

# Financial Intermediaries, Corporate Debt Financing, and The Transmission of Systemic Risk <sup>1</sup>

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# Financial Intermediaries, Corporate Debt Financing, and The Transmission of Systemic Risk

## ABSTRACT

We revisit the spillover effects to non-financial, corporate borrowers from a systemic event in which a number of large, important banks simultaneously become imperiled. To shed light on this question, we build a novel, comprehensive dataset, covering both firms' borrowing activities through bank loans, revolvers, corporate bonds, and commercial paper and the particular institutions to which they are connected. We demonstrate that while there are over one thousand financial institutions active in facilitating the borrowing activity of non-financial firms before the financial crisis, roughly 80% is facilitated by a group of large, central institutions. As many of these central institutions approach the edge of failure during the crisis, we uncover significant cross-sectional variability in the degree to which non-financial firms are affected, depending upon whether and how these firms rely on external debt financing. First, the one-third of firms that (largely) do not rely on external debt financing exhibit limited exposure to the systemic event. Second, for the remaining firms that do rely on external debt financing, the cross-sectional variation in their crisis exposure is mainly driven by *measurable* pre-crisis connections to the central financial institutions. Further, crisis exposures do not appear to be significantly lower for those firms that exhibit multiple bank connections or have access to the public debt market. The often-hypothesized means of diversifying funding risks appear to be limited in an episode where the central institutions are collectively impaired.

# 1 Introduction

There is a long-standing body of research geared towards advancing our understanding of how banking crises originate and are amplified. One particular focus is on the degree to which financial intermediary distress, given the dual roles banks serve in both liquidity creation and risk transformation (Bhattacharya and Thakor (1993)), spills over to the real economy. Bank distress (or outright failure) due to, amongst other things, difficulties in funding its operations in the face of a run and/or impaired assets on its balance sheet can limit or halt its ability to facilitate debt financing. In such a scenario, distress is then transmitted to the broader economy through the particular non-financial firms that it serves. When a bank slashes its lending, the *specific* borrowers connected to that bank for external financing will be negatively affected. This direct, contractual transmission mechanism is known as the “lending channel” (Kashyap and Stein (1995, 2000), Holmstrom and Tirole (1997), Stein (1998)). However, some borrowers may be able to effectively “undo” a negative shock of this type if they are able to raise financing from alternative (presumably larger, healthier, and more resilient) banks and/or from the public debt (corporate bond) market.<sup>4</sup>

A critical assumption underlying the idea that connections to alternative banks (or markets) can help borrowers mitigate funding risk hinges on the health of those banks (or markets) themselves and, at the highest level, the health of the system at large. A systemic event in which a number of large banks, those who play the central role in the facilitation of firms’ debt financing, simultaneously become imperiled could be far more challenging as firms may not be able to pivot to alternative funding sources. For example, Diamond and Rajan (2005) develop a model in which a bank run, triggered by a set of banks’ non-performing assets, exacerbates aggregate funding shortages across the financial system, leading to a systemic meltdown. In such a situation, large banks may themselves struggle to finance their operations and hence be distressed (or even outright fail). In this paper, we examine the possible spillover effects to non-financial firms in a setting where the largest and most important financial institutions simultaneously struggle to play their traditional role.

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<sup>4</sup> Please refer to, among others, Kashyap, Stein, and Wilcox (1993), Slovin, Sushka, and Polonchek (1993), Gertler and Gilchrist (1994), Kashyap, Lamont, and Stein (1994), Gibson (1995), Peek and Rosengren (1997, 2000), Kang and Stulz (2000), Bae, Kang, and Lim (2002), Campello (2002), Ashcraft (2005), Faulkender and Petersen (2006), Khwaja and Main (2008), Paravisini (2008), Leary (2009), Chava and Purnanandam (2011), Iyer and Peydro (2011), Puri, Rocholl and Steffen (2011), Schnabl (2012), and Garcia-Appendini and Montoriol-Garriga (2013).

The spillover effects for the non-financial firms documented in this study exhibit unique characteristics in comparison to what is generally expected under the traditional lending channel. We measure the degree to which each non-financial firm’s sensitivity to economy-wide market risk is elevated during the financial crisis. We are particularly interested in whether the cross-sectional variation in crisis risk exposures are explained by measurable connections to various financial institutions that play central roles in facilitating private and public debt financing. Accordingly, we build a novel dataset on non-financial firms’ debt financing, which includes multiple financing vehicles, the role of lead financial institutions, and firms’ measured links to various financial institutions.

First, as the nature of debt financing is heterogeneous (Rauh and Sufi (2010)), we consider other important vehicles through which firms finance themselves beyond just the traditional focus on bank loans and lines of credit. We collect firm-level borrowing amounts through detailed records on four important vehicles: loans, revolvers, corporate bonds, and commercial paper. These four, together, account for over 90% of debt financing for non-financial firms in Compustat (Colla, Ippolito, and Li (2013)). At a consolidated level, our data permit a more comprehensive estimate of the size of economy-wide borrowing, and we can identify the institutions that play a central role in debt financing across multiple markets.

Second, while we measure debt financing activity facilitated by and connected to all financial institutions, the primary focus in this study is on the central financial institutions that play the largest part in firms’ debt financing. Rather than concentrate on raw asset size (as is not uncommon in regulatory conversations), we instead focus on the institutions that play the largest role in debt intermediation, as we contend that their correlated distress, which we take as given the financial crisis, is a defining feature of a systemic crisis.<sup>5,6</sup> We find that 97 (out of nearly 2,000) banks dominate the market, accounting for over 80% of the financing activity channeled through these four markets. Further, they are themselves very large, with total assets accounting for 75% of the total

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<sup>5</sup> In measuring systemic risk, Acharya, Pedersen, Philippon, and Richardson (2016) focus on financial institutions with market equity in excess of \$5 billion. While there is a significant degree of overlap between the largest financial institutions that they define as systemically important and those that play a central role in the debt financing, these are not the same set of firms. The correlation between the size and debt facilitation is 0.61. For example, AIG is large in size, but is identified in our data as a peripheral institution from the perspective of debt facilitation. We therefore hypothesize that the real economy spillover effects of its distress are less important.

<sup>6</sup> While we take the correlated distress among central institutions during the crisis as given, we do not directly measure or model why the financial system is collectively impaired. As pointed out in Hansen (2013), systemic risk could reflect a range of characteristics, spanning old or modern versions of bank-runs, network effects associated with the failure of a particularly large bank, and correlated impaired assets on the asset side of the balance sheet given ex ante herding behavior.

assets across the financial industry. These financial institutions are central to both liquidity creation and risk transformation across the entire economy. Any correlated distress experienced by these large, central institutions may engender a vacuum in the market for firm-level debt financing that is very difficult to replace through the traditionally hypothesized diversification channels related to connections to alternative banks or public markets. Correspondingly, we show in Figure I that the equal-weighted average cumulative return across these 97 banks (or even a smaller group of the largest 20) fall by roughly 80% (81%) during the crisis period<sup>7</sup>.

Third, in order to examine whether and how systemic risk may affect the broad economy, we measure the exposure of more than 3,500 non-financial firms to the crisis by a market beta, given that the overall market is declining sharply during this period due to clear systemic risk concerns. Further, we separate those firms with a pre-crisis history of external debt financing from those that do not have such a history. Empirically, we attempt to match each non-financial firm to borrowing records associated with any of the four debt vehicles identified above. Among these, roughly 2,300 firms are linked to at least one borrowing record over the pre-crisis period across our various data sources. Of the firms that are connected to the financial system, we further focus on their distinct connections to the large institutions at the center of the various private and/or public debt markets, as multiple connections to (large) banks (and/or the public debt market) are presumed to help mitigate funding risk. Last, we examine the remaining roughly 1,200 firms that do not raise debt financing prior to the crisis (and exhibit median leverage ratios close to zero). Given that these firms do not appear to be directly connected to the financial system via an obvious debt financing channel, we examine whether they exhibit limited exposure to a crisis characterized by the correlated distress of several large, central financial institutions.

Using these novel data, we uncover several important results. We find that the non-financial firms actively engaged in debt financing are associated with elevated crisis risk exposures during the financial crisis (relative to their pre-crisis market betas). On the contrary, we find that the remaining one-third of firms, those that do not engage in debt financing, are associated with *reduced* crisis risk exposures. Among the firms actively engaged in borrowing, the risk exposure increases are larger for individual firms with private lending activity connected to the large, central institutions. In a systemic crisis characterized by the inability of the central institutions to finance their own activities, the

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<sup>7</sup> The equal weighted stock price is indexed to 100 on January 3, 2007. By the first week of March 2009, the index is 20 for the central 97 banks and 19 for largest 20 banks.

presumed benefit of a connection to a large bank is absent. Further, we do not observe any of the presumed diversification benefits associated with multiple connections to the central institutions, nor does a measured connection to the public debt (corporate bond) market appear to help borrowers diversify their crisis risk exposures. We also find that several measures of the intensity of these bank relationships, used elsewhere in the literature, show that relationship intensity does not appear to be helpful in reducing crisis risk exposures during this episode. Given the focus on formal banking relationships (indeed, firms' bank-dependence) in the lending channel narrative, this cross-sectional variation in crisis risk exposures is hard to explain.

Of course, several econometric issues arise. First, we also find that large and more levered firms exhibit larger increases in market risk exposures during the financial crisis, suggesting that the results that we find on multiple connections or access to the public debt market could instead be driven by certain firm characteristics unrelated to measured connections to debt financing. We address this concern by conducting additional tests separating firms with and without measured debt financing, matched along important firm characteristics (including the pre-crisis market beta itself). Controlling for these characteristics, we continue to observe that firms that raise private or public debt in the pre-crisis period from or through the central financial institutions exhibit significantly larger in-crisis risk exposures than the matched control firms. On the other hand, in-crisis risk exposures for firms with established debt financing connections to smaller, peripheral financial institutions do not exhibit the same sizeable increases. Taken together, we continue to observe that elevated crisis risk sensitivities are mainly driven by connections to the central institutions. In sharp contrast to the usual arguments about the vulnerabilities associated with bank-dependence, these results corroborate the notion that it is the correlated inability of the largest institutions to function that severely limit non-financial firms' funding options.

As an additional consideration, we acknowledge that nearly all of the central financial institutions possess significant quantities of impaired mortgage assets on their balance sheets. Among the central institutions, we consider two subsets of banks, one that captures those that play the very largest roles in debt intermediation and another that captures those that possess significant degrees of impaired mortgage-related assets. We then focus on the non-financial firms that have one measured connection to the subset of central institutions that have a large mortgage exposure. Holding this first bank connection constant (so that all the non-financial firms under consideration have a direct connection to mortgage-related distress), we document that the increase in crisis risk is

yet larger if there is a second connection to the most important financial institutions in debt financing. This result further highlights an important aspect of the very different results we obtain during the crisis in contrast to what one might expect from the traditional lending channel literature. It seems the distress of the most important banks (not just the most exposed banks) that help firms finance their operations and investments is an important channel through which systemic risk is transmitted to the real economy.

Finally, we also demonstrate that the transmission effects that we document extend to both non-financial firms' equity returns and their real corporate performance. Those firms with an elevated market (crisis) beta also exhibit significantly larger (negative) returns; this is particularly true for borrowers with measured connections to the central institutions in comparison to those that either are connected only to smaller, peripheral institutions or those not engaged in pre-crisis debt financing at all. Second, firms with debt financing connections to the central institutions also exhibit poorer corporate performance, as measured by sales, capital investment, operating income, and return on assets, in 2009 than otherwise.

There are several contributions of this study. First, we build a novel, detailed dataset on the network of institutions that help firms raise debt financing across multiple markets. By focusing on the specific connections, we evaluate the extent to which firm-level crisis risk is correlated with measured connections to the large, central institutions that suffer correlated distress during the financial crisis. The cross-sectional variation in crisis risk is strongly linked to each firm's history of debt financing going into the crisis, with a particular attention to the banks to which each firm is connected. Finally, we also highlight the limited efficacy of traditional funding diversification mechanisms. When the large institutions that play a central role in the facilitation of debt financing suffer correlated constraints, the spillover effects (and potential avenues for risk mitigation) to their non-financial customers differ significantly from those implied by the lending channel literature.

The remainder of the paper proceeds as follows. Section two provides two key testable hypotheses. Section three describes the construction of our novel dataset measuring the role each financial institution plays in market-wide debt financing and the particular connections each non-financial firm and financial institutions share. Section four presents our results, and section five concludes.

## 2 Hypotheses and empirical design

We aim to understand how a systemic crisis, characterized by the correlated distress of several large banks that play a central role in the facilitation of debt financing, affects the cross-sectional of non-financial firms that collectively drive the real economy. We employ our novel data (discussed in detail in the next section) to test several hypotheses. First, we examine the degree to which crisis risk, which we measure as a market beta during the financial crisis in which equity values are collectively collapsing largely due to systemic concerns, differ across non-financial firms depending upon the importance of debt financing. Our first hypothesis focuses on the degree to which crisis exposures depend upon measured pre-crisis debt financing activity.

*Hypothesis #1: Regardless of whether a non-financial firm possess a history of debt raising before the crisis or not, its exposure is equivalent to that of any other firm, holding everything else constant, to a systemic crisis characterized by the correlated distress of a significant number of the banks that play a central role in the facilitation of debt across the economy.*

Firms that are not actively engaged in debt financing, for obvious reasons, receive little attention in the traditional lending channel literature. We test this in the cross-section by evaluating whether measured crisis risk exposures are elevated for the roughly two-thirds of non-financial firms that appear to rely on debt financing in comparison with those that do not. Is it instead the case that a period during which aggregate debt intermediation is constrained should be differentially less impactful for firms less reliant to debt financing?

Next, we focus on the non-financial firms that are actively engaged in debt financing prior to the financial crisis. We exploit our detailed data set on measured connections between each firm and the financial institutions that either directly lent to the firm or facilitated a bond issue. Conditional on actively raising debt, our second hypothesis focuses on the degree to which crisis exposures depend upon measured connections to the large, central institutions.

*Hypothesis #2: Non-financial firms that do actively engage in debt financing are less exposed to a systemic crisis if the measured connection is to any of the large financial institutions that play a central role in the facilitation of debt.*

Specifically, we test this in the cross-section by evaluating whether measured crisis risk exposures are elevated for firms with connections to the central financial institutions that we identify in our data construction as the most important players in debt intermediation. In normal times, where one might hypothesize that a connection to a large, and presumably healthier and more resilient, bank would help to mitigate funding risk for its customers. We examine the extent to which this holds during a period in which aggregate debt intermediation is constrained and hence a connection to the most important institutions may not play the same role.

We then turn to two other methods by which firms may be able to diversify funding risk: (1) access to the public debt (corporate bond) market and (2) through multiple connections to financial institutions. Again, focusing on the non-financial firms that are actively engaged in debt financing prior to the financial crisis, we first examine whether access to public debt helps to mitigate crisis risk.

*Hypothesis #3: Non-financial firms that do actively engage in debt financing are less exposed to a systemic crisis if they possess the ability to raise financing via the public debt (corporate bond) market.*

The institutions that nearly monopolize the corporate debt issuance market overlap strongly with the firms that play the largest roles in the private lending market. Hence, given the correlated distress of the most important institutions during a systemic crisis, one may wonder whether this presumed risk mitigant is as effective in such a state as would perhaps be imagined during normal times.

Finally, focusing on the non-financial firms that are actively engaged in debt financing prior to the financial crisis, we examine whether multiple measured connections to financial institutions help to mitigate crisis risk.

*Hypothesis #4: Non-financial firms that do actively engage in debt financing are less exposed to the systemic crisis if the firm also has multiple banking connections from which it can diversify funding risk.*

The existence of multiple connections may mean, in normal times, that a firm can pivot to another institution if one connection faces distress. However, the efficacy of this risk mitigant presumes that the other institutions are themselves healthy enough to fill

the vacuum left by the absence of the first. Given the correlated distress of the most important institutions during a systemic crisis, one may also wonder whether this presumed risk mitigant is as effective in such a state as would perhaps be imagined during normal times.

We now turn to our data construction to explain how we identify the central institutions, the connections between non-financial firms and the banks that help to facilitate their debt financing, and the measurement of crisis exposure.

### **3 Data Construction on Debt Financing**

In this section, we describe the construction of a novel dataset on non-financial firm's debt financing, which includes multiple financing vehicles, the role of lead financial institutions, and firm's measured links to various financial institutions. First, we extend beyond the traditional focus on bank loans and lines of credit to include other important vehicles through which firms finance themselves. At a consolidated level, this permits a more comprehensive estimate of the size of economy-wide borrowing, and we can identify the institutions that play a central role in debt financing across multiple markets. Second, we separate non-financial firms with a history of external debt financing from those that do not have such a history, with a particular eye to the measurable connections (at least for the former group) to the particular (especially central) financial institutions that help to facilitate borrowing. As an aside, we also measure the extent to which pre-crisis mortgage exposure affects the central institutions and their borrowers / clients as we will use this information in later analyses.

#### **3.1 Individual Borrowers and Aggregate Debt Financing**

The nature of debt financing is heterogeneous (Rauh and Sufi (2010)). For all non-financial borrowers, and the particular financial institutions to which they are connected, we collect the dollar borrowing amount through detailed records on the top four vehicles: loans, revolvers, corporate bonds, and commercial paper. These four together account for over 90% of debt financing for non-financial (non-utility) firms in Compustat (Colla, Ippolito, and Li (2013)).

Because the borrowing frequency varies from firm to firm, and also because we desire to characterize the network of borrowing relationships as they stood prior to the 2008 crisis, we search over the five-year period (as in Bharath, Dahiya, Saunders, and

Srinivasan (2009)) from the beginning of 2002 to the end of 2006. Roughly 30,000 borrowing companies are identified from three databases: Dealscan,<sup>8</sup> FISD,<sup>9</sup> and Capital IQ. Dealscan and FISD report new loan/revolver facilities and new bond issuance in calendar time, and also have information on the particular financial institutions that facilitated the debt financing. Capital IQ reports outstanding revolving credit and commercial paper from each company’s 10K filings.

The borrowing amount through loans and revolvers is aggregated in each year for each firm from Dealscan. Corporate bond issuance is attributed similarly from FISD, and the firm-level amounts associated with revolvers and commercial paper are from Capital IQ. Capital IQ provides total revolving credit (commercial paper) and undrawn revolving credit (commercial paper); we employ the amount of total revolving credit and total commercial paper.<sup>10</sup> For firms reporting revolvers in Dealscan and revolving credit in Capital IQ, we add the two numbers together.<sup>11</sup> This information permits the identification of whether a firm has had (and presumably would continue to have) access to private debt markets, public debt markets, or both in the years prior (and subsequent) to the crisis. Then, to characterize economy-wide debt financing, we aggregate borrowing through loans, revolvers, corporate bonds and commercial paper *across* firms in each year. Put differently, the time series of aggregate borrowing that we provide could be understood as the aggregate new demand for debt financing each year met by the aggregate new supply provided by the financial industry, which includes banks and non-bank financial institutions (Pozsar, Adrian, Ashcraft, and Boesky (2010)). From 2002 to 2006, aggregate debt financing for all borrowers is over \$32 trillion dollars.

### 3.2 Central Financial Institutions

Our data collection effort yields over one thousand financial institutions engaged in lending and underwriting activity. However, the names of several dozen large financial institutions appear frequently across both loans as well as bond issuance. Our second step

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<sup>8</sup> The link between the facility ID and the borrower company GVKEY follows that in Chava and Roberts (2008).

<sup>9</sup> 6-digit issuer CUSIP is used to map the borrowing companies to GVKEY.

<sup>10</sup> Although the average maturity of a line of credit contract is around two years (Campello, Giambona, Graham and Harvey 2011), the total revolving credit reported in Capital IQ is the amount actually drawn, which is updated each year.

<sup>11</sup> We acknowledge a possible double counting issue. However, the magnitude of this issue is limited. For firms reporting their revolver lines of credit in both Dealscan and Capital IQ, the dollar amount in Dealscan is more than double the total revolving credit and approximately 20% more than the summary of total revolving credit and undrawn revolving credit reported in Capital IQ. The dollar amount that firms report in Capital IQ but not in Dealscan is approximately 4% of the dollar amount that firms report in Dealscan but not in Capital IQ.

is to identify the particular financial institutions that play a central role in facilitating debt financing.

For each loan or revolver in Dealscan,<sup>12</sup> we allocate the dollar amount associated with each deal evenly to the reported lead institution(s).<sup>13</sup> Over the 5-year period, 1,774 lead lenders serve this role for over 24,000 borrowing companies with over \$15 trillion in loans and revolvers. The dollar amount from all loans and revolvers in this 5-year period cumulates to each lead lender as part of a constructed ‘pseudo’ private debt financing service.<sup>14</sup>

We use the names of the top 150 financial institutions, ranked by 2006 fiscal year total assets in COMPUSTAT, to standardize the names of the 1,774 lead lenders. This is mainly due to two reasons. Many different lead institutions in Dealscan share the same parent institution, and one could hypothesize that any systemic shocks felt by a parent will transmit to its subsidiaries. Further, 586 of 1,774 lead lenders can be standardized to 87 financial institutions,<sup>15</sup> which together account for 81% of the borrowing amounts covered by Dealscan (Table I Panel A).

As mentioned, we broaden our notion of debt financing by identifying the financial institutions that play a central role in the corporate bond market by searching the FISD database. While institutions that play a role in underwriting corporate bonds do not necessarily monitor or provide terminal financing for borrowers, they nevertheless play a critical role in helping firms access the public debt market. Over the period from 2002 to 2006, 740 (lead) underwriters help facilitate over \$14 trillion of bond issuance for more than 4,500 firms.<sup>16</sup> After a similar method of name-driven standardization, 332 of the 740

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<sup>12</sup> The single lender in Dealscan accounts for less than 2% of the dollar amount from 2002 to 2006. We omit single lenders to be consistent with the common practice in the literature. Our results would not change were we to retain them.

<sup>13</sup> Other syndicate members, if any, are ignored. This method is common in the literature, essentially arguing that the lead financial institutions are more important than other syndicate members, perhaps because they may play a monitoring role. See Diamond (1984) and Holmstrom and Tirole (1997), for theoretical studies, and Sufi (2007), for an empirical study.

<sup>14</sup> For example, suppose there are five lenders in a \$10 million loan, two of which play the lead role. In focusing on these two lenders, each institution will be assigned a ‘pseudo’ deal amount of \$5 million. For robustness, we calculate alternative measures for lead financial institutions by allocating \$10 million to all five lenders. The results on the ranking of the leading banks do not materially change.

<sup>15</sup> The financial institutions could be borrowers to access loans and revolvers.

<sup>16</sup> We also calculate a cumulated ‘pseudo’ borrowing amount from the bond market for each lead underwriter in a fashion similar to what is described in the loan or revolver market.

underwriters are standardized to 75 institutions, which are together associated with over 89% of the bond issuance covered by the FISD database (Table I Panel A).<sup>17</sup>

Merging 75 key bond underwriters and 87 key lenders, we obtain 97 unique financial institutions that play a central role in firm’s borrowing activity. For robustness, we search the remaining lead lenders and underwriters to ensure that no other financial institutions<sup>18</sup> are associated with larger ‘pseudo’ amounts than any of the 97 institutions in the period from 2002 to 2006. Henceforth, we define these 97 financial institutions as “central” and the remaining we refer to as “peripheral”.

First, these central institutions dominate the loan, revolver, and corporate bond markets. Table I, Panel A, lists total borrowing amounts for several groups: all borrowers, all North American borrowers, six U.S. agencies, and all CRSP-listed borrowers. The market shares in dollar amount and in the number of borrowers facilitated by the 97 institutions ranges from 81% to 97% in either Dealscan or FISD for different borrower groups. Also note that the debt financing amounts facilitated by the central institutions are further concentrated. The top 20 institutions account for 89% of the borrowing amounts facilitated by the central financial institutions. In later work, we isolate the very largest institutions (among these 97 central institutions) from the remaining to differentiate among those with relatively more or less facilitation amounts.

[Insert Table I pane A about here]

Second, the central institutions are also large in size. Forty-four (seventy-eight) of the institutions have balance sheet assets that exceed \$250 (\$50) billion. The total assets of the ninety-seven institutions account for 74.8% of the total assets of all institutions in the financial industry by the end of 2006.<sup>19</sup> In Appendix B, we list the sample of 97 central financial institutions ranked by the debt facilitation amount.

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<sup>17</sup> Capital IQ has no information on the particular financial institutions involved in the revolving credit and commercial paper markets. However, the impact of this is limited mainly because the financial institutions have been identified in the new revolvers recorded in Dealscan. In addition, the amount of borrowing from Dealscan and FISD is much higher than that from Capital IQ. For all borrowers, borrowing covered by Dealscan and FISD is over \$30.2 trillion and the outstanding amount covered by Capital IQ is \$2.5 trillion. For borrowers with a PERMNO from 2002 to 2007, the borrowing amount from Dealscan and FISD is more than four times as large as the amount from Capital IQ.

<sup>18</sup> SICCD for firms in the finance industry is in the range of (6000-6999).

<sup>19</sup> In Compustat, there are 2,963 financial institutions in 2006, and 1,801 of 2,963 report asset (ATQ) in 2006 Q4. The sum of reported total assets from 1,801 financial institutions is \$ 59,107,643 million. The sum of reported total assets from the 97 central institutions is \$44,224,539 million, or 74.8% of all institutions in finance industry.

For comparison, we plot a time series of the syndicated loan (similar to Ivashina and Scharfstein (2010)) and the corporate bond issuance in Figure II.<sup>20</sup> We provide the separation of the borrowing amounts through the central institutions from that of the peripheral institutions. The total reduction in the aggregated borrowing activities through the central institutions exceeds \$400 billion on loans and revolvers from \$583.8 billion in 2007 Q2 to \$102.3 billion in 2009 Q3 and \$180 billion on corporate bonds over the same period, representing a 77% reduction over this period. During the same period, borrowing activities through the peripheral institutions on loans, revolvers, and corporate bonds fall by less than \$2.4 billion from \$32.78 billion to \$30.44 billion, a 7% reduction.

[Insert Figure II about here]

### 3.3 Debt Financing and Measured Bank Connections

In order to examine whether and how systemic risk may affect the broad economy, we attempt to measure the exposure (through the debt financing channel) that non-financial firms may exhibit to a systemic event. We separate those firms with a pre-crisis history of external debt financing from those that do not have such a history. Empirically, we attempt to match the 3,518 non-financial, non-utility firms listed in CRSP to documented borrowers with at least one borrowing record from any of the four debt vehicles identified above. Among these, 2,378 firms are linked to at least one borrowing record across our various data sources. We are unable to match the remaining 1,140 non-financial firms from CRSP to any documented borrowing record; since we are interested in the fact that these firms do not appear to be directly connected to the financial system via an obvious debt financing channel. We further scrutinize the different nature of these firms by confirming that they have an average (median) pre-crisis leverage ratios of 0.0884 (0.001). These firms (largely) do not rely on external debt financing, and therefore may exhibit limited exposure to a systemic event.

Among the roughly two-thirds of non-financial borrowers engaged in debt financing, we further examine the nature of the particular banks to which they are connected. For an individual borrower, we measure the number of distinct connections to the 97 central financial institutions from 2002 to 2006. We find that 1,911 of the 2,378 firms have at least one connection, and the median number of distinct connections is 2.

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<sup>20</sup> In Ivashina and Scharfstein (2010), the loan dollar amount is \$701.5 billion for 2007 Q2, while it is \$519.8 billion in Figure II. The discrepancy comes from sample differences. The sample in their paper includes all “U.S. corporate loans”, but the companies in our sample must also have a GVKEY.

In contrast, 467 of the 2,378 firms are connected only to peripheral institutions. The summary is reported in Table II.

### 3.4 Measuring Mortgage-related Exposures

In later analyses, we also gauge the importance of balance sheet exposures to mortgage related assets that later become impaired as these exposures may play different roles either as a trigger of the systemic event (Diamond and Rajan (2005)) or as a source of cross-bank heterogeneity concerning distress that gets passed to connected borrowers via a traditional lending channel argument. To identify the exposure of each to mortgage-related assets, we generate two measures. The first measure is from bank's reported balance sheets. We start from bank holding companies' FR Y-9C reports,<sup>21</sup> from which we collect mortgage assets and Tier 1 capital for all 401 bank holding companies. We also search the annual 10K report for U.S. non-bank financial institutions and the 20F report for non-U.S. financial institutions. For each of the 97 institutions from 2002 to 2006, we record mortgage assets, total assets, and equity capital.

Among the central institutions, 82 can be linked to one of the FR Y-9C/10K/20F filings. Among these, 80 exhibit exposure to mortgage-related assets on their balance sheets. The average pre-crisis (2002 to 2006) ratio of mortgage assets to equity capital is 2.53. Further, the average pre-crisis leverage ratio, measured by the equity multiple for the 82 financial institutions, is 16.18. The two numbers indicate that a hypothetical price decline in mortgage assets of, say, 15%<sup>22</sup> would engender an equity capital loss of 41.55%, thereby raising the equity multiple to more than 29. While mortgage exposure is significant, we do observe some cross-bank heterogeneity that we will employ later; the 25% of the equity multiple is 10.27 versus a number of 21.22 for the 75%.

### 3.5 Mitigating Funding Risk

The literature has emphasized the particular vulnerabilities that may be associated with direct business connections to particular banks facing resource or distress concerns (i.e., the lending channel). As a result, there may be benefits to firms with diversified access to multiple funding sources. To examine this more closely, we provide some

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<sup>21</sup> Thanks to Xiumin Martin for mentioning the FR Y-9C report. In these reports, mortgage assets are reported as a sub-category in Item 2 Securities, Item 4 Loans and Lease Financing Receivables, and Item 5 Trading Assets.

<sup>22</sup> When Fannie Mae and Freddie Mac were placed into conservatorship by the Federal Housing Financing Agency (FHFA) in September 2008, the average recovery rate of the MBS from these two institutions was 85%.

additional detail on the exact nature of the (possibly multiple) connections non-financial firms exhibit to various financial institutions.

First, if a bank to which the firm is connected is forced to reduce its lending, a borrower could switch to public bond markets. However, we uncover significant cross-firm variation in the degree to which firms appear to have access to public debt markets. Leaving aside the firms that do not raise debt financing during the pre-crisis period, 793 of the 2,378 CRSP-listed non-financial firms that do raise financing access the corporate bond and/or commercial paper markets in the period from 2002 to 2006. In contrast, the remaining 1,585 firms obtain debt financing over this period *only* through private loans and/or revolvers.<sup>23</sup>

Second, if a bank to which the firm is connected is forced to reduce its lending, a borrower may be able to switch to an alternative bank that may be in better health. Further, the substitution benefit may more pronounced if the alternative bank is larger, better capitalized, and/or is itself better diversified. Following this intuition, we find that 1,138 firms (of the 1,585 mentioned above) have at least one measurable connection to private debt financing through the 97 central institutions. The remaining 447 firms have measured connections only to peripheral institutions.

[Insert Table II about here]

## 4 Empirical Results

### 4.1 Access to Debt Financing and Crisis Risk Exposures

In this section, we provide novel evidence on the spillover effects from a systemic crisis to non-financial industries. Specifically, to test our first hypothesis, we examine the degree to which crisis risk exposures are more or less elevated during the financial crisis for individual firms depending upon whether or not they actively raise debt financing in the pre-crisis period.

Specifically, we run a panel regression for which the dependent variable is the market beta; we contend that firms significantly exposed to a market-wide, systemic event which exhibit elevated market betas. Accordingly, each firm will have two risk exposure measurements: a traditional market beta measured (1) during the crisis over a period of 96 weeks from August 1, 2007 to May 31, 2009 and (2) before the crisis from September 1, 2005 to June 30, 2007. The main independent variable is labelled *In Crisis*, and is equal

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<sup>23</sup> We also identify bond rating in end of year 2006 for these firms following Faulkender and Petersen (2006). It has been argued that the existence of a bond rating is a proxy for access to public debt markets.

to one during the defined crisis period and zero before. To control for possible sources of firm-level beta variation unrelated to crisis dynamics, we incorporate firm characteristics, including capitalization, leverage, book-to-market ratios, and illiquidity, and industry fixed effects, using the Fama French 12-industry classification. Standard errors are clustered at PERMNO level. Table III reports results from the following regression:

$$\text{Market Beta}_{it} = \alpha + \beta_1 \cdot \text{In Crisis}_t + \delta \cdot \text{firm controls}_{it} + \gamma \cdot \text{Industry effect} + \varepsilon_{it}$$

Given the sizeable variation that we observe in the degree to which firms employ the financial system to facilitate debt financing, we separate the more than 3,000 non-finance, non-utility firms into two groups: 2,378 firms that raise debt financing in the pre-crisis period (Table III, column (1)) and the remaining 1,140 firms that do not (Table III column (2)). While market betas are significantly elevated during the crisis, we find that the cross-sectional variation in this increase is linked to the extent to which firms engaged in debt financing. In particular, while firms with measured debt financing activity report significantly higher market betas during the crisis, the average in-crisis beta is actually lower for firms with no measured debt financing activity. The results are consistent with our first hypothesis. When the economy faces externalities associated with wide-spread financial system distress, this risk sensitivity is largely limited, on average, to those firms with a history of borrowing that is facilitated by the (now constrained) financial industry. In sharp contrast, firms that do not have an immediate borrowing history do not show elevated crisis exposures.

Beyond the observable differences in risk sensitivity between those firms that are active borrowers versus those that are not, it is important to recall that measured connections to either the largest financial institutions and/or the ability to issue public debt might be associated with risk mitigation. If a bank to which a firm is connected is forced to reduce its lending, a firm's connections to other, possibly large, well-capitalized, banks or the public bond market may help to limit the risk that the firm is unable to finance its operations or investments. In the spirit of the lending channel, we conduct several additional tests to explore whether measured connections to the largest financial institutions and/or the public debt market are associated with reduced crisis risk exposures. We further separate the 2,378 actively borrowing firms (in Table III column (1)) into three sub groups: 1,138 firms with a history of private borrowing only, but with direct borrowing connections to the central financial institutions (column (3)); 447 firms with a history of private borrowing, but with direct connections to the smaller, peripheral

financial institutions (column (4)); and finally, 773 firms with a history of access to the corporate bond market through the 97 central financial institutions (column (5)).

We use the same basic panel regression structure as in first two columns for columns (3) through (5). The results presented in column (3) show that borrowing firms with measured connections to the central financial institutions (but we assume without access to public debt markets) are associated with elevated crisis sensitivities. The results presented in column (5) show the same elevated crisis sensitivities for those firms that access public debt markets through connections to the central financial institutions. We interpret these results as evidence that neither connections to the largest, central institutions nor the ability to borrow via the corporate bond market appear to help mitigate the financing risks embodied in our measure of market (crisis) risk exposures.

[Insert table III here]

In addition, we perform an additional difference-in-difference test that compares firms that only borrow through private debt markets (those used in Table III columns (3) and (4)) as ‘treated’ with firms that do issue public debt (those used in Table III column (5)) as a control. We build a 0/1 indicator variable, *Private Debt Only*, for the former group of firms. Following the traditional emphasis on the potential risk mitigation benefits of access to the corporate bond market, one might expect that firms that can only raise private debt will be worse off when the banks to which they are connected are constrained. Therefore, in a regression of crisis exposure on the interaction  $In\ Crisis \times Private\ Debt\ Only$ , we might expect a positive and significant coefficient. Table IV (Column 1) reports results from the following DID regression:

$$\begin{aligned} Market\ Beta_{it} &= \alpha + \beta_1 \cdot In\ Crisis_t + \beta_2 \cdot Private\ Debt\ Only_i + \beta_3 \\ &\cdot InCrisis_t \times Private\ Debt\ Only_i + \delta \cdot firm\ controls_{it} + \gamma \cdot Industry\ effect \\ &+ \varepsilon_{it} \end{aligned}$$

Interestingly, we do not find a statistically significant interaction coefficient (in fact, it’s insignificantly negative). That is, our evidence suggests that it does not appear that access to public debt market is statistically linked to reduced crisis exposure given that the very nature of a systemic crisis is that in which financial institutions are broadly constrained (including bond underwriters). Diversification of banking connections appears to be limited in this context.

While our first measure employs the pre-crisis incidence of realized corporate bond issuance, we also consider an alternative measure of access to the bond market based on

whether a firm possesses a bond rating (Faulkender and Petersen (2006)). We create a 0/1 indicator variable, *Bond Rating*, that takes a value of 1 for firms that have a bond rating by the end of 2006, and zero otherwise. Firms whose *Bond Rating* equals one include firms both with previous corporate bond issuance and firms with a bond rating at the end of 2006 (but without a bond issuance). If this alternative measure better captures the potential benefit of access to the public debt market (even if it not actually executed during the pre-crisis period), one again might expect that firms with bond ratings would exhibit reduced crisis risk exposures. However, we find that the coefficient on the interaction term in Table IV column (2) is positive and statistically significant.

[Insert Table IV here]

Taken together, the results in Tables III and IV suggest that measured links to various debt markets, regardless of whether they are private or public were associated with elevated crisis risk exposures. Access to either public debt markets and/or to large, central financial institutions does not seem to be associated with a risk mitigation effect, supporting our first hypothesis. Indeed, the only non-financial firms that do not exhibit elevated risk exposure were those that (largely) do not access debt financing at all before the 2008 crisis.

#### 4.1.1 *The implications of connections to the central financial institutions*

To dig a bit deeper on the nature of measured financial institution connections, we next scrutinize the 1,911 firms that possess at least one pre-crisis record of connection with one of 97 central financial institutions (through either private debt markets, public debt markets, or both). Following the difference-in-differences tests in Table IV, we add a new variable that measures these connections, *# Conn to Cntrl Inst*, defined as  $\ln(1 + \#$  of distinct connections to the central financial institutions). The main coefficients of interest are those on *# Conn to Cntrl Inst* and on the interaction of *In Crisis*  $\times$  *# Conn to Cntrl Inst*. To control for the potential difference of access to public and private debt markets discussed above, we retain our 0/1 indicator associated with firms that borrow from the private debt market, *Private Debt Only*, as well as the interaction of that variable with our *In Crisis* indicator. We include these from the previous table will serve along with our usual firm-level controls and industry fixed effect. Table V reports results from the following regression:

*Market Beta*<sub>it</sub>

$$\begin{aligned}
&= \alpha + \beta_1 \cdot \text{In Crisis}_t + \beta_2 \cdot \text{Private Debt Only}_i + \beta_3 \\
&\cdot \text{InCrisis}_t \times \text{Private Debt Only}_i + \beta_4 \cdot \# \text{ Conn to Cntrl Inst}_i + \beta_5 \\
&\cdot \text{In Crisis}_t \times \# \text{ Conn to Cntrl Inst}_i + \delta \cdot \text{firm controls}_{it} + \gamma \\
&\cdot \text{Industry effect} + \varepsilon_{it}
\end{aligned}$$

First, we find that the direct coefficient on the number of connections to the central institutions, *# Conn to Cntrl Inst*, is both negative and significant in Table V. During normal times, multiple documented connections to the central financial institutions does indeed serve as a risk mitigation tool to the extent that market risk exposure is muted for such firms. Consistent with the lending channel literature, borrowing firms avoid concentrated bank dependence by having the capacity to raise financing elsewhere. Our results are in line with the importance of this diversification channel during normal times. However, during a systemic crisis period characterized by wide-spread constraints, this presumed risk mitigation effect might be less effective. We turn to the coefficient for the interaction of *In Crisis*  $\times$  *# Conn to Cntrl Inst*; it is both positive and statistically significant and the sum of the direct coefficient on the number of connections with this interaction coefficient together approach zero. This result holds in both columns (2) and (3), regardless of whether we include a control variable (*Private Debt Only*;) the captures those firms that do not possess access to the public bond market (and might be presumed to be ‘bank-dependent’ in other lending channel studies). These important results suggest that the number of connections to distinct central institutions is not associated with the same risk mitigation effect during a systemic crisis event when many financial institutions are simultaneously impaired. Simply put, the risk mitigation effects associated with access to multiple private debt sources and/or the public debt market appear to have been less effective during the financial crisis as it was likely difficult to find a place to turn that was not itself facing important, binding constraints.

[Insert table V here]

When examining the nature of specific connections to the individual financial institutions, it has been argued that the strength of relationship could be helpful in mitigating risk during the crisis period. Borrowed from the literature, we construct several variables designed to gauge the intensity of the relationship between the non-financial borrower and the connected bank. First, following Bharath, Dahiya, Saunders, and Srinivasan (2009), we build a measure of the amount of loans by the central financial institution *m* to borrower *i* in the 5 years from 2002 to 2006 divided by total amount of loans by borrower *i* during the same period, denoted REL (Amount). Second, we build a

measure of the number of loans/revolvers by central financial provision institution  $m$  to borrower  $i$  in the 5 years from 2002 to 2006 divided by total number of loans by borrower  $i$  during the same period, denoted by and REL(Number). Third, following Ivashina, Nair, Saunders, Massoud, and Stover (2008), we build a measure of the amount of loans/revolvers by central financial institution  $m$  to borrower  $i$  in the 5 years from 2002 to 2006, denoted by Relationship intensity (Exposure). Finally, we build a measure of the number of loans/revolvers by central financial institution  $m$  to borrower  $i$  in the 5 years from 2002 to 2006, denoted by and Relationship intensity. For a borrower with multiple connections to the central financial institutions, we focus on the institution with strongest connection based on each of these measures.<sup>24</sup>

If relationship banking serves as a risk mitigation role, we hypothesize that a stronger relationship should help to limit the degree to which a borrower's risk exposure increases. Specifically, we focus on two sets of terms – the direct coefficients on each measure of the strength/intensity of relationship banking as well as the coefficients on the interaction terms between our *In Crisis* indicator and each intensity measure. While one might expect to observe a negative and significant coefficient on the interaction effect, we find that none of the four interaction coefficients suggest that stronger bank relationships mitigate risk exposures.

[Insert table VI here]

There are a couple of interesting observations. First, for the measures derived from Bharath, Dahiya, Saunders, and Srinivasan (2009), we do not observe a direct risk mitigation effect on market risk exposures associated with higher amounts or numbers of lending connections. Further, the coefficient on the interaction of our crisis indicator with these measures is also insignificant. Second, for the measures derived from Ivashina, Nair, Saunders, Massoud, and Stover (2008), we do observe a direct risk mitigation effect on market risk exposures associated with higher amounts or numbers of lending/revolver connections. In normal times, there appears to be a possibly risk mitigation associated with banking relationships. However, the coefficient on the interaction of our crisis indicator with the Ivashina, Nair, Saunders, Massoud, and Stover (2008) measure of intensity based on numbers is positive and significant, where the sum of the direct and interaction coefficients approaches zero. As in several cases provided above, what may serve as risk mitigation appears to be less effective during a crisis characterized by widespread constraints. However, the coefficient on the interaction of our crisis indicator

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<sup>24</sup> As shown in Table II, the median value for REL(Number), REL(Amount), Relation Intensity (Exposure), and Relationship Intensity (N) is 1, 0.63, \$0.3 billion, and 2, respectively.

with the Ivashina, Nair, Saunders, Massoud, and Stover (2008) measure of intensity based on borrowing amounts is statistically insignificant; this is the only case where we observe a possible risk mitigation effect that remains present during a systemic crisis.

In sum, a systemic crisis characterized by widespread constraints permeating the financial sector appears to affect, on average, all firms engaged in debt financing regardless of the particular vehicles through which they raise financing, the nature or number of financial institutions to which they are connected, or the intensity of those relationships. The only firms that we observe to have been relatively insulated, in the sense that their market betas do not significantly increase, are those that (largely) do not employ debt financing at all. These observations form the core results of this study. From there, we address several measurement concerns in the sections that follow.

## 4.2 Matching by Firm Characteristics

In addition to any contagion effects associated with a reliance on debt financing, higher risk exposures are also associated with two firm characteristics, size and leverage. In this section, we provide an alternative approach to control for difference in firm characteristics. Table VII Panel A reports size and leverage of four subsamples of firms presented in Table III. The mean and median are presented for the period prior to the crisis.

The observed variation in firm size is pronounced. In particular, the non-financial firms with connections to the private debt market through the peripheral institutions are generally the smallest, whereas firms with connections to the public debt market (through the central institutions) are generally the largest. As mentioned earlier, non-financial firms without measured pre-crisis debt financing do report close to zero leverage, especially the median. The leverage ratios of the three other subsamples are both larger than zero and quite different from each other.

[Insert Table VII, Panel A about here]

Taking into consideration the large cross-sectional variation in measured size and leverage (which may affect market betas), we conduct a matched sample analysis. Treatment firms (those with pre-crisis access to debt financing) and control firms (those without) are matched by firm characteristics. Three treatment firm groups are selected from the 1,138 firms with connections to private debt through the central institutions (Table III column (3)), the 447 firms with connections to private debt only through peripheral institutions (column (4)), and the 773 firms with connections to public debt

through the central institutions (column (5)). The matched control firms for each treatment group are selected from the 1,140 firms without access to pre-crisis debt financing (Table III column (2)). For each pair, we match the treatment and control firms by size, leverage, book-to-market ratios, and market beta, all of which are matched based on pre-crisis measurements and are adjusted by the relevant industry median.

We conduct  $t$ -tests on the equality of firm characteristics and the market beta before and during the crisis between the treatment and control firms. The results are reported, separately for each of the three groups mentioned above, in Table VII Panel B, Panel C and Panel D.

[Insert Table VII Panel B, C and D about here]

In all three panels, firm characteristics between treatment firms (those with pre-crisis access to debt financing) and the control firms (those without) are not significantly different after matching, either before or during the crisis. However, the difference in market beta during the crisis is statistically significant in two cases. Specifically, market betas (i.e., crisis risk exposures) are statistically larger during the financial crisis for firms with access to either public and/or private debt financing through a connection to the central institutions. As in our earlier regressions, connections to the market for debt financing appear to be a channel through which systemic risk is passed, and the mechanism appears largest for those firm with connections to the central institutions. Consistent with our earlier regressions, the matched sample analysis supports the conclusions that there were limited crisis benefits associated with either access to the corporate bond market or to connections to the largest banks (that one might presume could better absorb shocks).

### **4.3 The Implications of Mortgage Exposure**

In addition to the limited benefits associated with public debt or connections to the largest banks during a systemic crisis, we have thus far documented that the diversification benefits of multiple banking connections are also muted. From the lending channel literature, banks facing crisis-related shocks associated with any impaired assets they hold (Kho, Lee and Stulz (2000)) will transmit these shocks onto to their non-financial borrowers. In such a situation, this transmission effect arises from a bank's direct exposure to, say, mortgage-related assets, and distress is passed along to the individual borrowers that share a connection (and may be mitigated by that borrower's access to public debt or to alternative banks that do not face distress). In sharp

contrast, our evidence points to a broad transmission effect instead associated with system-wide distress, where most banks ceased to provide their usual liquidity creation function so that multiple connections provided limited benefits. In this section, we examine these two sources of risk transmission more carefully.

We provide two relevant stylized facts associated with the institutions that sit at the center of the financial system. First, most of the central institutions do have significant mortgage assets on their balance sheets in the period leading up to the financial crisis. On average, the ratio of mortgage assets to equity capital is 2.53 from 2002 to 2006. Second, the market for debt financing is extremely concentrated; for example, the largest 20 institutions (of the 97 central) account for about 70% of the debt financing business that we capture. To attempt to better parse the role for the two transmission mechanisms discussed above, we design a difference-in-difference test with particular central institutions and particular borrowers. In the first step, we differentiate the risk transmission effects of the largest 8 institutions from those of the remaining in order to highlight the importance of system-wide banking services. In the second step, we focus on the largest banks to try to distinguish the importance of system-wide contagion effects from the effect of direct connections to the institutions with impaired mortgage-related assets.

The test design considers the spillover effects from two fronts. All borrowers possess direct connections to banks with significant exposure to mortgage assets, so we account for the spillover effect as documented in lending channel literature. For the same borrowers, the focus of the test is instead on the differential effect of an additional connection. Holding mortgage exposure relatively constant, half of the borrowers are connected to the very top banks that play a major role in debt intermediation, while the other half are connected to banks with a significant lower rank in terms of debt intermediation.

Among the central institutions, institutions with a higher (lower) rank in the debt financing business are identified as *Top (Secondary)* institutions. We identify the 8 large institutions as *Top*, and the remaining 89 are labeled as *Secondary* (yet still central) institutions. All 8 top institutions carry impaired assets, and the ratio of mortgage assets to equity capital is 2.55. Among the 8 top institutions<sup>25</sup>, we further separate four of the institutions as *Mortgage* and the remaining four as *Debt Financing* because the former

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<sup>25</sup> The top 8 intermediaries are Citigroup, JP Morgan, Bank of America, Deutsche Bank, Merrill Lynch, UBS AG, Morgan Stanley, and Wachovia.

four institutions have relatively higher mortgage exposure and the latter four institutions play a larger market role in debt financing.

The non-financial borrowers are selected as follows. We start with the 1,911 firms (in Table V) that possess a measured connection (private or public debt) to the central financial institutions. We select all borrowers with exactly two distinct connections to the central institutions as candidates. We require that all selected borrowers share the first connection to the one of the four *Mortgage* institutions so that they all exhibit a direct connection to a bank with a sizable mortgage concern. Our group of treated borrowers, labeled as *Mortgage & Debt Financing*, possess a second measured connection to one of the four *Debt Financing* institutions. Our group of control borrowers, labeled as *Mortgage & Secondary Debt Financing* possess a second measured connection to any of the *Secondary* financial institutions. Our design is motivated by one borrower with two banks in the lending channel studies (Kawajia and Mian (1998) and Schnabl (2012)), yet to serve very different goals. By controlling the spillover effects from the institutions with significant mortgage exposure, we aim to differentiate the spillover effect from two institutions with significant different rank in terms of debt intermediary service.

The setting of difference-in-differences is the same as that in Table V. The coefficient of interest is that highlighting the difference between the crisis exposure for treated and control borrowers based upon their second connection, where all borrowers have a first direct connection to the banks with elevated mortgage exposure -- central institution with impaired assets. In the regression, the focus is on the interaction  $In\ Crisis \times Mortgage\ \&\ Debt\ Financing$ , an indicator variable equal to one if the second connection is to an institution with a significant role in debt financing service and zero if the second connection is to a secondary institution. The estimated coefficient is positive and significant at the 5% level (Table VIII, column (1)). In this specification, the number of connections of each borrower is limited to two, which narrows the focus on the effect on the number of connections to the key debt financing institutions. The borrowers in the two groups share the same connection to the institutions with mortgage assets above the average level, where the mortgage exposure should have the same direct lending channel transmission effect for both the treated and control borrowers. The result holds in column (2) after adding an additional variable,  $In\ Crisis \times Private\ Debt\ Only$ , separating out the effect of those bank-dependent firms that do not enjoy access to the public debt market. In addition, the coefficient for *Mortgage & Debt Financing* is negative and significant, confirming the same pattern we uncovered in our earlier regressions (see Table V). Surprisingly, the results show that a borrower might exhibit a higher crisis risk exposure if

they switched from a secondary debt financing institution to a top debt financing institution. Among the 97 central institutions, a very large (core) institution with a high ranking in market-wide debt financing appears to pose greater risk to the non-financial economy.

[Insert Table VIII about here]

#### 4.4 An Examination of the Benefits of Multiple Connections

One of the central results of our regressions above (see Table V), is that the multiple banking connections to the central institutions, in contrast to the implications of the lending channel literature, do not appear to help mitigate against funding risk during a systemic event. In this section, we examine the same issue from a different perspective by focusing on a subset of key financial institutions.

The subset of debt financing institutions include the top 20 institutions that collectively account for roughly 70% of the business in facilitating debt issuance. Accordingly, their role would be difficult to replace. Compared to the remaining 77 central institutions (of the 97 we have considered throughout the paper), these 20 institutions share similarities among each other relatively to asset size, multi-line businesses, and general exposures to mortgage-related assets.

The selection of treatment and control non-financial borrowers is meant to help identify the potential diversification effects associated with multiple bank connections. The candidate borrowers are restricted to those with multiple connections only to these top 20 institutions. The control borrowers are selected based on having one and only one connection to these top 20 institutions. We consider two cases -- borrowers in treatment group A (treatment B) possess exactly two (more than two) distinct connections to the top 20 institutions.

We take the same difference-in-difference setting and include the same controls as in Table IX. The results are presented in Table X. While addressing the same question on the diversification benefit of multiple connections, here the selected borrowers and central institutions are more homogeneous than the sample in Table V. The key independent variable of interest is *Multiple Conn*, which is equal to one if borrowers have more than one connection to the top 20 institutions, and zero otherwise.

[Insert Table IX here]

As we have seen before, multiple connections can play a diversifying role during normal times. The negative and significant coefficients on the *Multiple Conn* (Table IX

column (3) and (4)) demonstrate the often-presumed diversification benefit. Similar to Tables V and Table IX, we again find that borrowers with more than one connection to the top 20 institutions are less sensitive to the general economic risk before the crisis. However, the interaction effects on *In Crisis*  $\times$  *Multiple Conn*, are positive and significant in all four specifications (regardless of whether we control for bank-dependent firms with the variable *Private Debt Only*). The efficacy of multiple connections appears again to be limited during a systemic event in which multiple institutions are collectively distressed.

## 4.5 Additional Effects on Equity Returns and Corporate Performance

Finally, we turn to the question of whether systemic risk reaches beyond crisis risk exposures to equity returns and corporate performance. Diamond and Rajan (2005) predict a progressive feedback effect from an individual bank failure to the meltdown of the system. Consistent with the widespread nature of the crisis, stock prices of the central institutions declined by 80%, on average, from May 2007 to March 2009. Lehman Brothers, in particular, was a central institution in the debt financing business, and its failure provides an interesting setting to examine the impact of crisis risk on stock returns. This perspective is different from that in Fernando, May, and Megginson (2012), in which the transmission effect is analyzed by examining the spillover of Lehman’s distress to other firms through *specific* investment-banking relationships. Rather, we examine the cross-sectional variation, across several thousand financial and non-financial firms, in equity returns after Lehman’s insolvency in relations to the measured differences in market betas (crisis risk exposures). Table X reports regression results from the following regression:

$$\begin{aligned} \text{Cumulative Return}_i \\ = \alpha + \beta_1 \cdot \text{market beta}_i + \delta \cdot \text{firm controls}_{it-1} + \gamma \cdot \text{industry effect} + \varepsilon_i \end{aligned}$$

The dependent variable is the cumulative weekly equity return for each firm. The Lehman default occurred on September 15, and the post-event period covers September 19, 2008, to March 6, 2009 with the ending point chosen as the beginning of the post-crisis equity market recovery. The main independent variables are the *Market Beta In Crisis* (as a measure of crisis risk exposure). We conduct the above regressions for institutions in the financial industry (column (1)) and non-financial firms over the same four sample groups

(considered in Table III, column (2) to (5)) that differ along various degrees of connectivity to debt financing markets. The results are reported in Table XI.

[Table X about here]

After Lehman’s insolvency, cumulative equity returns were significantly lower (more negative) for financial institutions with larger market betas (crisis risk exposures). For non-financial firms, we separate firms into groups with access to private debt through the central institutions in column (2), with access to public debt through the central institutions in column (3), firms with access to private debt through the peripheral institutions in column (4), and the remaining firms without pre-crisis debt financing in column (5). Stock returns for all non-financial firms are negatively associated with market betas (larger crisis risk exposures are associated with larger stock market declines). The point estimates linked return declines with crisis risk exposures are larger for the firms with measured connections to the largest institutions; further, we find that the differences between the largest and smallest groups are statistically significant. Not only do we show that systemic risk is associated with elevated risk exposures for firms with connections to the central financial institutions, but we also find that firms with larger market betas also exhibit larger equity declines around a key focal point of the financial crisis when systemic risk was more pronounced.

Finally, we explore the degree to which the risk of systemic failure affected real corporate performance across firms for 2008 and 2009. Table XI reports the regression results from the following form:

*Corporate performance*<sub>it</sub>

$$\begin{aligned}
 &= \alpha + \beta_1 \cdot Year2009_t + \beta_2 \cdot \#Conn\ to\ Cntrl\ Inst_i + \beta_3 \\
 &\cdot \#Conn\ to\ Cntrl\ Inst_i \cdot Year2009_t + \beta_4 \cdot DTD_{it} + \beta_5 \cdot Beta_{it} + \delta \\
 &\cdot firm\ controls_{it} + \gamma \cdot industry\ effect + \varepsilon_{it}
 \end{aligned}$$

The dependent variables are sales (*SALE*), investment (*CAPX*), and operating income (*OI*) scaled by assets (*AT*) in the corresponding fiscal year as well as return on assets (*ROA*) for firm *i* in year t-1, 2008, and year t, 2009. The key explanatory variables of interest are the number of distinct connections to the central institutions (*# Conn to Cntrl Inst.*) and the 2009 fiscal year (*Year2009*). Following Ivashina and Scharfstein (2010), we also include several firm level control variables, including leverage, Tobin’s Q, return on assets (*ROA*)<sup>26</sup>, and size (log *AT*).

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<sup>26</sup> When exploring the role for ROA during the crisis, we exclude it from the controls.

We consider 2009 because it coincides with the trough in the recession arising from the financial crisis. However, we do acknowledge possible concerns related to the mixture of supply and demand effects for credit. To address this concern, we add two additional control variables: (1) the firm’s distance-to-default (DTD) to control for the firm’s credit worthiness (following Dell’Ariccia, Detragiache and Rajan (2008)); and (2) the firm’s market beta to address the concern that the decrease in the firm’s operating activities occurs because of the overall elevated systematic risk (following Calomiris and Mason (2003)). Results are reported in Table XII.

We start with the 3,518 non-financial firms (Sample one) that make up the core of our analysis throughout the paper (those with or without pre-crisis measured connections to the debt financing market). For the sake of brevity, we omit the coefficients on *Year2009*, *# Conn to Cntrl Inst*, and all the control variables. The results show that firms with multiple pre-crisis connections are associated with significant larger reductions in sales, return on assets, and operating income in 2009 relative to firms without such connections.

Finally, we examine whether access to either the private or public debt markets through connections to the central financial institutions provided a diversification role for funding risk. We consider two groups of firms featured earlier in the paper – 1,138 firms with pre-crisis access to the *private* debt market through measured connections to the central institutions (Sample two) and 773 firms with pre-crisis access to the *public* debt market through measured connections to the central institutions (in Sample three). In each case, the 1,140 firms that do not exhibit pre-crisis debt financing are also included as controls. The results demonstrate that both sets of firms (those with connections to either private or public markets through connections to the central institutions) exhibit larger decreases in real activity in 2009 relative to the firms that do not exhibit connections at all. Taken together, elevated risk not only manifests in risk measurements but also in subsequent corporate performance. Financial market disruptions, then, appear to be far more than only a sideshow.

[Table XI about here]

## 5 Conclusions

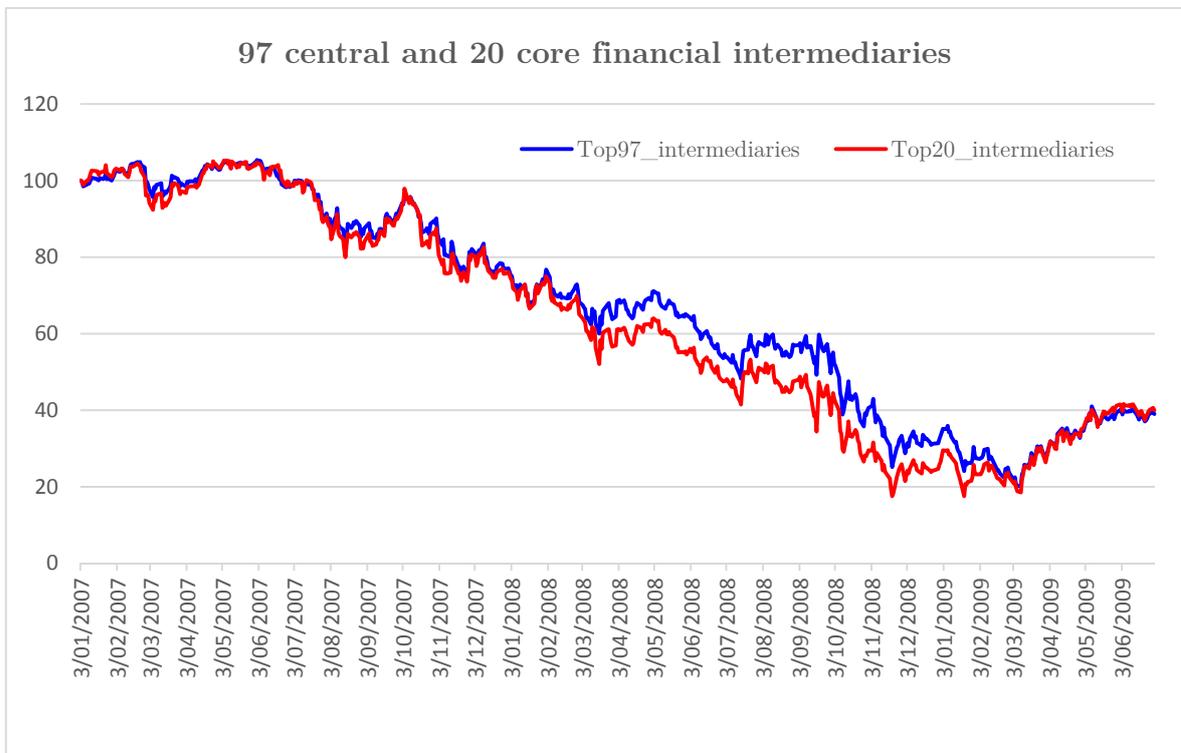
We identify the role of large financial institutions as a channel through which crisis risk is transmitted to non-financial firms. Specifically, we uncover several key results. First, non-financial firms that do not raise debt financing in the years leading up to the

crisis appear to be relative insensitive to a systemic event. Second, those firms that do exhibit measured connections to the institutions engaged in facilitating debt financing, in contrast, do exhibit larger crisis risk exposures, and this is particularly pronounced for those firms for which we identify connections to the 97 financial institutions that sit at the center of the market for private and public debt financing. Third, a non-financial firm's access to the public debt (corporate bond) market (through business connections to the central institutions) does not appear to play a risk mitigation role during a systemic risk event. Finally, while firms with diversified pre-crisis connections to the central institutions may enjoy a diversification benefit during normal times, multiple connections appear to offer not benefit during a systemic event.

Our results suggest that there exists a transmission mechanism through which systemic risks spreads that is quite different from what has traditionally been understood in the lending channel literature. If one views bank failures as relatively isolated cases (and failed banks are relatively small in size), the vacuum left by a bank failure can be replaced by other banks. As a consequence, from the perspective of non-financial borrowers, connections to multiple banks and/or access to the public debt market are important risk mitigation tools. However, when the largest financial institutions that together play the dominant role in the debt financing market are on the edge of collapse, there appear to be few places to turn. Systemic risk is widespread and the benefits of alternative financing sources (either to other financial institutions or public debt markets) may largely disappear. While aspects of the lending channel appear to be empirically relevant, our results suggest the importance of broader, largely undiversifiable problems manifesting throughout the financial system.

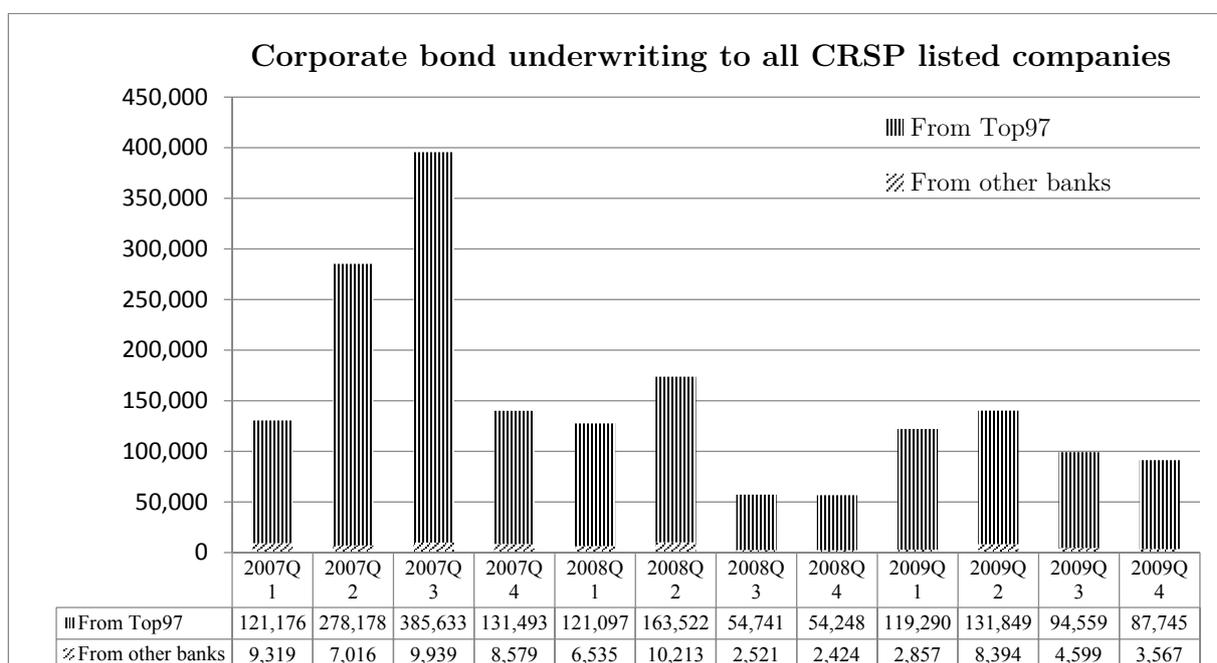
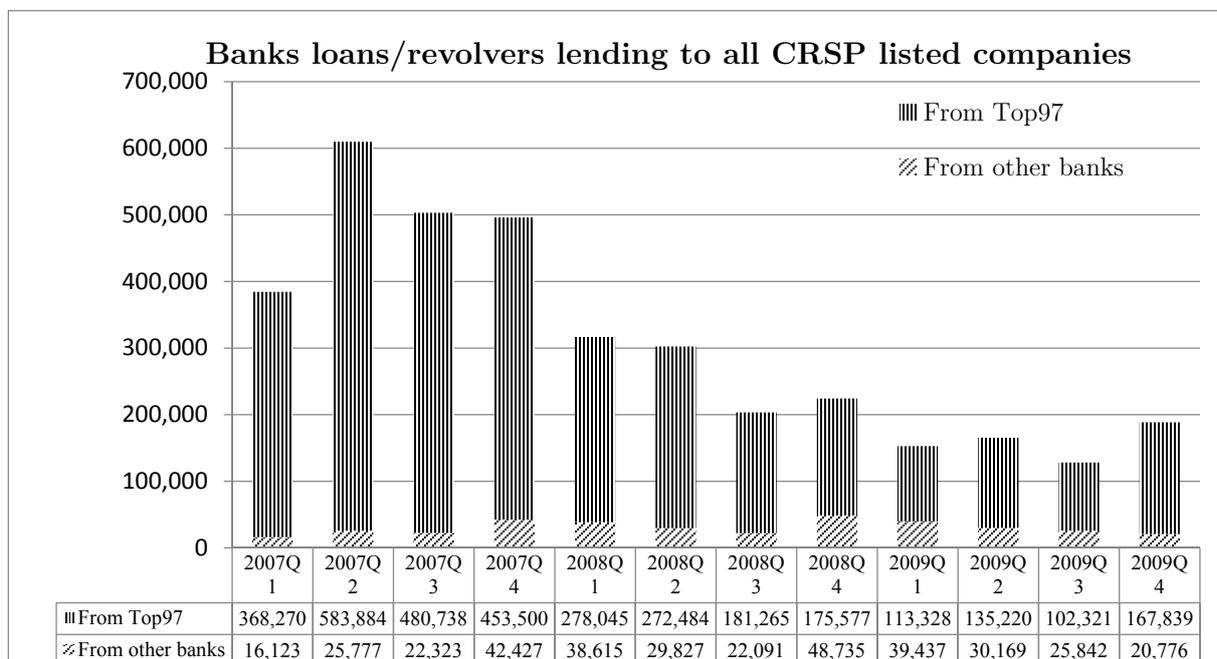
**Figure I: Stock Price of Top 97 and Top 20 Financial Intermediaries**

This figure plots the an equally-weighted stock price index of 97 central financial intermediaries and a subset of the top 20 financial intermediaries. The indexed initiates at 100 on January 3, 2007. The sample period ranges from January 2007 to June 2009.



**Figure II: Debt Intermediary Service to All CRSP-listed Companies.**

The figure plots the amount of debt intermediary service (\$ million) through syndicated loans, revolvers, and corporate bonds for all CRSP-listed companies. The sources of data are Dealscan and FISD. The lead lenders and (lead) underwriters are categorized into two subgroups: the 97 central financial intermediaries and any other banks. The dollar amount of each facility/bond is evenly allocated to all lead financial intermediaries. The dollar amount of all facilities/bonds is calculated with a start date in each quarter from 2007 to 2009.



**Table I**

**Aggregate Debt Financing, Central Financial Intermediaries, and Individual Borrowers**

This table summarizes the characteristics of debt financing. The characteristics include individual borrowing firms and financial intermediaries. From 2002 to 2006, ninety-seven central financial intermediaries are identified from Dealscan and FISD.

**Panel A: The borrowing activities in private and public debt markets and the role of the central financial intermediaries**

Panel A reports the borrowing activities from 200 to 2006 in two datasets: Dealscan and FISD. The Dealscan data include borrowing activities through loans and revolvers. FISD data include borrowing activities through corporate bonds. We report the dollar amount of borrowing activity for all borrowers, borrowers from North America, six U.S. agencies (US agency (FHLMC, FNMA, FHLB)<sup>1</sup> US agency (FFCB, IBRD, IDB)<sup>2</sup>), and CRSP listed companies.

	Dealscan for loans and revolvers			FISD for corporate bonds		
	# company	\$ Trillion	Market share	# company	\$ Trillion	Market share
# central financial intermediaries	87			75		
Borrower: All	24,729	\$15.99		4,553	\$14.19	
Through central financial intermediaries	20,097	\$12.99	81.20%	4,370	\$12.74	89.81%
Borrower: North American	11,919	\$7.66		3,334	\$9.46	
Through central financial intermediaries	10,503	\$7.30	95.35%	3,222	\$8.41	88.87%
Borrower: US agency (FHLMC, FNMA, FHLB)	2	\$0.00		3	\$3.98	
Borrower: US agency (FFCB, IBRD, IDB)				3	\$0.26	
Borrower: North American listed in CRSP	3,924	\$5.00		1,253	\$2.03	
Through central financial intermediaries	3,432	\$4.82	96.36%	1,215	\$1.82	89.68%

<sup>1</sup>Federal Home Loan Mortgage Corporation(FHLMC), Federal National Mortgage Association (FNMA), Federal Home Loan Banks (FHLB)

<sup>2</sup> Federal Farm Credit Banks Funding Corporation(FFCB), International Bank for Reconstruction and Development (IBRD), Inter-American Development Bank (IDB)

## Panel B: How do firms access debt financing

Panel B reports how firms access debt financing, which includes loans, revolvers, corporate bonds and commercial paper. The sample firms include 3,518 non-financial, non-utility CRSP listed firms. Borrowing activities is from 2002 to 2006. Firms are first separated into two subgroups: with or without a history of debt financing during the period from 2002 to 2006. Firms with a history of debt financing are further classified by whether they access private or public debt markets, and whether the access is through the central or peripheral financial intermediaries.

3,518 non-financial, non-utility firms and debt financing, 2002-2006
<hr/>
2,378 firms with history of debt financing
<hr/>
• 1,138 firms access private debt at least once through the 97 central intermediaries
• 447 firms access private debt only through the peripheral intermediaries
• 773 firms access public debt at least once through the 97 central intermediaries
• 20 firms access public debt only through the peripheral intermediaries
<hr/>
1,140 firms without a history of debt financing
<hr/>

**Table II**  
**Summary Statistics**

This table reports the summary statistics for all CRSP listed companies, financial and non-financial, in this study.

Variable	N	Mean	25th	Median	75th	Std Dev
<i>All companies (financial &amp; non-financial)</i>						
Market beta before crisis	4,555	1.0249	0.5791	1.0328	1.4424	0.6317
Market beta in crisis	4,555	1.1292	0.7283	1.0656	1.4551	0.5929
# distinct connections to the 97 central institutions	2,309	3.8146	1	2	5	4.0022
- for financial	398	5.0804	1	3	7	5.3759
- for non-financial	1,911	3.5510	1	2	5	3.5979
REL(Number)	2,016	0.7712	0.6	1	1	0.3323
REL(Amount)	2,015	0.6415	0.4684	0.6364	1	0.3305
Relation Intensity (Exposure, bn\$)	2,015	0.9248	0.05	0.3	0.855	2.0511
Relation Intensity (N)	2,016	3.3031	1	2	5	3.1166
Illiquidity	4,535	0.9904	0.0011	0.0085	0.1226	5.7821
Leverage	4,502	0.1930	0.0140	0.1397	0.2977	0.2005
Book to Market	4,110	-0.7121	-1.2162	-0.7161	-0.2926	1.0465
Size	4,126	6.2216	4.8695	6.0875	7.4286	1.9061

**Table III**  
**Crisis Risk Exposure and a History of Debt Financing**

This table reports regression results on crisis risk exposures. A firm's exposure to crisis risk is measured by the market beta, which is estimated by weekly returns across two periods, one for the pre-crisis period and the other for the crisis period. The pre-crisis period includes 96 weeks from September 1, 2005 to June 30, 2007. The crisis period includes 96 weeks from August 1, 2007 to May 31, 2009. Hence, each firm has two beta measurements. The key independent variables are *In Crisis*, which is a dummy equal to one for observations during the crisis period, and zero otherwise. 3,518 non-financial firms are examined in different subsamples. Column (1) is for firms with a history of debt financing; column (2) is for firms without a history of debt financing. Column (3) is for firms with access to private debt through the central financial intermediaries. Column (4) is for firms with access to private debt only through the peripheral intermediaries. Column (5) is for firms with access to public debt through the central institutions. Please refer to the appendix for variable definition. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors, clustered at the PERMNO level, and *t*-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

	Dependent variable: Market Beta				
	With	Without	Access to private debt through		Access to public debt
	history of access to debt financing	access to debt financing	central institutions	peripheral institutions	through central institutions
	(1)	(2)	(3)	(4)	(5)
In Crisis	0.064*** (4.64)	-0.081*** (-3.58)	0.061*** (3.01)	0.055 (1.48)	0.071*** (3.33)
Leverage	0.328*** (6.13)	0.168* (1.76)	0.251*** (3.26)	0.091 (0.69)	0.448*** (4.39)
Book to Market	-0.012 (-1.24)	-0.003 (-0.29)	-0.004 (-0.38)	-0.041 (-1.35)	-0.004 (-0.18)
Size	0.039*** (6.90)	0.098*** (11.90)	0.067*** (7.14)	0.138*** (7.42)	-0.053*** (-4.92)
Illiquidity	-0.001*** (-3.25)	0.000 (1.34)	-0.002*** (-3.36)	-0.000 (-0.18)	-0.005*** (-4.99)
Industry F.E.	Y	Y	Y	Y	Y
R-square	0.1117	0.1099	0.1214	0.1593	0.1862
Company number	2,378	1,140	1,138	447	773

Table IV

## Crisis Risk Exposures and Access to the Corporate Bond Market

This table reports results of difference-in-difference regressions on crisis risk exposures. A firm's exposure to crisis risk is measured by the market beta, which is estimated by weekly returns across two periods, one for the pre-crisis period and the other for the crisis period. The pre-crisis period includes 96 weeks from September 1, 2005 to June 30, 2007. The crisis period includes 96 weeks from August 1, 2007 to May 31, 2009. Hence, each firm has two beta measurements. The key independent variables are *In Crisis*, *Bond Rating*, and *Private Debt Only*. *In Crisis* is a dummy which is equal to one for observations during the crisis period, and zero otherwise. *Bond Rating* is a dummy variable equal to one if a non-financial firm has bond rating by the end of 2006, and zero otherwise. The dummy *Private Debt Only* is equal to 1 if the company has history of a loan or revolver line of credit, but does not have a history of either a bond or commercial paper issue in the period from 2002 to 2006. Please refer to the appendix for the variable definitions. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors clustered at PERMNO level, *t*-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

Dependent variable: Market Beta		
	Access to private or public debt	
	(1)	(2)
In Crisis	0.082*** (3.73)	0.033* (1.92)
Bond Rating		0.026 (0.95)
In Crisis × Bond Rating		0.109*** (3.72)
Private Debt Only	0.011 (0.42)	
In Crisis × Private Debt Only	-0.027 (-0.94)	
Leverage	0.327*** (5.84)	0.273*** (4.95)
Book to Market	-0.012 (-1.24)	-0.018* (-1.84)
Size	0.039*** (6.16)	0.031*** (5.07)
Illiquidity	-0.001*** (-3.23)	-0.001*** (-3.26)
Industry F.E.	Y	Y
R-square	0.1118	0.1166
Company number	2,378	2,378

Table V

**Crisis Risk Exposures and Multiple Connections to Central Institutions**

This table reports results of difference-in-difference regressions on crisis risk exposures. A firm's exposure to crisis risk is measured by the market beta, which is estimated by weekly returns across two periods, one for the pre-crisis period and the other for the crisis period. The pre-crisis period includes 96 weeks from September 1, 2005 to June 30, 2007. The crisis period includes 96 weeks from August 1, 2007 to May 31, 2009. Hence, each firm has two beta measurements. The key independent variables are *In Crisis* and *# Conn to Cntrl Inst*. *In Crisis* is a dummy equal to one for observations during the crisis period, and zero otherwise. *# Conn to Cntrl Inst* = ln (distinct connections to the central financial intermediaries +1). 1,911 non-financial firms have at least one connection to the central institutions. Please refer to the appendix for variable definition. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors clustered at the PERMNO level, and *t*-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

Dependent variable: Market Beta			
	Access to private debt or public debt through 97 central institutions		
	(1)	(2)	(3)
In Crisis	0.075*** (3.42)	-0.003 (-0.08)	-0.041 (-0.74)
Private Debt Only	-0.013 (-0.45)		-0.076** (-2.36)
In Crisis × Private Debt Only	-0.019 (-0.65)		0.032 (0.85)
# Conn to Cntrl Inst		-0.075*** (-3.19)	-0.106*** (-3.99)
In Crisis × # Conn to Cntrl Inst		0.049** (2.26)	0.065** (2.37)
Leverage	0.380*** (6.17)	0.445*** (7.19)	0.418*** (6.66)
Book to Market	-0.007 (-0.72)	0.002 (0.15)	0.005 (0.44)
Size	0.017** (2.40)	0.030*** (3.79)	0.028*** (3.47)
Illiquidity	-0.002*** (-3.63)	-0.002*** (-3.67)	-0.002*** (-3.66)
Industry F.E.	Y	Y	Y
R-square	0.1173	0.1196	0.1213
Company number	1,911	1,911	1,911

**Table VI**  
**Crisis Risk Exposures and the Strengths of Bank Relationships**

This table reports results of difference-in-difference regressions on crisis risk exposures. A firm's exposure to crisis risk is measured by the market beta, which is estimated by weekly returns across two periods, one for the pre-crisis period and the other for the crisis period. The pre-crisis period includes 96 weeks from September 1, 2005 to June 30, 2007. The crisis period includes 96 weeks from August 1, 2007 to May 31, 2009. Hence, each firm has two beta measurements. The key independent variables are *In Crisis*, *REL (Amount)*, *REL (Number)*, *Relation Intensity (Exposure, bn\$)*, and *Relation Intensity (N)*. *In Crisis* is a dummy which is equal to one for observations during the crisis period, and zero otherwise. *REL (Amount)* is a ratio equal to the amount of loans (\$) by institution *m* to borrower *i* in the 5 years from 2002 to 2006, divided by total amount of loans by borrower *i* during 2002 to 2006. *REL (Number)* is a ratio equal to the number of loans/revolvers by institution *m* to borrower *i* in the 5 years from 2002 to 2006, divided by total number of loans by borrower *i* during 2002 to 2006. *Relationship intensity (Exposure, bn\$)* is dollar amount of loans/revolvers (bn\$) by institution *m* to borrower *i* in the 5 years from 2002 to 2006. *Relationship intensity (N)* is the number of loans/revolvers by institution *m* to borrower *i* in 5 years from 2002 to 2006. In all four relationship measures, if borrower *i* has a connection to more than one central institution, we choose the institution with the largest amount of business connected to borrower *i* in the five-year period. Please refer to the appendix for the variable definitions. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors clustered at PERMNO level, and *t*-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

	Dependent variable: Market Beta			
	Access to private debt through the central institutions			
	(1)	(2)	(3)	(4)
In Crisis	0.117** (2.09)	0.174** (2.08)	0.061*** (2.81)	0.008 (0.25)
REL(Amount)	0.004 (0.06)			
In Crisis × REL(Amount)	-0.075 (-1.06)			
REL(Number)		0.011 (0.13)		
In Crisis × REL(Number)		-0.131 (-1.41)		
Relation Intensity (Exposure, bn\$)			-0.035*** (-3.18)	
In Crisis × Relation Intensity (Exposure, bn\$)			-0.002 (-0.26)	
Relation Intensity (N)				-0.016*** (-2.71)
In Crisis × Relation Intensity (N)				0.017** (2.40)
Leverage	0.236*** (2.95)	0.240*** (3.06)	0.288*** (3.73)	0.280*** (3.53)
Book to Market	-0.007 (-0.60)	-0.006 (-0.48)	0.004 (0.34)	-0.003 (-0.24)
Size	0.064*** (6.42)	0.066*** (7.03)	0.078*** (7.66)	0.069*** (7.18)
Illiquidity	-0.002*** (-3.32)	-0.002*** (-3.32)	-0.001*** (-3.34)	-0.002*** (-3.37)
Industry F.E.	Y	Y	Y	Y
R-square	0.1201	0.1207	0.1252	0.1222
Company number	1,138	1,138	1,138	1,138

**Table VII**

**Crisis Risk Exposure and Firm Characteristics, Matching Sample Tests**

This table reports results of firm characteristics and difference-in-difference *t*-tests after matching firm characteristics. Panels A reports size and leverage differences on four sub samples of firms. Panel B, C, and D report treatment and control firms matched by firm characteristics. The treatment firms in Panel B are selected from firms with access to public debt through the central institutions, in Panel C selected from firms with access to private debt through the central institutions, and in Panel D selected from firms with access to private debt through the peripheral institutions. The control firms for Panels B, C, and D are selected from firms without a history of debt financing from 2002-2006. Please refer to the appendix for variable definitions. The treatment and control firms are matched by pre-crisis market beta, size, leverage, and book-to-market ratios, adjusted by industry median. The industry classification follows the Fama-French 12-sectoral definitions.

**Panel A Firm size and leverage**

	with history of access to			without history of debt financing
	private debt		public debt	
	central inst	peripheral inst	central inst	
	(1)	(2)	(3)	
Size, \$mn, mean	2,414	516	10,696	1,049
Size, \$mn, median	602	168	2,832	182
Leverage, mean	0.2026	0.1461	0.3149	0.0884
Leverage, median	0.1731	0.0793	0.2851	0.0015
Firm number	1,138	447	773	1,140

**Panel B: Treatment: access to public debt through the central institutions.**

	# firms	# unique firms	Market Beta		Leverage	B/M	Size	Leverage	B/M	Size
	(1)	(2)	bef crisis	in crisis	(5)	bef crisis	(7)	(8)	in crisis	(10)
Treatment	158	140	0.1342	0.2418	0.0977	0.0134	1.212	0.0839	0.0408	1.2599
Control	158	146	0.1331	0.0971	0.0886	0.0441	1.0276	0.0598	-0.044	1.0749
t-statistic			0.02	2.66***	0.46	-0.25	0.94	1.1	0.69	0.84

**Panel C: Treatment: access to private debt through the central institutions**

	# firms	# unique firms	Market Beta		Leverage	B/M	Size	Leverage	B/M	Size
	(1)	(2)	bef crisis	in crisis	(5)	bef crisis	(7)	(8)	in crisis	(10)
Treatment	509	451	-0.0272	0.0719	0.0012	0.0861	-0.1679	0.0062	0.1097	-0.1663
Control	509	439	-0.0289	-0.0273	0.0038	0.0422	-0.2304	-0.0018	0.0296	-0.3482
t-statistic			0.04	3.16***	-0.26	0.65	0.63	0.64	1.19	1.55

**Panel D: Treatment: access to private debt through the peripheral institutions**

	# firms	# unique firms	Market Beta		Leverage	B/M	Size	Leverage	B/M	Size
	(1)	(2)	bef crisis	in crisis	(5)	bef crisis	(7)	(8)	in crisis	(10)
Treatment	294	281	-0.2117	-0.0366	-0.0052	-0.0258	-1.1358	-0.0157	-0.0351	-1.0791
Control	294	249	-0.2077	-0.0432	-0.0093	0.0129	-1.1429	-0.0345	-0.0351	-1.2654
t-statistic			-0.07	0.15	0.31	-0.52	0.06	1.21	0	1.38

**Table VIII**  
**Crisis Risk Exposure and Accesses to Central Institutions**

This table reports results of difference-in-difference regressions on selected borrowers with access to selected central financial intermediaries. A firm's exposure to crisis risk is measured by the market beta, which is estimated by weekly returns across two periods, one for the pre-crisis period and the other for the crisis period. The pre-crisis period includes 96 weeks from September 1, 2005 to June 30, 2007. The crisis period includes 96 weeks from August 1, 2007 to May 31, 2009. Hence, each firm has two beta measurements. Among the central 97 institutions, we select the Top 8 institutions, which account for a very large fraction of aggregate debt financing. All top 8 institutions carry mortgage assets, and the average ratio of mortgage assets to equity capital is 2.55. The remaining 89 central institutions are labeled as *Secondary*. Among the top 8 institutions, we further label 4 institutions as "*Mortgage*" and the other 4 as "*Debt Financing*", because the former 4 institutions have relatively higher mortgage exposure and the latter 4 institutions facilitate relatively more debt financing. The key independent variables include *In Crisis*, and *Mortgage & Debt Financing*. *In Crisis* is a dummy which is equal to one during crisis period, and zero otherwise. Each borrower has two distinct access to the central institutions. Treatment and control borrowers in each panel share the first connection, which is *Mortgage*. The second connection for the group of treatment (control) borrowers is with connections to *Debt Financing (Secondary)* institutions. Please refer to the appendix for variable definition. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors clustered at PERMNO level, and t-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

Dependent variable: Market Beta		
	Access to private debt or public debt through 97 central institutions with exact two distinct connections	
	Mortgage & Secondary vs. Mortgage & Debt Financing	
	(1)	(2)
In Crisis	-0.031 (-0.39)	-0.058 (-0.51)
Private Debt Only		-0.08 (-0.66)
In Crisis × Private Debt Only		0.039 (0.29)
Mortgage & Debt Financing	-0.189 (-1.61)	-0.197* (-1.70)
In Crisis × Mortgage & Debt Financing	0.298** (2.30)	0.302** (2.34)
Leverage	0.567* (1.87)	0.535* (1.66)
Book to Market	-0.025 (-0.54)	-0.024 (-0.53)
Size	-0.032 (-1.03)	-0.039 (-1.13)
Illiquidity	-0.004* (-1.66)	-0.004* (-1.69)
Industry F.E.	Y	Y
R-square	0.1864	0.1887
Firm number	113	113

**Table IX**  
**Crisis Risk Exposure and Diversified Accesses to Central Institutions**

This table reports results of difference-in-differences regressions on selected borrowers with access to selected central financial intermediaries. A firm's exposure to crisis risk is measured by the market beta, which is estimated by weekly returns across two periods, one for the pre-crisis period and the other for the crisis period. The pre-crisis period includes 96 weeks from September 1, 2005 to June 30, 2007. The crisis period includes 96 weeks from August 1, 2007 to May 31, 2009. Hence, each firm has two beta measurements. Among the 97 central institutions, we select the top 20 institutions, which account for 89% of the debt intermediation. The key independent variables include *In Crisis* and *Multiple Conn*. *In Crisis* is a dummy which is equal to one during crisis period, and zero otherwise. There are two groups of treatment borrowers. Treatment borrowers in column (1) and (2) have exact two distinct connections to the 20 core institutions. Treatment borrowers in column (3) and (4) have more than two distinct connections to the 20 core institutions. Please refer to the appendix for variable definition. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors clustered at PERMNO level, and t-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

	Dependent variable: Market Beta			
	Access to private debt or public debt through the top 20 institutions			
	Only one connection vs. Exact two distinct connections		Only one connection vs. More than two distinct connections	
	(1)	(2)	(3)	(4)
In Crisis	-0.022 (-0.68)	-0.127** (-2.05)	-0.019 (-0.58)	-0.101* (-1.77)
Private Debt Only		-0.084 (-1.52)		-0.139*** (-2.82)
In Crisis × Private Debt Only		0.127* (1.96)		0.099* (1.73)
Multiple Conn	0.009 (0.19)	-0.001 (-0.02)	-0.104** (-2.44)	-0.178*** (-3.51)
In Crisis × Multiple Conn	0.107* (1.80)	0.125** (2.08)	0.141*** (3.11)	0.205*** (3.59)
Leverage	0.476*** (4.66)	0.458*** (4.34)	0.415*** (4.46)	0.366*** (3.85)
Book to Market	0.000 (0.00)	0.000 (0.01)	0.004 (0.21)	0.005 (-0.26)
Size	0.059*** (4.41)	0.057*** (4.15)	0.023** (1.99)	0.018 (1.55)
Illiquidity	-0.003*** (-6.08)	-0.003*** (-6.00)	-0.006** (-2.52)	-0.007** (-2.56)
Industry F.E.	Y	Y	Y	Y
R-square	0.1316	0.134	0.1294	0.1342
Firm number	649	649	763	763



**Table XI**  
**Corporate Performance and Access to the Central Institutions**

This table reports difference-in-difference regression results on a company's economic performance. The dependent variables include *SALE2AT*, *CAPX2AT*, and *OI2AT*, which are Compustat annual fiscal data in 2008 and 2009 scaled by assets (AT) as well as ROA. SALE is annual net sales, CAPX is capital expenditures, ROA is return on asset, and OI is operation income. Independent variables include leverage, Tobin's Q, return on assets (ROA), and size (log AT). When exploring the role for ROA during the crisis, we exclude it from the controls. To control firm default risk, we add *DTD*, distance to default, estimated following Bharath and Shumway (2004). To control the overall economic environment, we add *Market Beta in Crisis*. *YEAR2009* is equal to one if the dependent variable is in fiscal year 2009, or zero for fiscal year 2008.  $\# Conn to Cntrl Inst = \ln(\text{distinct connection to the central financial intermediaries} + 1)$ . The table only reports the coefficient for the interaction term of  $\# Conn to Cntrl Inst \times YEAR2009$ . Sample one includes 3,518 non-financial companies. 1,911 are treatment with connections to the central financial intermediaries, and the remaining 1,607 firms serve as a control with no such connections. Sample two includes 1,138 treatment firms with access to private debt through the central institutions and 1,140 control firms. Sample three includes 773 firms with access to public debt through the central institutions and the 1,140 control firms. The control firms in sample two and sample three do not possess a history of debt financing. Please refer to the appendix for variable definition. Industry fixed effects are included at the FF 12 sectoral level. Heteroskedasticity-consistent standard errors clustered at PERMNO level, and *t*-statistics are reported in brackets. The symbols \*, \*\*, \*\*\* denote significance at the 10%, 5%, and 1% level, respectively.

		Dependent variables			
		SALE2AT	CAPX2AT	ROA	OI2AT
		(1)	(2)	(3)	(4)
<b>Sample one</b>					
	All 3,518 non-financial firms	-0.030*** (-3.50)	-0.002 (-1.21)	-0.017** (-2.11)	-0.011*** (-3.11)
<hr/>					
Other controls		Y	Y	Y	Y
Industry F.E.		Y	Y	Y	Y
R-square		0.1982	0.3125	0.2229	0.7241
Company number		3,518	3,518	3,518	3,518
<hr/>					
<b>Sample two</b>					
	1,138 firms with access to private debt through 97 central institutions and 1,140 firms without a history of debt financing	-0.055*** (-3.30)	-0.002 (-0.93)	-0.034* (-1.77)	-0.026*** (-3.07)
<hr/>					
Other controls		Y	Y	Y	Y
Industry F.E.		Y	Y	Y	Y
R-square		0.2059	0.2674	0.2669	0.7588
Company number		2,278	2,278	2,278	2,278
<hr/>					
<b>Sample three</b>					
	773 firms with access to public debt through 97 central institutions and 1,140 firms without a history of debt financing	-0.022* (-1.91)	-0.005*** (-2.75)	-0.027** (-2.22)	-0.009* (-1.66)
<hr/>					
Other controls		Y	Y	Y	Y
Industry F.E.		Y	Y	Y	Y
R-square		0.1950	0.3366	0.2959	0.7582
Company number		1,913	1,913	1,913	1,913

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## Appendix A: variable definition

Variable	Definition
<b># Conn to Cntrl Inst</b>	Ln (distinct connection(s) to the 97 central financial intermediaries +1). The 97 central financial intermediaries are defined in Appendix B. The connection refers to intermediary service for a borrower to access loans/revolvers in Dealscan or/and corporate bonds in FISD from 2002 to 2006.
<b>Private Debt Only</b>	Non-financial firms have records in Dealscan for revolvers/loans or records for revolving credit lines in Capital IQ but do not have debt financing records in FISD or commercial papers in Capital IQ from 2002 to 2006.

<b>Variable</b>	<b>Definition</b>
<b>Access to public debt</b>	Non-financial firms have debt financing records in FISD or commercial papers in Capital IQ from 2002 to 2006, regardless the access to revolvers or loans.
<b>Bond rating</b>	A non-financial firms with bond rating by the end of 2006, or zero otherwise.
<b>REL(Amount)</b>	Amount of loans (\$) by liquidity provision institution $m$ to borrower $i$ in 5 years from 2002 to 2006 divided by total amount of loans by borrower $i$ during 2002 to 2006. For a borrower with access to multiple liquidity provision institutions, we pick up the institution with highest value. This is measure is similar to that in Bharath, Dahiya, Saunders, and Srinivasan (2009).
<b>REL(Number)</b>	Number of loans/revolvers by liquidity provision institution $m$ to borrower $i$ in 5 years from 2002 to 2006 divided by total number of loans by borrower $i$ during 2002 to 2006. For a borrower with access to multiple liquidity provision institutions, we pick up the institution with highest value. This is measure is similar to that in Bharath, Dahiya, Saunders, and Srinivasan (2009).
<b>Relationship intensity (Exposure) (bn\$)</b>	Amount of loans/revolvers (bn\$) by liquidity provision institution $m$ to borrower $i$ in 5 years from 2002 to 2006. For a borrower with access to multiple liquidity provision institutions, we pick up the institution with highest value. This measure is similar to the measure of Loan intensity (exposure) in Ivashina, Nair, Saunders, Massoud, and Stover (2008).
<b>Relationship intensity (N)</b>	Number of loans/revolvers by liquidity provision institution $m$ to borrower $i$ in 5 years from 2002 to 2006. For a borrower with access to multiple liquidity provision institutions, we pick up the institution with highest value. This measure is similar to the measure of Loan intensity (N) in Ivashina, Nair, Saunders, Massoud, and Stover (2008).
<b>In Crisis</b>	A dummy variable equal to one for observations in crisis, or zero before crisis. The before crisis period (BC) covers 96 weeks from September 1, 2005 to June 30, 2007. The in-crisis period (IC) covers 96 weeks from August 1, 2007 to May 31, 2009.

Variable	Definition
<b>YEAR2009</b>	YEAR2009 is a dummy variable equal to one if the dependent variable is in fiscal year 2009, or zero for fiscal year 2008.
<b>Leverage</b>	Leverage is T-1 fiscal year book leverage. (Debt in Current Liabilities + Long-Term Debt) / Asset = (DLC+DLTT) / AT, following Ivashina and Scharfstein (2010).
<b>Book to market (B/M)</b>	LogBM is book-to-market following Fama French (1992). LogBM = Ln (BE/ME). BE is the book value of common equity plus balance-sheet deferred taxes. ME is market equity in December. Before crisis book-to-market is measured in 2005. In crisis book-to-market is measure in 2007.
<b>Size</b>	LogME is size following Fama French (1992). Before crisis LogME is measured on 30Jun2006. In crisis LogME is measured on 30Jun2008.
<b>Illiquidity</b>	<p>Illiquid measure follows Amihud (2002).</p> $ILLIQ_{iy} = 1/D_{iy} \sum_{t=1}^{D_{iy}}  R_{iyt}  / VOLD_{iyt}$ <p>Before crisis Amihud is measured by trading days in the period from January 1, 2006 to December 31, 2006. In crisis Amihud is measured by trading days from January 1, 2008 to December 31, 2008.</p>
<b>Q</b>	Q = (Assets + Market value of equity - Book value of equity - Deferred taxes) / Assets = (AT + CSHO * PRCC_F - CEQ - TXDB) / AT, following Ivashina and Scharfstein (2010).
<b>ROA</b>	ROA = Income before extraordinary items / Total assets = IB / AT, following Ivashina and Scharfstein (2010).
<b>AT</b>	Total Assets.
<b>SEQ</b>	Shareholder equity.

## Appendix B: Ninety-seven central financial institutions

This appendix reports a sample of ninety-seven financial institutions ranked by financial intermediary service in dollar amount in Dealscan and FISD from 2002 to 2006. The lead lenders and (lead) underwriters are standardized by top 150 financial institutions measured by their total assets in the end of 2006.

Rank of debt provision	Compustat Company Name
1	CITIGROUP INC
2	JPMORGAN CHASE & CO
3	BANK OF AMERICA CORP
4	DEUTSCHE BANK AG
5	MERRILL LYNCH & CO INC
6	UBS AG
7	CREDIT SUISSE GROUP
8	MORGAN STANLEY
9	ABN-AMRO HOLDINGS NV
10	GOLDMAN SACHS GROUP INC
20	MITSUBISHI UFJ FINANCIAL GRP
30	SUNTRUST BANKS INC
40	BANCO SANTANDER SA
50	BB&T CORP
60	NORTHERN TRUST CORP
70	BANK OF IRELAND
80	EDELMAN FINANCIAL GROUP INC
90	CAPITAL ONE FINANCIAL CORP
97	UNIBANCO UNIAO DE BANCO