in the market and, for many institutions, are available almost continuously. As a result, while prior studies support the notion that an implicit guarantee exists worldwide, they do not provide a precise measure of it. In addition, they use limited controls for differences in bank characteristics and risk. They also examine limited time periods: Ueda and di Mauro examine only two points in time (year-end 2007 and year-end 2009) and Rime examines only the period from 1999-2003.

Instead of measuring implicit government support, prior research has mainly attempted to measure explicit government support. For instance, Laeven and Valencia (2010) estimate that

[10] We exclude deposits backed by explicit government insurance. It is also possible that investors have different expectations of a guarantee for different aspects of liabilities of a given firm. Total uninsured liabilities, therefore, provides a rough estimate of the dollar value of the implicit guarantee.

the direct fiscal cost of the U.S. government's response to the financial crisis amounted to approximately 5% of GDP. Veronesi and Zingales (2009) estimate the direct cost to be between \$21 and \$44 billion.[11] Direct costs of bailouts have always caught the attention of the public (Stern and Feldman 2004). Indeed, there is a growing concern in the literature that bailouts may have grown so large that they are straining the public finances in many countries and governments cannot continue to afford them (e.g., Brown and Dinç 2011; Demirgüç-Kunt and Huizinga 2010).

But direct costs provide only a narrow quantification of bailouts and likely underestimate their actual cost. Estimates of the direct, or ex post, cost of government interventions overlook the ex ante cost of implicit support (i.e., the resource misallocation it induces), which is potentially far greater. While explicit support is relatively easy to identify and quantify, implicit support is more difficult and has received less attention. We have focused on quantifying the cost of implicit government support since it is the more comprehensive measure of the cost of bailouts. Our approach recognizes that, even when the banking system appears strong, safety net subsidies exist for large financial institutions.

V. Robustness

In this section, we address the potential for endogeneity in the relationship between spreads and TBTF status. First, we examine in greater detail the relationship between the size of a financial institution and its risk. Next, we examine credit ratings issued by Fitch, which provide third-party measures of an institution's credit risk and an institution's likelihood of receiving external support in a crisis. Third, we perform an event study to examine shocks to investor expectations of support.

1. The TBTF-Risk Relationship

It is often claimed that large financial institutions are considered less risky by investors. Large institutions might benefit from government guarantees, reducing their risk of loss. But large financial institutions, by virtue of their size, might benefit from other factors that reduce the level of their risk vis-à-vis other financial institutions. For instance, large financial institutions

[11] Veronesi and Zingales use bailout events to quantify the value of the subsidy. While that approach may reveal the change in the subsidy that a particular intervention produced, it does not capture the level of the subsidy, which can be substantial even during periods between crises.

might benefit from better investment opportunities. If so, they may have inherently less risky portfolios. In addition, large financial institutions might enjoy superior economies of scale and be better diversified than smaller ones. A growing literature argues that economies exist in banking (Wheelock and Wilson 2001, 2012; Hughes and Mester 2011; McAllister and McManus 1993). However, economies are often attributed to advances in information and financial technology and regulatory changes that have made it less costly for financial institutions to become large, not increasing size itself (e.g., Stiroh 2000; Berger and Mester 1997). Moreover, most research has concluded that economies exist only for financial institutions that are not very large (Amel et al. 2004; Berger and Humphrey 1994; Berger and Mester 1997).[12] This suggests that economies disappear once a certain size threshold is reached, with diseconomies emerging due to the complexity of managing large institutions and implementing effective risk-management systems (e.g., Laeven and Levine 2007; Demirguc-Kunt and Huizinga 2011).

Nevertheless, in this subsection, we address the potential endogeneity concern. If investors believe risk-reducing benefits accompany large size for reasons other than TBTF guarantees, larger institutions should exhibit superior credit risk. Hence, we regress credit risk on size, with controls, as follows:

$$Risk_{i,t} = \propto + \beta^1 TBTF_{i,t} + \beta^2 Firm\ Controls_{i,t} + \ Firm\ FE + Year\ FE + \varepsilon_{i,t} \quad (3)$$

We use two measures of systemic importance, *size* and *size90*, and two measures of risk, distance to default and z-score. Results appear in Table 4. The coefficients on the size variables are insignificant in columns 1, 3 and 4. *Size* fails to significantly impact either distance to default or z-score, and *size90* fails to significantly impact z-score. This finding is consistent with the lack of any observable pattern between size and risk in Figure 2. *Size90* actually has a positive impact on risk (by lowering the distance to default) in column 2. This latter result indicates that riskiness *increases* with firm size, not decreases. The finding that large financial institutions follow riskier strategies than smaller ones is consistent with the moral hazard literature and contradicts the charter value literature (cited earlier). Overall, our results provide support for a

[12] The literature generally finds a U-shaped cost curve with a minimum typically reached within a range of $10 billion to $100 billion in assets, depending on the sample, time period, and methodology.

large literature that has failed to detect efficiency and risk-reduction benefits for very large banks (see, e.g., Demirguc-Kunt and Huizinga 2011; Demsetz and Strahan 1997).

In short, Table 4 shows that larger financial institutions are not less risky than smaller ones. Hence, it is not because of a reduction in underlying default risk that large institutions experience a reduction in their spreads. By showing that larger size does not imply lower risk, Table 4 supports our main finding that the credit market prices an expectation of government support for large financial institutions.

2. Individual and Support Ratings

To further alleviate concerns about endogeneity, we exploit credit ratings and government-support ratings as alternative measures of credit risk and implicit support. In this subsection, we examine ratings issued by Fitch, which provide third-party measures of credit risk and potential external support.

In rating financial institutions, Fitch distinguishes between an institution's own financial strength and the support it might receive from external sources. Accordingly, Fitch assigns both an "issuer rating" and an "individual rating" to financial institutions. Fitch's issuer rating is a conventional credit rating. It measures a financial institution's ability to repay its debts after taking into account all possible external support. In contrast, Fitch's individual rating measures a financial institution's ability to repay its debts without taking into consideration any external support. The individual rating reflects an institution's "standalone" financial strength, or in other words, the intrinsic capacity of the institution to repay its debts. The difference between these two ratings reflects Fitch's judgment about expected government support for a financial institution.

We use Fitch's long-term issuer rating (*issuer*) and Fitch's individual rating (*individual*) as independent variables in the spread regression specified in equation (1) above. The issuer rating scale ranges from AAA to C- (with 25 notches) (ratings below C- are excluded from our dataset since they indicate defaulted firms). The individual rating scale ranges from A to E (with 9 notches). We transform the ratings into numerical values using the following rule: AAA=1, AA+=2, ..., C-=25 for the issuer rating and A=1, A/B=2, …, E=9 for the individual rating.

Table 5 contains results of regressions similar to the spread regressions of Table 2, but with the addition of the rating variables. The individual rating (*individual*) is employed in specifications 1 and 2. In those specifications, the coefficient on *individual* lacks significance. A financial institution's standalone risk profile does not significantly impact the credit spread on its bonds. In contrast, the coefficients on the two size variables, *size* and *size90*, are significant and negative, indicating that size impacts spreads. Specifications 3 and 4 employ the issuer rating. In those specifications, the coefficient on *issuer* is significant and positive. The issuer rating incorporates implicit government support, and that expectation of government assistance has a significant downward impact on credit spreads. Financial institutions likely to receive government support pay lower spreads on their bonds. Moreover, the expectation of government support overwhelms the effect of size on credit spreads. The coefficients on both size variables lose their significance in the presence of the issuer rating, indicating that the effect of the issuer rating subsumes the effect of the size variables. In sum, we find that the issuer rating impacts spreads, but the individual (i.e., standalone) rating does not. In other words, investors do not price the true, intrinsic ability of a financial institution to repay its debts, but instead price implicit government support for the institution. This result is consistent with the findings of Sironi (2003) using European data and supports our earlier conclusion that the expectation of government support for large financial institutions impacts the credit spreads on their bonds.

3. Event Study

Next, we examine how credit spreads were impacted by events that might have changed investor expectations of government support. We examine two events: the government's rescue of Bear Stearns on March 17, 2008 and the collapse of Lehman Brothers on September 15, 2008. These events offer natural experiments to confirm the existence of TBTF expectations.

Prior to the financial crisis, investors may have been unsure about whether the government would guarantee the obligations of large financial institutions should they encounter financial difficulty, since there was no explicit commitment to do so. When Bear Stearns collapsed, its creditors were protected through a takeover arranged and subsidized by the Federal Reserve, despite the fact that Bear Stearns was an investment bank and not a commercial bank.[13]

[13] In connection with Bear Stearns' merger with JP Morgan, the Federal Reserve provided JP Morgan with regulatory relief and nearly $30 billion in asset guarantees, and Bear Stearns with lending support under section 13(3) of the Federal Reserve Act of 1913, the first time since the Great Depression that the Federal Reserve directly supported a non-bank with taxpayer funds. The Fed also announced the Primary Dealer Credit Facility, which opened the discount window to primary dealers in government securities, some of which are investment banks, bringing into the financial safety net investment banks like Lehman, Merrill Lynch, and Goldman Sachs.

This intervention likely reinforced expectations that the government would guarantee obligations of large financial institutions. The later decision to allow Lehman Brothers to fail, in contrast, served as a negative shock to those expectations. Although the Federal Reserve and the Treasury intervened the day after Lehman was allowed to collapse (including a rescue of AIG's creditors), the government adopted a series of unpredictable and confusing policies around Lehman's collapse, making future intervention increasingly uncertain. Hence, the Bear Stearns event and the Lehman event provide contrasting shocks to investor expectations of government support.

We examine both events using a window of +/- 5 trading days around the event. We run the following regression:

$$Spread_{i,b,t} = \propto + \beta^1 post + \beta^2 TBTF_{i,t} \times post + \beta^3 Risk_{i,t} \times post + \beta^4 Bond\ Controls_{i,b,t} \times post + \beta^5 Firm\ Controls_{i,t} \times post + \beta^6 Macro\ Controls_t + Issue\ FE + \varepsilon_{i,b,t} \qquad (4)$$

As before, we use two systemic importance measures, *size* and *size90*.[14] We use a dummy variable, *post*, which equals one on the event date and the five subsequent trading days. We use issue fixed effects (*Issue FE*) and the regression corresponds to a difference-in-difference estimation. First, we look at the rescue of Bear Stearns on March 17, 2008. Results appear in Table 6. The variable of interest is the term interacting *post* with the size measures (*size* and *size90*). This interaction term measures the impact of the event on spreads for large institutions. The coefficient on the interaction term is significant and negative in the Bear Stearns event regressions. The result indicates that larger institutions saw greater decreases in their spreads following the government-assisted rescue of Bear Stearns.

Next, we look at the collapse of Lehman Brothers on September 15, 2008. We recognize that, in addition to signaling a reduced likelihood of bailouts, Lehman's collapse might have exerted a more direct effect on financial institutions. Hence, we control for institutions' exposure to Lehman by including an indicator variable (*exposure*) that takes the value of one for an institution that declared direct exposure to Lehman in the weeks following its collapse, and zero otherwise (following Raddatz 2009).[15] Again, our variable of interest is the term interacting

[14] Here, however, we define *size* as the log of the institution's assets, without dividing by average (log) assets of all institutions, since we are looking over a 10 day period only.
[15] We obtain similar results without the *exposure* variable.

post with the systemic importance measures. The coefficient on the interaction term is significant and positive for the Lehman event. The result indicates that larger institutions saw greater increases in their spreads after the government allowed Lehman to collapse.

These results suggest that market participants revised their expectations of government intervention during these events. By analyzing two recent shocks to investor expectations of government assistance, we find additional evidence consistent with our main finding that credit markets price expectations of government support for large financial institutions.

We also examined the adoption of the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank) as an additional event. One of the main purposes of the legislation was to end investors' expectations of future government bailouts. Table 6 shows results for June 29, 2010, the date the House and Senate conference committees issued a report reconciling the bills of the two chambers. The results indicate that Dodd-Frank failed to achieve its goal. The coefficient on the interaction term is insignificant when *size* is used, and is significant and negative when *size90* is used, suggesting that Dodd-Frank actually lowered spreads for the very largest financial institutions. These results show that Dodd-Frank failed to eliminate investors' expectations of future support for major financial institutions. Dodd-Frank designates certain companies as "systemically important" if their failure will cause instability of the financial system. Bank holding companies with assets of more than $50 billion are automatically designated as systemically important. Similar to the Comptroller of the Currency naming eleven banks "too big to fail" in 1984, Dodd-Frank's designation of certain institutions as systemically important may have had the unintended consequence of firming market expectations that these institutions are likely to receive government support in the future should they encounter financial problems.

VI. Policy Implications

As Figure 3 shows, expectations of government bailouts for large financial institutions persist over time. Even when the banking system appears strong, large financial institutions benefit from expectations of too-big-to-fail assistance. Bailout expectations exist not only in times of crisis, but also in times of relative tranquility, and vary with government policies and actions.

The 1980s were a time of high expectations of government support for troubled institutions. In 1984, the U.S. government rescued Continental Illinois, once the seventh largest bank, in what constituted the largest bank bailout in U.S. history at the time. The bailout resulted in no losses for bank depositors or investors. While testifying on the bailout before Congress shortly thereafter, the Comptroller of the Currency formalized the previously implicit TBTF policy by declaring that eleven financial institutions were "too big to fail."

In the early 1990s, the government took steps to erode the perception that it backed large financial firms. In 1991, Congress passed the FDIC Improvement Act (FDICIA). It was believed that FDICIA would limit regulators' discretion to support distressed banks and enable regulators to save insured depositors without saving uninsured investors.[16] Accordingly, Figure 3 shows a decline in the implied subsidy during this period, reflecting diminishing expectations of government support for the largest financial institutions.

In contrast, expectations of government support increased during the late 1990s. In 1997 and 1998, the government responded to perceived threats to financial stability that emanated from currency crises in emerging economies. In 1998, the Federal Reserve brokered a bailout of hedge fund Long-Term Capital Management. Accordingly, the implicit subsidy spiked and remained elevated for several years as expectations of government bailouts became embedded in the market. In November, 1999, Congress formally repealed Glass-Steagall's separation of commercial banks from investment banks, enabling banks to engage in a wider range of activities and to merge with other financial firms, potentially bringing new activities and entities under the government's watchful eye. The Federal Reserve flooded the banking system with liquidity to prepare for the possibility of technical problems in connection with the year 2000 conversion and then the bursting of the tech bubble in 2000. In response to the terrorist attacks of September 11, 2001, the Federal Reserve provided an unusual amount of liquidity and reduced the federal funds rate. As Figure 3 shows, the implicit subsidy reached a record level at the time.

In 2003 and 2004, the implicit subsidy declined, as the economy recovered from recession and the market's appetite for risk re-emerged. As the economy expanded, investors exhibited a growing risk tolerance, lowering the credit spreads they required from smaller

[16] FDICIA obligated regulators to take "prompt corrective action" against severely distressed banks, limited regulators' discretion to support distressed banks, and mandated "least-cost" resolution of failed banks. These provisions imposed a relatively stringent process on the FDIC before it could extend protection in a failed-bank resolution beyond insured deposits.

financial institutions relative to the largest. This period of diminished expectations of support, however, was short lived.

The financial crisis began during the summer of 2007, as liquidity dried up as a result of uncertainty about financial institutions' exposure to "toxic assets." The financial crisis was at its most intense during 2008-2009 (during which time CDS spreads on financial institutions grew considerably and reached record peaks). In responding to the crisis, government actions nearly formalized the implicit public guarantee of the financial sector. As Figure 3 shows, investor expectations of government assistance surged to unprecedented levels.

In the post-crisis period after 2009, the implicit subsidy remained at an elevated level. The passage of the Dodd-Frank in the summer of 2010 did not eliminate investors' expectations of government support. Dodd-Frank makes no attempt to price implicit guarantees and, in fact, expectations of support increased in 2010 compared to 2008. The centerpiece of Dodd-Frank is the creation of the Financial Stability Oversight Council whose objective is, in part, to "promote market discipline, by eliminating expectations on the part of shareholders, creditors, and counterparties of [large financial] companies that the government will shield them from losses in the event of failure." In pursuit of this objective, the Council is empowered to designate certain companies as "systemically important" if their failure will cause instability of the financial system and to subject them to additional oversight, including liquidation. While bank holding companies with assets of more than $50 billion are automatically designated as systemically important, the designation is otherwise highly discretionary and reflects a judgment that the institution is too big to fail. Because market participants believe every effort will be made to support systemically important institutions should they suffer financial distress, these companies have advantages over competitors in obtaining credit.[17] As a result, the credit market doubts whether Dodd-Frank will mitigate TBTF, believing instead that it will likely exacerbate the problem.

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[17] Despite Dodd-Frank's explicit no-bailout pledge, the Act leaves open many avenues for future TBTF rescues. For instance, although Dodd-Frank grants new authority to officials to resolve large institutions, President of the Federal Reserve Bank of Kansas City, Thomas Hoenig, noted: "The final decision on solvency is not market driven but rests with different regulatory agencies and finally with the Secretary of the Treasury, which will bring political considerations into what should be a financial determination." Moreover, prior to any resolution, the Federal Reserve can offer a "broad-based" lending facility to a group of financial institutions to provide an industry-wide bailout or a single-firm bailout in disguise. In addition, Congress may at any time decide to abandon Dodd-Frank by explicitly amending or repealing the statute or by allowing regulators to interpret their authority in order to protect creditors and partner with large financial institutions (see, e.g., Skeel 2011; Wilmarth 2011; Standard & Poor's 2011).

As Figure 3 shows, the value of the implicit subsidy provided to too-big-to-fail financial institutions is substantial. Expectations of state support for TBTF institutions has provided them with a sizable reduction in their cost of debt, which misaligns risk and return for their owners and managers and encourages them to take on more risk. A spiral can therefore develop - the implicit guarantee encourages institutions to take more risk, which increases the probability and cost of bank failure, which in turn increases the subsidy. Since any resulting bailouts are conducted using public funds, the implicit guarantee produces a transfer of resources from the government, and ultimately taxpayers, to major financial institutions.[18] As a result, to the extent TBFT institutions do not pay for this implicit guarantee, expectations of state support constitute a form of wealth redistribution. This redistribution is not a temporary event that exists only during times of crisis; it persists even during times of relative tranquility. That is, the subsidy generates an ongoing wealth transfer from taxpayers to TBTF institutions.

Governments are generally not required to make any apparent commitment or outlay, or request funds from legislatures or taxpayers, when they implicitly guarantee too-big-to-fail institutions. Since it happens implicitly, the transfer lacks the transparency and accountability that accompany explicit policy decisions. Taxpayer interests would be better served, in both good times and bad, by estimating on an ongoing basis the accumulated value of this subsidy.

Ideally, the government would simply foreswear bailouts and end the subsidy. However, evidence and experience show that such a no-bailout policy lacks credibility. Instead, public accounting of accumulated TBTF costs might restrain those government actions and policies that encourage TBTF expectations. Because the cost of implicit insurance is not fully visible to policymakers or taxpayers, insufficient attempts are made to reign in TBTF expectations. Requiring ongoing estimation and disclosure of the subsidy would generate feedback for regulators and policymakers about the consequences of their actions and might generate pushback from taxpayers when they see the size of the subsidy in dollar terms.

In addition to public accounting and disclosure, large financial institutions could be made to bear responsibility for the implicit taxpayer insurance they enjoy. These institutions could be charged a Pigovian-style tax designed to compensate for the underpricing of risk that results

[18] Dodd-Frank seeks to end this wealth transfer by requiring that the costs of resolving failed financial institutions be imposed on the surviving ones, not taxpayers. But during a systemic crisis, it is unlikely that the solvent part of the sector will be used to cover the losses of the failed part of the sector. Since capital is needed most during a crisis, taxpayer funds are likely to be used instead.

from the implicit guarantee. That is, the funding subsidy that big institutions enjoy could be neutralized by imposing a corrective levy, tax, or premium that extracts the value of the subsidy. This charge would act as a form of compensation for the public support large financial institutions are expected to receive in the event of a crisis. The goal is not to make institutions pre-pay future rescue costs, but to realign incentives among beneficiaries of the implicit guarantee.[19] By pricing the implicit guarantee and internalizing its cost, policymakers could require financial institutions to bear the true cost of their debt, resulting in a more proper alignment of risk and return for owners and managers. Effective funding costs would more fully reflect the risk taking of the financial institution, helping to reduce excessive risk taking. Such a Pigovian tax would be more straightforward and transparent than extensive government supervision and regulation that attempts to manage risk taking (the Dodd-Frank Act required 2,319 pages of legislation and mandates hundreds of additional rules, yet it does not directly address mispricing of conjectural government guarantees, leaving expectations of support to persist). If the cost of the implicit guarantee is instead internalized through a Pigovian tax, market discipline could then work with supervisory discipline to create a more stable and efficient financial system.

Similar recommendations have been put forth in papers examining systemic risk externalities. Contingent capital proposals have been popular among both academics and policymakers as way to limit systemic crises and TBTF expectations (see Acharya, Kulkarni and Richardson 2011). A form of debt that converts automatically into equity as credit quality deteriorates, contingent capital ensures that the institution maintains a sufficient level of capitalization, reducing the likelihood of default when an adverse shock materializes. By imposing losses on creditors, contingent capital would partially restore market discipline and reduce the need for government intervention. But, with its emphasis on reducing ex post distress, the contingent capital solution suffers from an important limitation, namely its ability to limit ex ante risk taking and buildup of systemic risk. Beneath contingent capital will remain debt that is implicitly (and explicitly) guaranteed by the government. The cost of this debt in

[19] In contrast to Dodd-Frank's ex post tax on financial institutions, recent proposals have called for an ex ante tax on financial institutions intended to recoup future bailout costs. Most of the proposed taxes are not particularly sophisticated in design (i.e., levied at a uniform rate on total assets or total liabilities net of insured deposits, see IMF 2010) and may result in simply transferring funds from well-managed institutions to reckless ones instead of mitigating moral hazard. We propose instead a tax designed specifically to capture the subsidy a financial institution enjoys as a result of an implicit government guarantee. Such a tax is intended to better align risk and return for bank owners and managers.

good times will not reflect the true risk of the institution, and so long as this is the case, contingent capital and equity capital will continue to find it desirable to undertake excessive risk at the expense of guaranteed debt. Hence, contingent capital should complement measures that attempt to directly control ex ante risk by internalizing its external cost, such as the Pigovian-style tax we propose, not substitute for such measures.

In the aftermath of the crisis, there has been a growing consensus that some elements of macro-prudential regulation should work like Pigovian taxes in order to discourage banks from pursuing strategies that contribute to the risk of the financial system as a whole (e.g., Acharya et al. 2010; Perotti and Suarez 2009; Brunnermeier et al. 2009; Financial Stability Forum 2009a, 2009b). A number of recent papers develop novel methods to measure and quantify systemic risk in the banking sector (Adrian and Brunnermeier 2011; Huang, Zhou, and Zhou 2009; Chan-Lau and Gravelle 2005; Avesani, Garcia Pascual and Li 2006; Elsinger and Lehar 2008). These papers use a portfolio credit risk approach to compute the contribution of an individual bank to the risk of a portfolio of banks. However, they examine the systemic risk contribution of each financial institution ex-post. Our results show that, as a result of the implicit guarantee, risk is not being priced appropriately on an ex-ante basis. Nevertheless, despite our different approaches, we arrive at similar policy recommendations – namely, that Pigovian-style taxes should be imposed on larger financial institutions to correct for the negative externalities they generate.[20]

VII. Conclusion

We find that expectations of state support are embedded in credit spreads on bonds issued by large U.S. financial institutions. While credit spreads are risk sensitive for most financial institutions, credit spreads lack risk sensitivity for the largest financial institutions. In other words, we find that bondholders of large financial institutions have an expectation that the government will shield them from losses and, as a result, they do not accurately price risk. This expectation of public support constitutes an implicit subsidy of large financial institutions, allowing them to borrow at government-subsidized rates. The cost of this implicit insurance could be internalized by imposing a corrective tax on large financial institutions. Removing the

[20] We recognize that, even in an efficient market without any guarantees, it is possible for there to be externalities associated with being systemically important that will not be fully internalized (see, for instance, Zingales 2009).

funding advantage would allow financial institutions to compete on a level playing field. In addition, requiring large financial institutions to bear the true cost of their debt would better align risk with return for their owners and managers, promoting a more stable and efficient financial system.

Until it is internalized, implicitly-guaranteed institutions will have an incentive to take actions that promise rewards to their owners and managers while imposing costs on the rest of society. Hence, public support for financial institutions in the name of systemic stability represents a cost to taxpayers as well as a subsidy for those firms. This arrangement produces a wealth transfer from taxpayers to major financial institutions. The wealth transfer is not a temporary one that exists only during times of crisis, but is ongoing. However, governments are not required to make any apparent commitment or outlay, or request funds from taxpayers, when they implicitly guarantee too-big-to-fail institutions. Since it happens implicitly, the wealth transfer lacks transparency and accountability. Taxpayer interests would be better served, in both good times and bad, by estimating on an ongoing basis the accumulated value of this subsidy, as we do in this paper. The privatization of gains and socialization of losses arising out of TBTF policies can undermine the public's faith that the capitalist system is responsible and fair.

Appendix

Bond characteristics	
spread (%)	The difference between the yield on a financial institution's bond and the yield on a treasury bond with similar maturity.
issuesize	The log value of the size of the issue.
ttm	Year to maturity.
rating	S&P issue rating, which is a number between 1 and 21, with 1 indicating the highest issue quality.
Financial variables	
size	Size of a financial institution (defined as the log value of total assets) divided by the average size of all financial institutions in that fiscal year.
size90	Dummy variable which equals 1 if an issuer's size is greater than the 90th percentile of its distribution in that fiscal year and 0 otherwise.
size60	Dummy variable which equals 1 if an issuer's size is greater than the 60th percentile of its distribution in that fiscal year but less than or equal to the 90th percentile and 0 otherwise.
size30	Dummy variable which equals 1 if an issuer's size is greater than the 30th percentile of its distribution in that fiscal year but less than or equal to the 60th percentile and 0 otherwise.
size_top_10	Dummy variable which equals 1 if an issuer ranks in the top ten in terms of size in that fiscal year and 0 otherwise.
covar	CoVar measure of systemic fragility, as described below.
leverage	Total liabilities divided by total assets.
roa	Return on assets, measured as net income divided by total assets.
mb	Market value of total equity divided by book value of total equity.
mismatch	Short-term debt (minus cash) divided by total liabilities.
mertondd	Merton's distance-to-default measure, calculated using firm-level fiscal year financial and stock return data, as described below.
zscore	Z-score, calculated as the sum of roa and equity ratio (ratio of book equity to total assets), averaged over four years, divided by the standard deviation of roa over four years.
Macro controls	
mkt	Market risk premium.
term	Term structure premium, measured by the yield spread between long-term (10-year) treasury bonds and short-term (three-month) treasuries.
def	Default risk premium, measured by the yield spread between BAA-rated and AAA-rated corporate bonds.
Additional controls	
exposure	Financial institution's exposure to Lehman, which equals 1 if an institution disclosed its exposure to Lehman in the weeks following Lehman's bankruptcy and 0 otherwise. Data comes from the Daily List of Companies Reporting Lehman Exposure, published by the Dow Jones News Service between Sept. 15, 2008 and Oct. 15, 2008.
individual	Fitch individual rating, which is a number between 1 and 9, with 1 indicating the highest issue quality.
issuer	Fitch long term issuer rating, which is a number between 1 and 21, with 1 indicating the highest issue quality.

Merton Measure of Default

We follow Campbell, Hilscher and Szilagyi (2008) and Hillegeist et al. (2004) in calculating Merton's distance to default. The market equity value of a company is modeled as a call option on the company's assets:

$$\begin{aligned} V_E &= V_A e^{-\delta T} N(d_1) - X e^{-rT} N(d_2) + (1 - e^{-\delta T}) V_A \\ d_1 &= \frac{\log(V_A / X) + (r - \delta - (\sigma_A^2 / 2))T}{\sigma_A \sqrt{T}} \\ d_2 &= d_1 - \sigma_A \sqrt{T} \end{aligned} \qquad \text{(A1)}$$

Above V_E is the market value of a financial institution. V_A is the value of a financial institution's assets. *X* is the face value of debt maturing at time *T*. *r* is the risk-free rate and δ is the dividend rate expressed in terms of V_A. σ_A is the volatility of the value of assets, which is related to equity volatility through the following equation:

$$\sigma_E = \left(V_A e^{-\delta T} N(d_1) \sigma_A\right) / V_E \qquad \text{(A2)}$$

We simultaneously solve the above two equations to find the values of V_A and σ_A.

We use the market value of equity for V_E and short-term plus one half long-term liabilities to proxy for the face value of debt *X*. We have found similar results using short term debt plus currently due portion of long term liabilities plus demand deposits as the default barrier. Since the accounting information is on an annual basis, we linearly interpolate the values for all dates over the period, using end of year values for accounting items. The interpolation method has the advantage of producing a smooth implied asset value process and avoids jumps in the implied default probabilities at year end. σ_E is the standard deviation of weekly equity returns over the past 12 months. In calculating standard deviation, we require the company to have at least 36 non-zero and non-missing returns over the previous 12 months. *T* equals one year, and *r* is the one-year treasury bill rate, which we take to be the risk free rate. The dividend rate, *d*, is the sum of the prior year's common and preferred dividends divided by the market value of assets. We use the Newton method to simultaneously solve the two equations above. For starting values for the unknown variables we use, $V_A = V_E + X$, and $\sigma_A = \sigma_E V_E (V_E + X)$. Once we determine asset values, V_A, we then compute asset returns as in Hillegeist et al. (2004): $\mu_t = \max\left(V_{A,t} / V_{A,t-1} - 1, r\right)$ As expected returns cannot be negative, asset returns below zero are set to the risk-free rate.[1] Merton's distance to default is finally computed as:

[1] We obtain similar results if we use a 6% equity premium instead of asset returns as in Campbell, Hilscher and Szilagyi (2008).

$$MertonDD = -\frac{\log\left(V_A / X\right) + \left(m - \P - \left(s_A^2 / 2\right)\right)T}{s_A \sqrt{T}} \quad \text{(A3)}$$

The default probability is the normal transform of the distance-to-default measure, defined as: $PD = N(MertonDD)$.

CoVar Measure of Systemic Fragility

Following Adrian and Brunnermeier (2011), we compute a conditional value-at-risk measure (CoVar) for each of the financial institutions in our sample using quantile regression. Quantile regression estimates the functional relationship among variables at different quantiles (Koenker and Hallock 2001) and allows for a more accurate estimation of credit risk co-dependence during stress periods by taking into account nonlinear relationships when there is a large negative shock. As in Adrian and Brunnermeier (2011), we estimate a time series CoVar measure using a number of state variables. We run the following quantile regressions over the sample period:

$$\Delta BankDD_{i,t} = \propto_i + \gamma_i M_{t-1} + \varepsilon_{i,t}$$
$$\Delta SystemDD_t = \propto_{system|i} + \beta_{system|i} \Delta BankDD_{i,t} + \gamma_{system|i} M_{t-1} + \varepsilon_{system|i,t} \quad \text{(A4)}$$

where $\Delta BankDD_{i,t}$ is the change in the Merton distance-to-default variable for bank *i* in week t and $\Delta SystemDD_t$ is similarly the change in the value-weighted Merton distance-to-default variable for all financial institutions in the sample. M_{t-1} are lagged state variables and include the change in the term spread (*term*), the change in the default spread (*def*), the CBOE implied volatility index (*vix*), the S&P 500 return (*spret*) and the change in the 3 month t-bill rate (*rate*). The CoVar variable is then computed as the change in the VaR of the system when the institution is at the q^{th} percentile (or when the institution is in distress) minus the VaR of the system when the institution is at the 50% percentile:

$$\Delta CovarSystem_t^q = \hat{\beta}_{system|i}^q \left(\Delta \widehat{BankDD}_{i,t}^q - \Delta \widehat{BankDD}_{i,t}^{50\%}\right) \quad \text{(A5)}$$

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Figure 1: Size and Spreads

This figure shows the relationship between the size of a financial institution and the credit spread on its bonds. Size (x-axis) is the relative size of a financial institution, computed as size (log of assets) in a year divided by the average size of all financial institutions in that year. Spread (y-axis) is the difference between the yield on a financial institution's bond and that on a corresponding maturity-matched treasury bond.

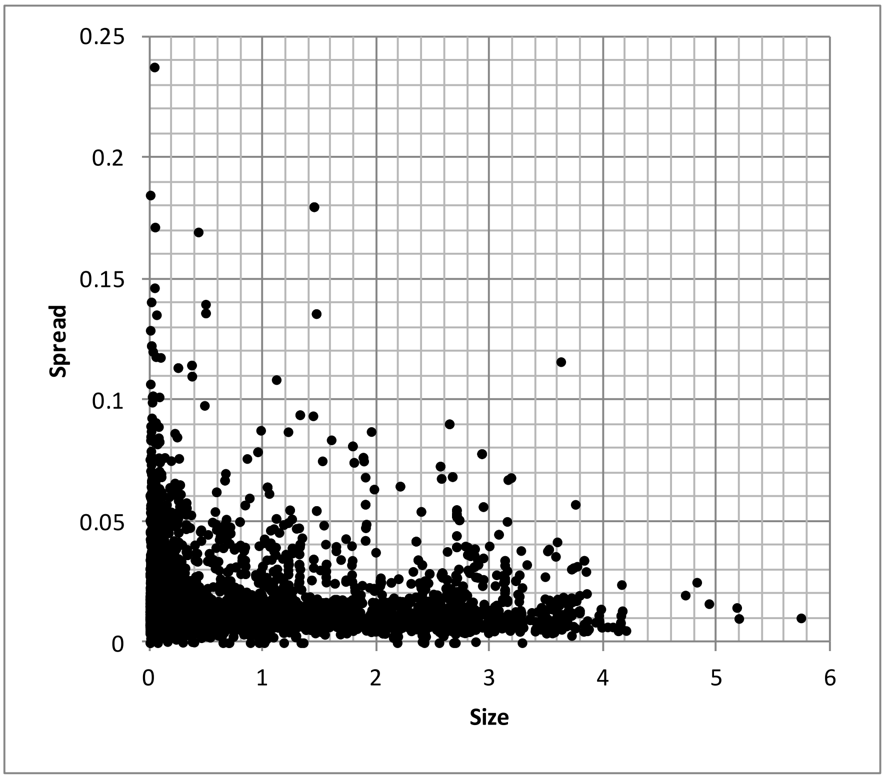

Figure 2: Size and Risk

This figure shows the relationship between the size of a financial institution and its risk. Size (x-axis) is the relative size of a financial institution, computed as its size (log of assets) in a year divided by the average size of all financial institutions in that year. Risk (y-axis) is distance to default of a financial institution, computed as defined in the Appendix.

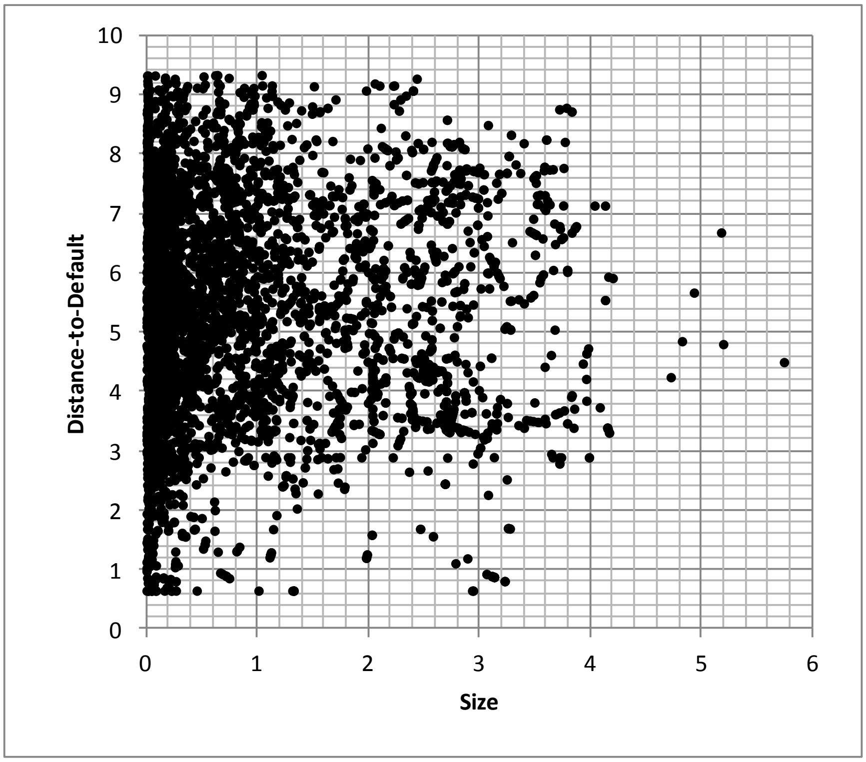

Figure 3: Value of the Implicit Subsidy (1990-2010)

This figure plots the annual subsidy to large financial institutions due to the implicit state guarantee. To compute the annual subsidy, we run the following regression each year: $Spread_{i,b,t} = \propto + \beta^1 \times issuesize_{i,b,t} + \beta^2 \times ttm_{i,b,t} + \beta^3 leverage_{i,t} + \beta^4 roa_{i,t} + \beta^5 mb_{i,t} + \beta^6 mismatch_{i,t} + \beta^7 mertondd_{i,t} + \beta^8 def_t + \beta^9 term_t + \beta^{10} mkt_t + \beta^{11} size90_{i,t} + \varepsilon_{i,b,t}$. Variables are defined in the Appendix. The coefficient on *size90* (right axis) represents the subsidy accruing to large financial institutions as a result of implicit government insurance. We also quantify the dollar value of the annual subsidy. We multiply the annual reduction in funding costs by total uninsured liabilities (in US$ millions) to arrive at the yearly dollar value of the subsidy (left axis).

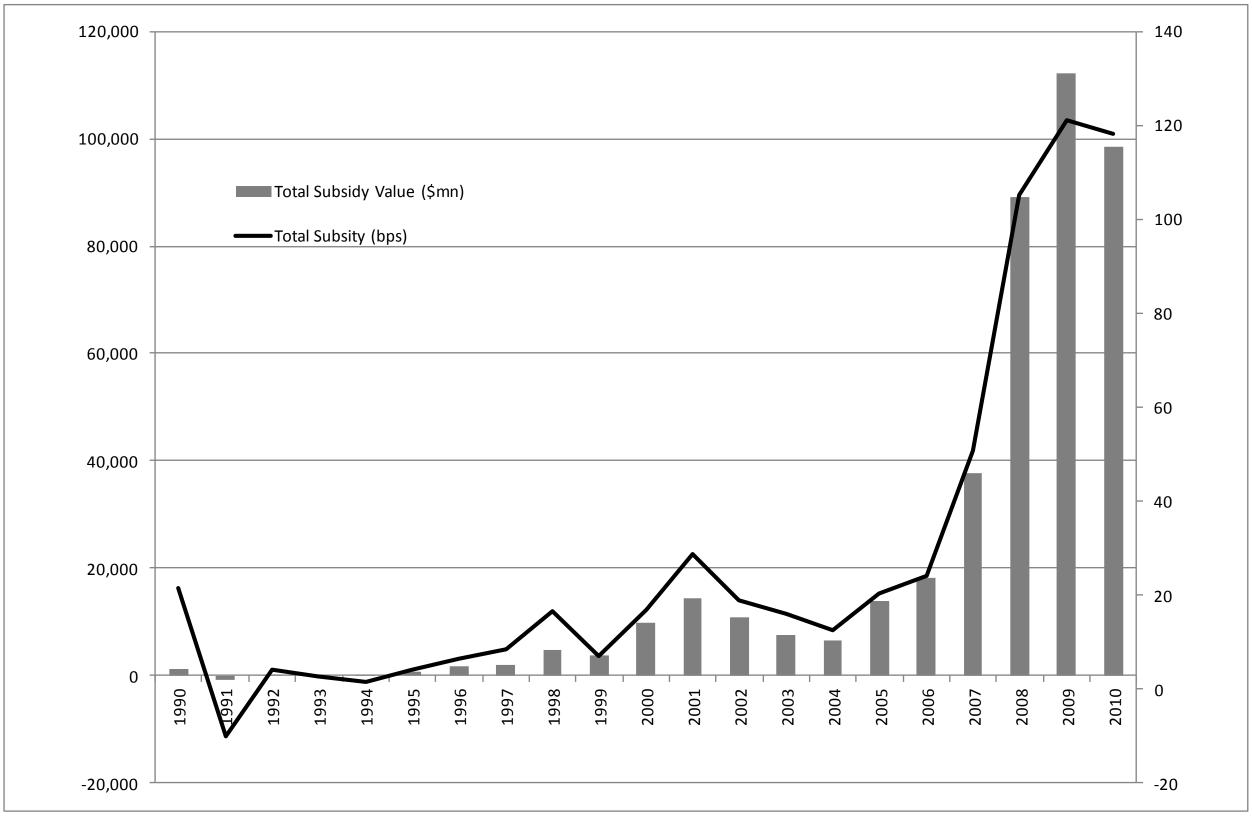

Table 1: Summary Statistics

Panel A presents the number of firms and the number of observations included in the sample, by type of institution and by time period. Panel B presents the summary statistics for the variables used in this study. Panel C presents the correlation matrix of variables. Variables are defined in the Appendix. * indicates significance at the 1% level.

Panel A	# of Firms	# of Obs
Depository Institutions	228	34,719
Nondepository Credit Institutions	80	22,819
Brokers, Dealers, Exchanges & Services	61	12,839
Insurance Carriers	125	10,315
Holding and Other Investment Offices	73	3,365
1990-1994	141	14,211
1995-1999	252	26,051
2000-2004	230	17,310
2005-2010	188	26,485

Panel B	N	Mean	Std Dev	P25	P50	P75
size	84,057	1.061	0.129	0.992	1.092	1.160
mertondd	84,057	5.513	2.043	4.095	5.725	7.189
zscore	75,538	37.120	39.547	14.669	24.080	47.615
spread	84,057	0.016	0.021	0.007	0.010	0.017
rating	84,057	6.032	2.541	5.000	6.000	7.000
leverage	84,057	0.342	0.223	0.179	0.280	0.521
roa	84,057	0.013	0.017	0.007	0.011	0.016
mb	84,057	2.038	1.504	1.298	1.767	2.419
mismatch	84,057	0.074	0.684	-0.006	0.070	0.204
idiovol	84,057	1.953	0.474	1.655	1.870	2.156
issue_size	84,057	12.294	1.237	11.918	12.324	13.122
ttm	84,057	6.217	5.525	2.664	4.631	7.819

Table 1: Summary Statistics (Cont'd)

Panel A presents the number of firms and the number of observations included in the sample, by type of institution and by time period. Panel B presents the summary statistics for the variables used in this study. Panel C presents the correlation matrix of variables. Variables are defined in the Appendix. * indicates significance at the 1% level.

Panel C:Correlations

Variables	size	mertondd	zscore	spread	rating	leverage	roa	mb	mismatch	idiovol	issue_size	ttm
size	1											
mertondd	-0.0090*	1										
zscore	-0.0138*	0.1107*	1									
spread	-0.1264*	-0.1691*	-0.0966*	1								
rating	-0.4309*	-0.0154*	-0.2514*	0.3122*	1							
leverage	0.1370*	-0.0946*	-0.2015*	0.0326*	-0.0843*	1						
roa	-0.3195*	0.1718*	0.0847*	-0.1262*	-0.0328*	-0.0065	1					
mb	-0.0693*	-0.0031	0.0273*	-0.0815*	-0.1546*	0.1142*	0.2674*	1				
mismatch	0.1806*	-0.006	0.0185*	-0.0142*	-0.0489*	0.2352*	0.0837*	-0.0441*	1			
idiovol	-0.1095*	-0.8362*	-0.1572*	0.2238*	0.1597*	0.0745*	-0.3042*	-0.1526*	-0.0986*	1		
issue_size	0.2138*	-0.1877*	0.0485*	0.0915*	-0.1018*	0.1689*	-0.0278*	0.0615*	0.0408*	0.0727*	1	
ttm	-0.0989*	0.0983*	0.0625*	0.0583*	0.2046*	-0.1404*	0.0181*	-0.0449*	-0.0223*	-0.0673*	-0.0059	1

Table 2: TBTF-Spread Regressions

Regression results for the model, $Spread_{i,b,t} = \propto + \beta^1 TBTF_{i,t} + \beta^2 Risk_{i,t} + \beta^3 Bond\ Controls_{i,b,t} + \beta^4 Firm\ Controls_{i,t} + \beta^5 Macro\ Controls_t + Firm\ FE + Year\ FE + \varepsilon_{i,b,t}$, are reported in this table. We measure the systemic importance (*TBTF*) of an institution using a number of different proxies. s*ize* is the relative size of a financial institution, computed as its size (log of assets) in a year divided by the average size of all financial institutions in that year. s*ize90* is a dummy variable equal to one if a given financial institution's size is in the top 90th percentile. s*ize60* is a dummy variable equal to one if a given financial institution's size is between the 60th and 90th percentiles. s*ize30* is a dummy variable equal to one if a given financial institution's size is between the 30th and 60th percentiles. *size_top_10* is a dummy variable equal to one if a given financial institution is ranked in the top ten in terms of size in a given year. *covar* is a systemic risk measure. Variables are defined in the Appendix. Standard errors are reported in parentheses below their coefficient estimates and are adjusted for both heteroskedasticity and within correlation clustered at the issuer level. ***, ** and * indicate significance at the 1%, 5% and 10% two-tailed level, respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	spread	spread	spread	spread	spread
issuesize	-0.136***	-0.141***	-0.135***	-0.133***	-0.127*
	(0.035)	(0.051)	(0.050)	(0.050)	(0.071)
ttm	-0.002	-0.003	-0.002	-0.001	0.005
	(0.003)	(0.006)	(0.005)	(0.005)	(0.006)
rating	0.213***	0.222***	0.212***	0.206***	0.219***
	(0.022)	(0.058)	(0.052)	(0.050)	(0.043)
leverage	-0.020	-0.187	0.068	0.045	0.422*
	(0.200)	(0.587)	(0.464)	(0.457)	(0.215)
roa	-14.655***	-17.737***	-14.727***	-14.868***	-17.395***
	(1.872)	(5.094)	(4.079)	(4.041)	(6.699)
mb	-0.046*	-0.039	-0.044	-0.044	-0.037
	(0.027)	(0.053)	(0.053)	(0.052)	(0.035)
mismatch	0.052***	0.043**	0.036*	0.035**	0.024
	(0.015)	(0.019)	(0.019)	(0.018)	(0.026)
def	1.984***	2.010***	1.985***	1.984***	1.986***
	(0.078)	(0.180)	(0.177)	(0.175)	(0.206)
term	0.128***	0.130***	0.128***	0.128***	0.119***
	(0.016)	(0.031)	(0.029)	(0.028)	(0.035)
mkt	-0.289	-0.147	-0.278	-0.253	-0.152
	(0.176)	(0.284)	(0.297)	(0.289)	(0.344)
mertondd	-0.075***	-0.084***	-0.080***	-0.074***	-0.063***
	(0.011)	(0.029)	(0.026)	(0.024)	(0.024)
size	-0.988*				
	(0.516)				
size90		-0.156**	-0.223**		
		(0.073)	(0.110)		
size60			-0.088		
			(0.153)		
size30			-0.053		
			(0.133)		
size top 10				-0.174**	
				(0.085)	
covar					5.348***
					(1.870)
Constant	0.335	0.335	-0.620	-0.347	0.850
	(0.582)	(0.644)	(0.658)	(0.638)	(0.527)

Year fixed effect	Y	Y	Y	Y	Y
Issuer fixed effect	Y	N	Y	N	N
Observations	84,057	84,057	84,057	84,057	75,538
R-squared	0.549	0.549	0.549	0.547	0.482

Table 3: TBTF and Risk Interactions

Regression results for the model, $Spread_{i,b,t} = \propto + \beta^1 TBTF_{i,t} + \beta^2 Risk_{i,t} + \beta^3 TBTF_{i,t} \times Risk_{i,t} + \beta^4 Bond\ Controls_{i,b,t} + \beta^5 Firm\ Controls_{i,t} + \beta^6 Macro\ Controls_t + Firm\ FE + Year\ FE + \varepsilon_{i,b,t}$, where risk of a financial institution is measured by distance-to-default (in column 1), z-score (in column 2), or idiosyncratic volatility (in column 3). Variables are defined in the Appendix. Standard errors are reported in parentheses below their coefficient estimates and are adjusted for both heteroskedasticity and within correlation clustered at the issuer level. ***, ** and * indicate significance at the 1%, 5% and 10% two-tailed level, respectively.

VARIABLES	(1) spread	(2) spread	(3) spread
issuesize	-0.138***	-0.135***	-0.138***
	(0.051)	(0.050)	(0.050)
ttm	-0.002	-0.003	-0.001
	(0.006)	(0.005)	(0.005)
rating	0.218***	0.205***	0.204***
	(0.055)	(0.049)	(0.050)
leverage	0.007	-0.137	0.053
	(0.528)	(0.556)	(0.508)
roa	-15.297***	-15.783***	-12.614***
	(4.382)	(4.250)	(3.439)
mb	-0.042	-0.039	-0.026
	(0.053)	(0.056)	(0.048)
mismatch	0.035*	0.119	0.061***
	(0.019)	(0.089)	(0.020)
def	1.987***	1.911***	2.076***
	(0.179)	(0.187)	(0.199)
term	0.125***	0.171***	0.099***
	(0.029)	(0.026)	(0.027)
mkt	-0.292	-0.285	-0.352
	(0.298)	(0.303)	(0.312)
size90	-0.465***	-0.372***	0.466
	(0.155)	(0.113)	(0.315)
mertondd	-0.089***		
	(0.028)		
size90*mertondd	0.058**		
	(0.028)		
zscore		-0.003**	
		(0.001)	
size90*zscore		0.007***	
		(0.002)	
idiovol			0.688***
			(0.185)
size90*idiovol			-0.324**
			(0.155)
Constant	0.295	-0.886*	-1.685**
	(0.628)	(0.523)	(0.763)
Year fixed effect	Y	Y	Y
Issuer fixed effect	Y	Y	Y
Observations	84,057	78,700	84,057
R-squared	0.549	0.550	0.554

Table 4: TBTF-Risk Relationship

Regression results for the model, $Risk_{i,t} = \propto + \beta^1 TBTF_{i,t} + \beta^2 Firm\ Controls_{i,t} + \ Firm\ FE + Year\ FE + \varepsilon_{i,t}$, where risk of a financial institution is measured by its distance to default or z-score. Variables are defined in the Appendix. Standard errors are reported in parentheses below their coefficient estimates and are adjusted for both heteroskedasticity and within correlation clustered at the issuer level. ***, ** and * indicate significance at the 1%, 5% and 10% two-tailed level, respectively.

	(1)	(2)	(3)	(4)
VARIABLES	mertondd	mertondd	zscore	zscore
leverage	0.437	0.437	-8.414	-7.918
	(0.425)	(0.426)	(12.280)	(12.214)
roa	15.372***	15.345***	213.148***	213.255***
	(1.907)	(1.905)	(49.983)	(49.792)
mb	-0.044**	-0.044**	2.318**	2.310**
	(0.022)	(0.022)	(1.039)	(1.037)
mismatch	-0.086***	-0.086***	5.336***	4.944***
	(0.026)	(0.026)	(1.299)	(1.330)
size	0.155		2.264	
	(0.109)		(2.314)	
size90		-0.105*		1.599
		(0.055)		(1.623)
Constant	5.870***	5.874***	13.922***	12.199**
	(0.182)	(0.182)	(5.223)	(5.280)
Year fixed effect	Y	Y	Y	Y
Issuer fixed effect	Y	Y	Y	Y
Observations	7,615	7,615	6,977	6,977
R-squared	0.725	0.724	0.549	0.549

Table 5: Ratings as an Exogenous Measure

Regression results for the model $Spread_{i,b,t} = \propto + \beta^1 Rating_{i,t} + \beta^2 TBTF_{i,t} + \beta^3 Bond\ Controls_{i,b,t} + \beta^4 Firm\ Controls_{i,t} + \beta^5 Macro\ Controls_t + Firm\ FE + Year\ FE + \varepsilon_{i,b,t}$. *Rating* is the individual standalone rating in columns 1 and 2, and the issuer rating in columns 3 and 4. Variables are defined in the Appendix. Standard errors are reported in parentheses below their coefficient estimates and are adjusted for both heteroskedasticity and within correlation clustered at the issuer level. ***, ** and * indicate significance at 1%, 5% and 10% two-tailed level, respectively.

	(1)	(2)	(3)	(4)
VARIABLES	spread	spread	spread	spread
issuesize	-0.110	-0.111	-0.115	-0.115
	(0.074)	(0.074)	(0.075)	(0.074)
ttm	0.012***	0.010***	0.012***	0.012***
	(0.003)	(0.004)	(0.003)	(0.004)
leverage	0.686	1.201*	0.634	1.002*
	(0.594)	(0.643)	(0.542)	(0.503)
roa	-57.593***	-58.096***	-46.356***	-46.771***
	(14.714)	(15.098)	(8.474)	(8.570)
mb	-0.037	-0.016	-0.006	0.003
	(0.077)	(0.080)	(0.061)	(0.060)
mismatch	1.104*	0.868*	1.003*	0.891
	(0.559)	(0.460)	(0.593)	(0.534)
def	1.383***	1.385***	1.385***	1.387***
	(0.157)	(0.160)	(0.150)	(0.151)
term	0.077*	0.081*	0.078**	0.079**
	(0.042)	(0.044)	(0.038)	(0.039)
mkt	0.186	0.162	0.231	0.230
	(0.166)	(0.165)	(0.165)	(0.163)
individual	0.088	0.113		
	(0.070)	(0.069)		
issuer			0.259**	0.274***
			(0.103)	(0.099)
size	-5.172**		-2.669	
	(2.250)		(2.005)	
size90		-0.449**		-0.271
		(0.210)		(0.196)
Constant	6.200**	0.545	2.057	-0.906
	(2.817)	(0.691)	(2.558)	(0.685)
Year fixed effect	Y	Y	Y	Y
Issuer fixed effect	Y	Y	Y	Y
Observations	15,245	15,245	15,233	15,233
R-squared	0.676	0.675	0.682	0.682

Table 6: Event Study

Regression results for the model, $Spread_{i,b,t} = \propto + \beta^1 post + \beta^2 TBTF_{i,t} \times post + \beta^3 Risk_{i,t} \times post + \beta^4 Bond\ Controls_{i,b,t} \times post + \beta^5 Firm\ Controls_{i,t} \times post + \beta^6 Macro\ Controls_t + Issue\ FE + \varepsilon_{i,b,t}$. The event date is March 17, 2008 (Bear Stearns), September 15, 2008 (Lehman), or June 29, 2010 (Dodd-Frank). The variable *post* equals 1 if the transaction date is the event date or one of the 5 trading days following the event date, and 0 if the transaction date is one of the 5 trading days prior to the event date. Other variables are defined in the Appendix. Standard errors are reported in parentheses below their coefficient estimates and are adjusted for both heteroskedasticity and within correlation clustered at the issuer level. ***, ** and * indicate significance at 1%, 5% and 10% two-tailed level, respectively.

	Bear Stearns (post=1 if date>=3/17/2008)		Lehman (post=1 if date>=9/15/2008)		Dodd-Frank (post=1 if date>=6/29/2010)	
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	spread	spread	spread	spread	spread	spread
def	-8.341	10.526	6.018**	5.956**	-3.971	-5.088
	(12.297)	(29.073)	(2.384)	(2.417)	(5.062)	(5.055)
term	6.203***	9.842**	2.231***	2.244***	-3.660**	-3.474**
	(1.786)	(4.432)	(0.462)	(0.464)	(1.718)	(1.713)
mkt	-1.819***	-1.220	3.066*	2.836	-0.641	-0.513
	(0.674)	(1.809)	(1.785)	(1.796)	(0.586)	(0.593)
issuesize*post	0.128*	-0.023	0.269	0.226	-0.048	-0.040
	(0.076)	(0.165)	(0.266)	(0.281)	(0.033)	(0.032)
ttm*post	-0.034***	-0.055	-0.078***	-0.094***	0.001	0.001
	(0.012)	(0.036)	(0.023)	(0.024)	(0.002)	(0.002)
rating*post	0.039	-0.040	0.129**	0.102*	0.016**	0.014**
	(0.031)	(0.123)	(0.051)	(0.054)	(0.008)	(0.006)
leverage*post	1.530***	1.013	-1.431	-0.750	0.009	0.009
	(0.457)	(0.839)	(3.525)	(3.196)	(0.094)	(0.094)
mb*post	0.051	0.241*	0.027	-0.121	-0.001	-0.005
	(0.086)	(0.126)	(0.828)	(0.668)	(0.012)	(0.009)
mismatch*post	-0.875	-0.737	-9.272	-5.323	0.202	0.224
	(0.605)	(1.548)	(7.277)	(5.855)	(0.165)	(0.155)
roa*post	-18.093***	-50.609**	40.980	-18.377	-0.384	-0.366
	(6.481)	(21.643)	(32.829)	(43.856)	(0.615)	(0.585)
mertondd*post	-0.176**	-0.135	-1.416**	-0.422	-0.008	-0.025
	(0.073)	(0.192)	(0.549)	(0.289)	(0.026)	(0.025)
exposure*post			-2.760	-2.005		
			(1.902)	(1.684)		
post	2.844**	3.234	-12.180	0.896	0.060	0.165
	(1.126)	(2.857)	(7.570)	(2.147)	(0.390)	(0.253)
size*post	-0.193***		1.585**		0.007	
	(0.069)		(0.793)		(0.021)	
size90*post		-1.683*		2.561**		-0.071**
		(0.997)		(1.209)		(0.030)
Constant	3.307*	-0.107	-10.271**	-10.177**	4.437***	4.536***
	(2.001)	(4.746)	(4.233)	(4.247)	(0.811)	(0.817)
Issue fixed effect	Y	Y	Y	Y	Y	Y
Observations	2,964	2,964	2,975	2,975	2,920	2,920
R-squared	0.919	0.867	0.853	0.845	0.880	0.880