Are Banks Too Big to Fail or Too Big to Save? International Evidence from Equity Prices and CDS Spreads

Demirgüc-Kunt, A.; Huizinga, H.P.

DOI:
10.2139/ssrn.1626132

Publication date:
2010

Document Version
Early version, also known as pre-print

Discussion paper

ARE BANKS TOO BIG TO FAIL OR TOO BIG TO SAVE? INTERNATIONAL EVIDENCE FROM EQUITY PRICES AND CDS SPREADS

By Asli Demirgüç-Kunt, Harry Huizinga

June 2010

European Banking Center Discussion Paper No. 2010–15

This is also a
CentER Discussion Paper No. 2010-59

ISSN 0924-7815

Are banks too big to fail or too big to save?
International evidence from equity prices and CDS spreads

Asli Demirgüç-Kunt[1]
World Bank

Harry Huizinga[1]
Tilburg University and CEPR

June 2010

Abstract: Deteriorating public finances around the world raise doubts about countries' abilities to bail out their largest banks. For an international sample of banks, this paper investigates the impact of government indebtedness and deficits on bank stock prices and CDS spreads. Overall, bank stock prices reflect a negative capitalization of government debt and they respond negatively to deficits. We present evidence that in 2008 systemically large banks saw a reduction in their market valuation in countries running large fiscal deficits. Furthermore, the change in bank CDS spreads in 2008 relative to 2007 reflects countries' deterioration of public deficits. Our results suggest that some systemically important banks can increase their value by downsizing or splitting up, as they have become too big to save, potentially reversing the trend to ever larger banks. We also document that a smaller proportion of banks are systemically important - relative to GDP - in 2008 than in the two previous years, which could reflect these private incentives to downsize.

Key words: Banking, Financial crisis, Credit default swap, Too big to fail, Too big to save
JEL classifications: G21, G28

[1]Demirguc-Kunt: World Bank (Ademirguckunt@worldbank.org); Huizinga: Tilburg University and CEPR (Harry.Huizinga@ecb.int). We thank seminar participants at the European Business School for comments. This paper was in part written while Harry Huizinga was a Duisenberg Research Fellow at the European Central Bank. Financial support from DFID is greatfully acknowledged. This paper's findings, interpretations, and conclusions are entirely those of the authors and do not necessarily represent the views of the European Central Bank and the World Bank, its Executive Directors, or the countries they represent.

1. Introduction

In the years leading up to the current financial crisis, banks around the world expanded their balance sheets to increase profitability in an environment of cheap funding. Access to international funding made it possible for individual banks and overall banking systems to reach enormous size relative to their countries' GDP. The prime example is Iceland where the liabilities of the overall banking system reached around 9 times GDP at the end of 2007, before a spectacular collapse of the banking system in 2008.[2] By the end of 2008, the liabilities of publicly-listed banks in Switzerland and the United Kingdom had reached 6.3 and 5.5 times their GDP. Liabilities of banks in Belgium, Denmark France, Ireland, and the Netherlands similarly exceeded two times their GDP. At the end of 2008, we identified 30 publicly-listed banks worldwide with liabilities exceeding half of their country's GDP. Twelve of these had total liabilities exceeding 1 trillion US dollars.

These huge banks have assets well over $100 billion, far exceeding the technologically optimal size of around $25 billion found by Berger et al. (1997) on the basis of US data. Huge banks are no doubt difficult to manage effectively, and huge size may yield few additional risk diversification benefits. Banks may have grown this large in part because bank managers see their stature and pay increase with bank size. Alternatively, bank growth has been motivated by a desire to reach too-big-to-fail status, implying lower funding cost. Banks perhaps can increase their implicit claim on the financial safety net by ever increasing their size under normal business cycle conditions and in the absence of a major financial crisis. The financial and economic crisis that started in 2008, however, has been unexpectedly deep with a severe deterioration of the public finances so far and projected in the years to come. This raises doubts about countries' ability and determination to save their largest banks. At the very least, financially strapped

[2] The liabilities of Glitner Bank, Kaupthing Bank and Landsbanki together were 9.0 times Icelandic GDP in 2007.

governments may be forced to resolve any future large-bank failures in a relatively cheap way, implying large losses to bank creditors.[3]

This paper investigates the impact of a country's public finances, in the form of government debt and deficits, on expected returns to bank shareholders as discounted in bank stock prices, making a distinction between systemically important and smaller banks. In a parallel fashion, we also consider the impact of government finances on expected losses on banks' liabilities, as reflected in the 5-year credit default swap (CDS) spreads. Specifically, we consider bank valuation over the 1991-2008 period, with 717 publicly-listed banks in 34 countries in 2008, and CDS spreads over the 2001-2008 period, with 59 banks in 20 countries in 2008.

Our results on the implications of bank size and government finances for bank stock valuation are as follows. A bank's market-to-book ratio is found to be positively related to the absolute size of its assets, while there is some evidence of a negative relationship between the market-to-book ratio and a bank's total liabilities-to-GDP ratio, as an indicator of systemic importance. For the overall sample, we further find that the bank market-to-book ratio is negatively related to government debt and deficits. The negative capitalization of government debt and deficits into bank share prices suggests that the expected consequences of higher public debts, which could be due to a combination of higher future taxation and lower future banking subsidies through the financial safety net, negatively affect returns to shareholders.

For our overall sample, we fail to find that bank valuation of systemically important banks is relatively sensitive to a country's public finances. At a time of financial crisis in 2008, however, we find that bank valuation of systemically large banks responds more negatively to a deterioration of the public deficit. This indicates that during a crisis distressed public finances reduce bank valuation through a less

[3] At a time of severe financial crisis, countries' ability to guarantee bank liabilities may be at least as important as their formal guarantees. In the recent crisis, many countries provided explicit guarantees of many non-deposit liabilities and they have extended deposit insurance. Explicit deposit insurance of some kind already was almost universal prior to the current crisis (see Demirgüç-Kunt, Kane, and Laeven (eds.), 2008).

generous financial safety net, rather than just through the prospect of higher future bank taxation. In particular, subsidies through the financial safety net to systemically large banks appear to be reduced relatively more by weak public finances. This indicates that at a time of crisis systemically large banks are too big to save.

Government finance variables do not materially affect bank CDS spreads over the 2001-2008 sample period. However, we find that the increase in bank CDS spreads between 2007 and 2008 is significantly related to the deterioration of the public deficit, as evidence that expected credit losses on bank liabilities reflect the public finances during a severe financial crisis. Moreover, we find that CDS spreads are positively related to the fiscal cost relative to GDP of resolving any previous banking crisis. Thus, investors in bank liabilities appear to expect larger losses in countries that experienced costly banking crises before.

We also consider the pricing of bank risk, as measured by the volatility of weekly bank stock returns, into bank stock prices and CDS spreads, separately for systemically large and small banks. We find that the share prices of systemically large banks are more positively related to bank risk, while CDS spreads of systemically large banks are more negatively related to bank risk. This suggests that a marginal increase in bank risk increases the implicit subsidy from the financial safety net relatively more for systemically large banks – after controlling for systemic size and government finances. These results are in line with the view that systemically large banks are too large to fail.

Overall, we find that a systemically large bank may benefit relatively more from taking on more risk, while it can also lose relatively more from being in a country that runs large government deficits at a time of financial crisis. This makes the net benefit of systemic size ambiguous. It also suggests that some banks – particularly those with limited risk and located in high-deficit countries – may have grown beyond the size that maximizes their implicit subsidy from the financial safety net. Such banks can increase shareholder value by downsizing or splitting up. For our overall sample, estimated coefficients imply that the share

prices of the average systemically important bank are discounted 22.3 percent on account of systemic size, providing strong incentives to reduce bank size relative to the national economy. Our data indicate that a smaller proportion of banks are systemically important - relative to GDP - in 2008 than in the two previous years, which could reflect private incentives to downsize.

This paper is related to several others that have considered the impact of bank size on bank stock returns and bank liabilities. In 1984, the US Comptroller of the Currency in testimony before Congress argued that a group of 11 large banks were 'too big to fail' (TBTF) and that for those banks total deposit insurance would be provided. Using an event study methodology for a sample 63 US banks, O'Hara and Shaw (1990) find that there are positive wealth effects accruing to these TBTF banks, while there are negative wealth effects accruing to the smaller banks.

The positive wealth effect of TBTF suggests that a bank merger that creates a bank that is TBTF can create wealth for bank shareholders. Considering US bank mergers over the 1991-1998 period, Kane (2000) finds that stockholders of large-bank acquirers have gained value when a deposit institution target is large and even more value when a deposit institution target was previously headquartered in the same state. Benston, Hunter and Wall (1995) similarly find that bank mergers and acquisitions are in part motivated by enhancing the deposit insurance put option.

Moreover, the benefits of gaining TBTF status following bank mergers are not limited to stockholders. Penas and Unal (2004) consider the returns to bond holders around US bank mergers in the 1991-1997 period. These authors find that adjusted returns of merging banks' bonds are positive across pre-merger and announcement months. These positive returns are attributed to gaining TBTF status, in addition to diversification gains and, to a lesser extent, synergy gains.

All of these papers have aimed to identify an impact of TBTF by considering the differential pricing of bank stock and liabilities for large and small banks. Alternatively, an impact of TBTF on bank liability

pricing can be ascertained by comparing the pricing of bank liabilities over different periods, during which TBTF is supposed to hold to different extents. In this vein, Flannery and Sorescu (1996) consider the determination of spreads on bank subordinated debentures over different subperiods during the years 1983-1991.[4] These spreads should reflect bank-specific risk indicators less during times of greater likelihood of application of TBTF policies. Flannery and Sorescu (1996) specifically find that spreads reflect bank risk indicators relatively less during the last three years of the 1983-1991 period, since after 1998 many bank and thrift debenture holders had suffered losses during bank failures signaling a lowered adherence to TBTF.

Similarly, Sironi (2003) considers the sensitivity of spreads of European banks' subordinated notes and debentures during the 19991-2001 period and finds that these spreads are relatively insensitive to bank risk in the second part of the 1990s, consistent with a disappearing perception of TBTF type guarantees on the part of investors. Sironi (2003) attributes the apparent diminution of TBTF in Europe during the 1990s to the joint effect of the loss of monetary policy by national central banks and the public budget constraints imposed by the European Monetary Union.

The TBTF literature essentially investigates the authorities' need or desire to provide more support for relatively large banks on the assumption that governments are able to do so. Brown and Dinç (2009) is the first paper to provide evidence that a country's ability to support its financial sector, as reflected in its public deficit, affects its treatment of distressed banks. These authors consider government takeover or closure decisions of banks in 21 emerging market economies during the 1990s. As expected, a bank is more likely to be taken over or closed by the government, if its own capital ratio is low. However, is it less likely to be taken over, if the average capital ratio of other banks in the same country is low as well. This is taken to be evidence of 'too many to fail,' as the state may be unable to close many weak banks simultaneously.

[4] This paper is part of a literature that considers whether yields on bank bonds and also stock prices adequately reflect bank risk, as reflected in accounting data, supervisory data, or subsequent credit downgrades (see Gropp, Vesala and Vulpes (2006) for an overview).

Interestingly, the 'too many to fail' effect is relatively weak in countries with high public budget balances. While Brown and Dinç (2009) find that countries with weak public finances are slow to close weak banks, it does not follow that banks in fact benefit from being in countries with weak public finances, since the counties may in the end be forced to adopt cheap resolution methods, implying large losses to bank creditors.

Differentiating between systeminally important and other banks, we consider the impact of the public finances on bank stock prices and CDS spreads, reflecting the net effect of potentially different timing and resolution method decisions. Our results indicate a negative effect of higher debt or deficits on bank stock prices, for the first time documenting how the state of public finances may limit net subsidies to the banking sector. This 'too large to save' effect is consistent with the observed downsizing of banks that has been occurring in recent years.

The remainder of this paper is organized as follows. Section 2 discusses the data. Section 3 outlines the empirical strategy and presents the results. Section 4 concludes.

2. The data

This section describes data on the size of bank liabilities relative to national economies as well as other variables used in this study.

2.1. The size of bank liabilities

In this study, we consider an international sample of banks over the 1991-2008 period. Accounting data on bank liabilities and other variables are taken from Bankscope. Our sample of banks excludes banks that are categorized as investment banks or securities houses. Also, we restrict ourselves to banks that are publicly-listed to ensure data quality and to enhance comparability across countries. The largest banks in most countries tend to be publicly-traded.

As a measure of systemic size, we take the ratio of a bank's total liabilities to national GDP, denoted Liabilities (see the Appendix for variable definitions and data sources). This reflects that in practice often a bank's total liabilities, rather than just insured deposits, are

honored in a bank bail-out. For 2008, we have identified 30 publicly-listed banks worldwide with liabilities in excess of half of their country's GDP. These major banks are listed in Table 1. UBS, a Swiss bank, had a liabilities-to-GDP ratio of 3.7, followed by ING of the Netherlands with an analogous ratio of 2.2, and Credit Suisse of Switzerland with a ratio of 2.1. Among these systemically large banks, the largest banks in terms of absolute liabilities were Barclays, BNP Paribas, Deutsche Bank and Royal Bank of Scotland, each with liabilities exceeding 2.5 trillion US dollars.

The world's largest banks tend to be international banks with large shares of assets and liabilities located in foreign branches and subsidiaries. In these instances, the home-country fiscal authorities tend to remain responsible wholly or in part for insuring the bank's liabilities and for paying for any bail-out. In the European Economic Area (including the European Union, Iceland, Liechtenstein, and Norway), bank deposits located at foreign branches are formally covered by the deposit insurance scheme of the home country, according to the EU directive on deposit insurance adopted in 1994. Furthermore, the EU directive on the reorganization and winding-up of credit institutions adopted in 2001 requires that domestic and foreign bank creditors are treated equally in bankruptcy proceedings, preventing selective bail-outs of only domestic bank liability holders. The distinction between foreign branches and subsidiaries in practice is often blurred, as international banks formally guarantee the liabilities of their foreign subsidiaries, or they de facto have to guarantee these liabilities to prevent reputational loss in case of a foreign-subsidiary insolvency.

As a measure of banking system size, we can compute ratio of banking-system liabilities to national GDP. Switzerland and the UK have the largest ratios of banking system total liabilities to GDP of 6.3 and 5.5 respectively, as seen in Table 2. The table further shows that 13 European countries are among the 20 countries with the largest ratios of banking-system liabilities to GDP.

Table 3 provides additional information on the distribution of systemically important banks internationally in 2008. Country coverage in the table is restricted to those countries for

which information on central government indebtedness or the fiscal balance is available from the IMF or the OECD. Columns 1 and 2 of the table first provide information on banking-system liabilities relative to GDP and on the largest bank's liabilities relative to GDP for this larger set of countries. Next, column 3 provides the total number of publicly-listed banks in 2008. The US stands out with a rather large number of 464 banks. The next four columns indicate how many banks are systemically large in that their liabilities-to-GDP ratio exceeds 0.1, 0.25, 0.5 and 1.0, respectively.

Several countries are seen to have highly concentrated banking systems with rather few but very large banks relative to GDP. Ireland, for instance, has three publicly-listed banks that all have liabilities exceeding half of GDP, while Belgium has three publicly-listed banks of which two have liabilities that exceed GDP. At the other extreme, the US has a highly dispersed banking system with only three banks that have a liabilities-to-GDP ratio exceeding 0.1. These three banks are Citigroup, Bank of America and JP Morgan Chase, with the latter bank having the highest liabilities-to-GDP ratio for any US bank of 0.14.

The final two columns of the table provide the country's central government debt to GDP ratio and its budget balance relative to GDP. Belgium, Greece, and Italy are shown to be countries with several systemically large banks and a high debt-to-GDP ratio of at least 0.9. Ireland, on the other hand, similarly has several systemically large banks, but its debt-to-GDP ratio is relatively low at 0.27.

The huge size of many countries' largest banks reflects that many banks' liabilities have grown faster than GDP over the last two decades. This is evident in Figure 1. This figure displays the percentages of large banks that are defined as systemic by their liabilities-to-GDP ratios in excess of various benchmarks for each of the years since 1991. The percentages of systemically large banks reached a temporary peak in the 1996-1998 period. In the early years of the new millennium, the relative frequencies of systemically large banks declined, but these frequencies reached new highs in the 2006-2007 period, before a slight drop-off in 2008. The

percentage of banks with a liabilities-to-GDP ratio exceeding 0.5, for instance, reached a high of 3.36 in 2006, and declined to 2.71 in 2008.

2.2. Bank market valuation, CDS spreads and other variables

In the empirical work below, we relate two variables using market prices to the systemic bank size and national public finance variables. Using stock price data, we first construct bank's market-to-book ratio as the market value of the bank's common equity divided by the book value of common equity. The market value of a bank's common equity is available from Datastream. The market-to-book ratio should reflect any costs or benefits of systemic bank size to bank shareholders. The market-to-book has a sample mean of 1.45 in the overall sample, as seen in Table 4.

Our second dependent variable is a bank's CDS spread. We construct a bank's yearly CDS spread as the average of daily CDS spreads, provided that there are at least 100 daily CDS spreads. We obtain CDS information from Markit. Typically, several CDS contracts are traded for a given major bank differing in the duration of the contract and in the definition of the deliverable bank liabilities in case of a specified credit event. Following Jorion and Zhang (2007), we consider 5-year CDS contracts as these contracts are the most liquid and constitute the majority of the entire CDS market. We further select on CDS contracts for senior unsecured debt with a modified restructuring (MR) clause.[5] Contracts can be denominated in dollars, euros or another major currency, with the currency of denomination selected in this order in case there are contracts in multiple currencies

The CDS spread provides a market indicator of expected credit losses on bank liabilities, as the seller of the CDS contract takes on the obligation to purchase specified bank liabilities at par in the event of a bank credit event, as set out in the CDS contract. CDS spreads provide direct market estimates of credit losses, as opposed to bond yield spreads that in addition contain

[5] This clause is part of the standard ISDA contract since 2001, and it limits deliverable obligations in the event of a restructuring agreement to those with a maturity of 30 days or less.

a liquidity component (see, for instance, Longstaff, Mithal and Neis (2005)). CDS spreads appear to reflect available information on credit future losses well, as they tend to anticipate debt downgrades (see Norden and Weber (2004)), and may reflect insider information (see Acharya and Johnson (2007)), and as price discovery takes place primarily in the CDS market (see Blanco, Brennan and Marsh (2005)).[6] Knaup and Wagner (2009) have found that the correlation between bank stock returns and an index of corporate CDS spreads provides a good indication of bank asset risk exposure during the financial crisis of 2008.

In practice, we have CDS spreads from 2001 to 2008, with CDS spreads available for a total of 59 banks in 2008, as seen in Table 5. In this table, we further see that the mean CDS spread per year has been extremely low for most years with a minimum of 0.23 percent in 2004, reaching a peak of 1.20 percent in 2008. The mean CDS spread for the entire sample is 0.43 percent, as seen in Table 4.

In the subsequent analysis, we include several additional bank-level and country-level variables. Starting with the bank-level variables, assets is the logarithm of total bank assets in millions of dollars. This variable measures a bank's absolute size - rather than its size relative to its national economy. Bank size may matter to bank shareholders and liability holders because of technological and managerial economies (or diseconomies) of scale. In addition, bank size can affect a bank's expected access to a country's financial safety net on account of too-big-to-fail considerations, independently of the bank's size relative to the national economy.

Next, pre-tax profits is the ratio of a bank's pre-tax profits to assets. Banks that are more profitable are expected to have a higher market-to-book ratio. Earning assets, in turn, is the ratio of earning assets to total assets, which proxies for a bank's business model. Specifically, a bank with a high earning assets variable may derive a large share of its income from traditional lending activities, rather than from fee-generating activities, such as advisory services, and trading on its own account. At a time of depressed values for traditional bank assets such as

[6] Recently Hart and Zingales (2009) proposed to use the CDS spread as a trigger device that forces banks to issue additional equity if it reaches a certain threshold level.

mortgage loans, this variable could negatively affect the market-to-book ratio, while the impact on the CDS spread may be positive. An additional bank-level variable is leverage, defined as the ratio of total bank liabilities to total assets. The market-to-book ratio may be positively related to leverage due to higher implicit subsidies from the financial safety net or alternatively because of the deductibility of interest from the corporate tax base, but a negative relationship may also exist since higher leverage may increase expected bankruptcy costs. Similarly, the CDS spread may be positively related to leverage, if high leverage implies relatively large expected credit losses on bank liabilities.

A country's past experience with banking crises may affect the financial support that will be available to banks in any future financial crisis. Therefore, we control for the occurrence and fiscal cost of past banking crises. Specifically, past crisis is a dummy variable that equals one if a country has emerged from a previous banking crisis, and it is zero otherwise. In the table, we see that the mean value of this variable is 0.79, which implies that 79 percent of banks are located in a country that has suffered a banking crisis. In addition, past fiscal cost represents the ratio of the fiscal cost - relative to GDP - of resolving the most recent past banking crisis. This variable is zero, if the country has not emerged from any past banking crisis. The information used to construct these variables is taken from Laeven and Valencia (2008).

The table also provides summary statistics on the government debt and fiscal balance variables. The fiscal balance is the net fiscal balance, computed as revenues minus expenses and depreciation of public capital. The mean government debt and fiscal balance ratios in the sample are 49.4 and -2.1 percent, respectively.

To represent bank risk, we construct the bank stock risk variable as the annualized standard deviation of weekly returns on bank stock holdings, based on returns information from Datastream. As an alternative index of bank riskiness, we use the Z-score, which is a bank's distance from default, computed as the sum of the bank's contemporaneous return on assets and capital assets ratio, divided by the standard deviation of the return on assets. A higher Z-score indicates higher bank stability.

Finally, the table provides summary statistics on the indicators of a banks' systemic size. Liabilities is a bank's liabilities-to-GDP ratio, with a mean of 3.7 percent. Sum of liabilities is the ratio of banking-system liabilities to GDP, with a mean of 1.11. Other Liabilities is the difference between Sum of Liabilities and an individual bank's own Liabilities variable, while Liabilities sq is the square of Liabilities. The variables Big 0.1, Big 0.25, Big 0.5 and Big 1.0 are dummy indicators of systemic size. For instance, Big 0.1 is a dummy variable that equals 1 if a bank's total liabilities exceed 10 percent of GDP, while it is zero otherwise. Big 0.25, Big 0.5 and Big 1.0 are defined analogously. In the tables, we see, for instance, that 5.5 percent of banks have a liabilities-to-GDP ratio that exceeds 0.1.

To conclude this section, it is interesting to see how systemically important banks tend to differ from smaller banks. To this effect, Table 6 provides the means of our set of variables in 2008 separately for banks with a liabilities-to-GDP ratio exceeding 0.5 and for smaller banks. The table shows that systemically important banks have significantly lower CDS spreads. The larger banks further have a higher average earning assets ratio and higher leverage. The larger banks in addition tend to be located in countries that experienced fewer banking crises with correspondingly lower past fiscal costs of banking crises, while on average they are located in countries with lower fiscal balances for the year 2008.

3. The empirical evidence

In this section, we will examine how bank size, in absolute terms and relative to the national economy, potentially affects bank valuation and CDS pricing on account of differential access to the financial safety net subsidies. We first discuss our tests of whether banks are too big too fail and too big to save. Then we present our main empirical results, followed by some robustness checks.

3.1. Tests of too big to fail and too big to save

Assets, or the log of bank assets in millions of US dollars, is our measure of absolute bank size. This variable can affect a bank's market-to-book ratio on account of any technological

or managerial economies of scale and potentially through a TBTF effect, if the bank is so large that a bank failure would create unacceptably high negative externalities to the economy. A bank's TBTF status affects the risk profile of its liabilities, and therefore potentially is priced into CDS spreads as well.

A bank that is large relative to its national economy stands to create large negative externalities relative to its economy, if it fails. Thus, systemic size, as proxied by the Liabilities variable and the various Big variables, also potentially bestows a bank with TBTF status, leading to higher share prices and a lower CDS spread. Conversely, systemic size can make it too expensive for a country to bail out a bank, rendering a bank 'too big to save' (TBTS). If so, systemic size leads to lower bank valuation and higher CDS spreads. Thus the relationships between systemic size on the one hand and bank valuation and CDS spreads on the other are a priori ambiguous and potentially non-monotonic.

A country's ability to bail out its systemically large banks should depend on the health of its public finances, as proxied by the central government debt and fiscal balance ratios. The government debt and deficit ratios are expected to negatively affect bank valuation, as higher government debt signals higher taxes in the future to service the debt and lower capacity to support banks through the financial safety net. Bank profitability tends to reflect economic rents so that expected future corporate income taxation may well be capitalized into lower share prices. A reduced ability on the part of governments to bail out banks affects the risk profile of bank liabilities, and hence potentially is priced into higher CDS spreads.

A restricted government ability to bail out banks on account of distressed public finances should especially affect systemically important banks. To test this, we can include an interaction variable of, say, the public debt ratio and a categorical indicator of systemic size in our empirical specifications. A negative estimated coefficient on such an interaction variable suggests that systemically large banks can expect fewer subsidies from the financial safety net in highly indebted countries, indicating that they have become 'too big to save.' Similarly, such an

interaction term may positively affect the CDS spread, signaling larger expected losses on bank liabilities for systemically sizeable banks in countries laden with public debt.

Banks are commonly taken to be subject to moral hazard as increased bank risk potentially increases expected benefits from the financial safety net, thereby increasing bank valuation. This can explain a positive relationship between bank valuation and an indicator of bank risk such as the annualized standard deviation of weekly bank stock return. The relationship between bank valuation and bank risk may be even more positive for systemically large banks if especially these banks are TBTF, and it can be less positive if there is an offsetting negative effect in case these banks are TBTS. To test the relative importance of TBTF and TBTS effects for systemic banks, we can include an interaction term of bank risk and an indicator of systemic size in the empirical specification.

Bank risk can be expected to imply larger losses on bank liabilities in the presence of an imperfect financial safety net. Thus, bank risk should lead to higher CDS spreads. The relationship between the CDS spread and bank risk may be more muted for systemic banks if TBTF is relatively more important, while can be more pronounced if TBTS is relatively more important. To test this, we can include an interaction variable of bank risk and bank systemic size in an empirical specification for estimating the CDS spread.

3.2. Empirical results on too big to fail versus too big to save

First, in Table 7, we present results of regressions where the market-to-book ratio and the CDS spread are related to bank and banking-system size and bank risk variables and a host of control variables. Specifically, Panel A presents regressions where the market-to-book ratio and the CDS spread are related only to the bank and banking-system size and risk variables, while Panel B presents regressions that in addition include the control variables. The market-to book ratio is the dependent variable in regressions 1-5 in either panel, while the CDS spread is the dependent variable in regressions 6 through 10. All regressions include country and year fixed effects, and errors are clustered at the level of the bank.

The market-to-book ratio is seen to be positively and significantly related to the assets variable as a measure of absolute bank size in regressions 1-5 in Panel A, while the CDS spread does not appear to reflect assets size in regressions 6-10. The positive relationship between bank size and bank valuation suggests a TBTF effect for large banks, even if it also may reflect economies of scale or management.

Next, the public debt variable negatively and significantly affects the market-to-book ratio in regressions 1 through 5. Public debt thus is negatively capitalized into bank share prices, potentially reflecting that banks cannot be saved as easily in fiscally strapped countries. In the CDS regressions 6 through 10, the public debt variable does not obtain a significant coefficient. Thus public indebtedness does not appear to affect expected credit losses on bank liabilities, at least for senior unsecured bank liabilities.

Bank risk, proxied by the bank stock risk variable, in turn positively affects the market-to-book ratio in regressions 1-5 (with significance at 10 percent), as well as the CDS spread in regressions 6-10 (with significance at 1 or 5 percent). Bank risk thus benefits bank shareholders, presumably because the financial safety net prevents banks' funding costs from fully reflecting bank risk. All the same, increased bank risk implies larger expected losses on bank liabilities, as reflected by higher CDS spreads.

The bank liabilities-to-GDP ratio enters the market-to-book regression 1 with a negative but insignificant coefficient, and it is estimated with a coefficient of zero in the CDS regression 6. In regressions 2 and 7, we replace the bank-level liabilities-to-GDP ratio by the system-level liabilities-to-GDP ratio, yielding insignificant estimated coefficients in both regressions. Next, in regressions 3 and 8 the systemic variables are the bank's own liabilities-to-GDP ratio and the ratio of other national banks' liabilities to GDP, again yielding coefficients that are statistically insignificant. Further, regressions 4 and 9 include a bank's own liabilities-to-GDP ratio and the square of this variable. In the market-to-book regression 4, the linear and quadratic liabilities-to-GDP variables enter with negative and positive coefficients, respectively, that are both significant at the 1 percent level.

The estimated coefficients of -0.570 and 0.190 on the linear and quadratic liabilities-to-GDP variables in regression 4 imply that the market-to-book ratio declines with the bank's liabilities-to-GDP ratio if the latter ratio is less than 1.5, while it increases with the liabilities-to-GDP ratio for higher values of this variable. This suggests that perhaps a very few large banks can obtain increased valuation from larger systemic size at the margin, while the vast majority can benefit from reduced systemic size. Moreover, the estimated coefficients suggest that all banks with a liabilities-to-GDP ratio less than 3.0 (which means all banks in 2008 apart from UBS as seen in Table 1) have a lower valuation on account of their systemic size than a negligibly small bank with a liabilities-to-GDP ratio of zero.[7]

In the CDS regression 9, the linear and quadratic liabilities-to-GDP terms instead are estimated with coefficients that are statistically insignificant. Regressions 5 and 10 jointly include the systemic variables included in regressions 3-4 and 8-9 with similar outcomes. Results so far suggest that bank valuation increases with absolute bank size, while it declines with systemic size for all banks other than a few very large banks. CDS spreads, instead, appear unrelated to either absolute or systemic bank size.

The regressions in Panel B of Table 7 include control variables. The market-to-book ratio is seen to be positively and significantly related to pre-tax profits throughout Panel B, while the relationship between the CDS spread and pre-tax profits is negative, but not statistically significant. The market-to-book ratio is negatively related to the earning assets variable, suggesting that traditional banking activities, involving earning assets, add relatively little value. The CDS spread, in turn, is negatively related to the past crisis dummy, and positively related to the fiscal cost of past crises in regressions 9 and 10 (both variables are significant at the 10 percent level). This suggests that CDS spreads positively reflect past crises that have been very costly, perhaps because the concerned countries have reformed the financial safety net to make

[7] Unless a bank relocates to another country, it cannot change its systemic size without at the same time changing its absolute size. Below, we present some illustrative calculations of the impact of a change in bank size on valuation, taking into account that systemic size and absolute size vary simultaneously.

costly crisis resolution in the future less likely. In some specification, the market-to-book value (but not the CDS spreads) is further positively related to per capita GDP (at the 10 percent significance level).

The relationships between bank valuation on the one hand and the bank size and risk variables on the other are not qualitatively affected by the inclusion of controls in Panel B. The linear liabilities-to-GDP variables, however, is now estimated with a coefficient of -0.008 that is significant at 5 percent in the CDS regression 9 of Panel B, while the quadratic liabilities-to-GDP variable obtains a coefficient of 0.003 that is insignificant in this regression. These point estimates suggest that essentially all banks (with liabilities to GDP less than 2.7) can reduce expected losses on their liabilities by increasing their systemic size, as evidence of TBTF.

The results in both panels of Table 7 suggest that the relationships between the market-to-book ratio and the CDS spread on the one hand and systemic size on the other may be non-linear. One way to deal with this is to introduce a categorical variable indicating whether systemic size exceeds a certain threshold level. The regressions in Table 8 include the Big0.5 variable, which equals one if the liabilities-to-GDP ratio exceeds 0.5 while it is zero otherwise. The table again contains two panels, with Panel A including only the bank and banking-system size and risk variables, and Panel B in addition including a range of control variables. In regressions 1-5 of either panel, the market-to-book value is the dependent variable, while the CDS spread is the dependent variable in regressions 6-10. Regressions 5 and 10 in either panel differ from the other regressions in that the fiscal balance rather than the public debt ratio is the included public finance variable. This leads to a reduced sample size in these regressions, as fiscal balance information is available from the IMF and OECD only for recent years for many countries.

The Big0.5 variable enters the market-to-book regression 1 and the CDS regression 6 with negative but insignificant coefficients in Panel A of Table 8. In regressions 2 and 6, an interaction term of Big0.5 with the public debt ratio is included as well, yielding insignificant coefficients in both regressions. Regressions 3 and 7 instead include an interaction term of the Big0.5 variable with the bank stock risk variable. Now the Big0.5 variable obtains a negative

coefficient of -0.454 that is significant at the 5 percent level in the market-to-book regression, while its interaction with bank stock risk obtains a positive coefficient of 0.763 that is significant at 10 percent. This suggests that systemically large banks see their valuation increase relatively more with higher bank risk at the margin, as bank risk apparently adds to these banks' TBTF status.[8]

In the CDS regression 8 of Panel A of Table 8, the Big0.5 variable is estimated with a coefficient of 0.004 that is significant at the 5 percent level, while its interaction with bank stock risk obtains a coefficient of -0.013 that is significant at the 1 percent level. These results suggest that especially systemically large banks can benefit from taking on more risk, as this reduces the expected losses on their bank liabilities on account of strengthening their TBTF status. Again we can consider the implications of systemic size for a bank with mean bank stock risk. Such a bank will see its CDS spread changed on account of its size by -0.0061 percent (or 0.004 – 0.013*0.303). The average-risk, systemically large bank thus faces a slightly lower CDS spread, on account of increased TBTF status. Regressions 4 and 9 jointly include interaction terms of Big0.5 with the public debt and bank stock risk variable, yielding that the Big0.5 variable no longer is statistically significant in regression 4.

In regressions 5 and 10, as indicated, the fiscal balance variable replaces the government debt variable. In regression 5, we see that the market-to-book ratio is positively and significantly related to the fiscal balance, confirming that the state of public finances is capitalized into bank share prices. The positive coefficient is consistent with the view that countries with sound public finances can afford a more generous financial safety net, implying larger implicit subsidies to the banking sector. The Big0.5 variable enters this regression with a coefficient of -0.360 that is significant at 5 percent, while its interactions with bank risk and the fiscal balance are not estimated to be statistically significant. In the CDS regression 10, the fiscal balance is not priced

[8] In line with this, we see in Table 6 that systemically large banks have a higher average stock market volatility, even if the difference from smaller banks is not statistically significant. In a study of bank risk, Gonzalez (2005) finds that regulatory restrictions increase banks' risk-taking incentives by reducing their charter value.

significantly into the CDS spread. Overall, the results of Panel A of Table 8 suggest that systemically important banks (with average bank risk) have lower valuation on account of TBTS and a slightly lower CDS spread, even if higher risk increase (reduces) bank valuation (CDS spreads) of systemically large banks relatively more.

The regressions in Panel B of Table 8 are analogous to those reported before but they include the set of control variables. Point estimates of coefficients in regressions 3 and 8 continue to imply that a systemically large bank with average risk has a relatively low valuation and a low CDS spread, while additional bank risk increases bank valuation and reduces CDS spreads relatively more for systemic banks. Note, however, that the coefficient for the Big0.5 variable, while negative, is no longer statistically significant in the bank valuation regression 5 that includes the fiscal balance variable.[9]

The estimation results so far can be used to assess the overall impact of systemic size on bank valuation. To do this, we make use of the estimated coefficients in regression 3 of Panel A of Table 8. To wit, a systemically large bank (with Big0.5 = 1) with the mean level of bank stock risk (i.e., with bank stock risk equal to 0.303 from Table 4) is estimated to obtain a valuation discount of 22.3 percent (as -0.454 + 0.763*0.303 = -0.223) on account of its systemic size. Note that this estimated discount of 22.3 percent for the share price of a systemically large bank with mean bank stock risk closely corresponds to the estimated discount of 22.2 percent on account of systemic size in regression 1.

This suggests that systemically important banks face a strong incentive to downsize or split up in order to eliminate the valuation discount. However, a systemically important bank that decides to downsize will also reduce its absolute size, thereby reducing the premium it receives on account of its absolute size (given that the assets variable is estimated with a positive and significant coefficient of 0.073 in regression 3 of Panel A of Table 8). As an example, we can

[9] In unreported regressions, we lagged the leverage variable in the specifications of Panel B of Table 8 to reflect that shocks to bank valuation or bank liability pricing may affect bank leverage which yielded qualitatively similar results.

consider that the average systemically important bank (with mean assets of 26.902 in 2008 in Table 6) downsizes to the average systemically unimportant bank (with mean assets of 22.250 in 2008). This reduces such a bank's premium on account of large absolute size by 34.0 percent (as 0.073*(26.902 – 22.250) = 0.340). This would make the overall valuation effect of downsizing, accounting for reduced systemic and absolute size, negative at -11.7 percent (as 22.3 – 34.0 = -11.8).

These calculations of the impact of downsizing on the valuation of the average bank, however, fail to take into account differences in country size. Thus, they do not recognize that a systemically important bank located in a small country has to reduce its absolute size relatively little to obtain a significant reduction in systemic size. Because of this, systemically large banks located in small countries do face incentives to downsize, as this would reduce their discount on account of systemic size relatively more, and reduce their premium on account of absolute size relatively little.

The limits imposed by the state of public finances on the financial safety net should be particularly important during a time of financial crisis. Therefore, we next consider how the market-to-book ratio and the CDS spread depend on the public finance variables in 2007 and 2008. In particular, regression 1 of Table 9 re-estimates the market-to-book regression 4 of Panel B of Table 8 including the public debt variable. This regression is estimated with data only for 2008, without country fixed effects, and with errors clustered at the country level. Further, regression 2 of Table 9 is a market-to-book ratio regression including the public debt variable with data for 2007-2008 and including bank-level fixed effects. In regression 1, assets is not statistically significant, but in regression 2 it enters with a negative and statistically significant coefficient, indicating that at a time of financial crisis an increase in absolute assets size is valued negatively. The public debt variable is not significant in regression 1 which omits country or firm fixed effects, but it enters with a negative coefficient that is significant at 10 percent in regression 2 suggesting that increases in public debt are priced negatively during a financial crisis. Bank stock risk enters with a positive and significant coefficient in regression 1, but it

obtains a negative and significant coefficient in regression 2. Thus, bank risk is priced positively on a cross-section basis in 2008 if we do not control for country or firm fixed effects, but additions to risk between 2007 and 2008 are priced negatively while controlling for bank-level fixed effects. This suggests a reduced pricing benefit of risk on account of a bank's contingent claim on the financial safety net during a financial crisis.

Regression 3 has the CDS spread as the dependent variable and, as regression 2, it is estimated with data for 2007 and 2008, and it includes firm-level fixed effects. In this regression, the bank stock risk variable obtains a positive and significant coefficient, indicating that innovations in bank risk are associated with higher CDS spreads during this period.

Regressions 4-6 in Table 9 are similar to regressions 1-3 but they include the fiscal balance rather than the public debt as the public finance variable. In regression 4 with 2008 data, we see a positive and significant coefficient for the interaction of the Big0.5 variable and the fiscal balance. Thus, the market-to-book ratio of systemically large banks is higher in countries with a higher fiscal balance which is evidence of a TBTS effect. In the market-to-book ratio and CDS regressions 5 and 6 including bank fixed effects, we see a positive and negative coefficient for the fiscal balance variable, respectively, indicating that an improvement of the fiscal balance between 2007 and 2008 is priced positively and negatively into bank share prices and CDS spreads, respectively. Especially the negative pricing of the fiscal balance into the CDS spread suggests a TBTS effect, as there is no apparent alternative explanation for this relationship (for instance, through the implication of the current fiscal balance on future corporate income taxation).

3.3. Robustness checks

In the empirical work so far, we have set the threshold level for the liabilities-to-GDP ratio used to define the Big variable somewhat arbitrarily equal to 0.5. Alternatively, Table 10 presents regressions analogous to the market-to-book and CDS regressions 3 and 8 of Panel B of Table 8 where we choose different thresholds to define the Big variable. Specifically, columns 1

and 5 of Table 10 present regressions of the market-to-book ratio and the CDS spread where the threshold value for the liabilities-to-GDP ratio in the definition of Big is 0.1, while in regressions 2 and 6 the threshold is 0.25 and in regressions 4 and 8 it is 1.0. For comparison, columns 3 and 7 copy regressions 4 and 9 of Panel B of Table 8. Looking across columns 1-4, we see that the Big variable obtains a significant negative coefficient, and its interaction with bank risk a significant negative coefficient, for thresholds in the definition of Big equal to 0.25 and 0.5. Apparently, the additional contribution of risk to bank valuation for large banks is only material for reasonably high thresholds for the liabilities-to-GDP ratio in the definition of Big. The Big variable and its interaction with bank stock risk fail to be estimated with a significant coefficient for a threshold level of 1.0, because either there are off-setting TBTF and TBTS effects or there are simply too few banks with liabilities exceeding GDP to estimate the coefficient for this interaction variable with precision.

The CDS spread is the dependent variable in regressions 5 to 8 of Table 10 for varying thresholds in the definition of the Big variable. The Big variable obtains a significant positive coefficient, and its interaction with bank risk obtains a significant negative coefficient, for all four thresholds in the definition of Big. This suggests a strong TBTF effect relative to the TBTS effect for systemically large banks for varying definitions of systemic size. The estimated coefficients in regressions 5-8 monotonically increase from -0.021 with a threshold for Big of 0.10 in regression 5 to -0.012 with a threshold for Big of 1.0 in regression 8. This implies that the very largest banks see their CDS spreads decline less with additional risk than banks that are somewhat smaller.

Table 11 represents several additional robustness checks. First, we recognize that a country's ability of bail out its biggest banks may depend on its public debt relative to its borrowing capacity rather than simply on its actual public debt ratio. To deal with this, we construct a country's public indebtedness relative to its borrowing capacity as the residual from a regression of the pubic debt ratio on per capita GDP, as richer countries can and in fact tend to borrow more. Then we re-estimate the market-to-book and CDS regressions 3 and 8 of Panel B

of Table 8 after replacing the public debt ratio by this residual public debt ratio, and present the results in columns 1 and 2 of Table 11. The residual public debt variable is seen to be negatively and significantly reflected in bank valuation, while the Big0.5 variable now obtains a coefficient of -0.380 that is significant at the 5 percent level.

Next, it can be the case that the public debt is endogenous to the state of the banking system, as declines of bank share prices and increases in CDS spreads may prompt a bank bail-out, which can raise public indebtedness. To deal with this, we replace the public debt ratio by its lagged value in regressions 3 and 8 of Panel B of Table 8, with the results in columns 3 and 4 in Table 11. The lagged public debt ratio is now estimated with a negative and significant coefficient in the market-to-book regression in column 3, confirming a capitalization of the public debt into lower bank share pricing consistent with a TBTS effect. Finally, in columns 5 and 6 of the table we replace the stock market variability variable by the bank's Z-score in the benchmark market-to-book and CDS specifications. This measure of bank risk derived from accounting information is negatively related the market-to-book ratio and the CDS spread (consistent with the positive relationships between bank stock risk and these two variables), but these relationships are not statistically significant.

4. Conclusion

Empirical evidence on economies of scale in banking, such as in Berger and Mester (1997), suggests that many banks grow beyond the size that minimizes average costs. One reason for this may be that size benefits managers who see their compensation increase with bank size, possibly at the expense of shareholders. Alternatively, banks increase their size beyond the economically efficient point in order to become 'too big to fail,' which reduces their costs of funding. A bail-out of a systemically large bank, i.e. a bank that is large relative to the economy, would put considerable strain on a country's public finances. This raises doubts about a country's ability and determination to bail out its systemically large banks. Systemic size thus reduces a bank's contingent claim on the financial safety net. Our estimation suggests that the

average systemically large bank's share price is discounted 22.3 percent on account of its systemic size, based on estimation for a large international sample of banks over the 1991-2008 period.

Especially at a time of financial and economic crisis, there are doubts about countries' ability to keep their largest banks afloat. For 2008, we present evidence that the share prices of systemically large banks were discounted relatively more on account of systemic size in countries running large fiscal deficits. This is evidence that systemic banks located in countries with stressed public finances saw their contingent claim on the financial safety net reduced relatively more in 2008, which is evidence that they have grown 'too big to save'.

The problem of 'too big to save' facing systemically large banks in fiscally strapped countries is likely to change the structure of the international banking system in the years to come. Banks in all banking systems will face pressure to deleverage in order to reduce risks for themselves and for the financial safety net. However, especially systemically large banks in fiscally constrained countries have incentives to downsize in order to be able to rely on the financial safety net in the future. Our evidence suggests that this should increase bank valuation. Indeed, in 2008 we see that very large banks are deleveraging also relative to their economy's size. The downsizing that occurred in 2008 may thus in part be driven by a desire to increase stock market valuation in the face of 'too big to save' effect, even if downsizing no doubt has also been forced by reduced capital on account of losses and difficulties to raise equity as well as other capital at a time of financial crisis.

There is an obvious policy interest in reducing bank size at least below the point where banks' national contingent liabilities are so large that there are doubts about countries' abilities to stabilize their banking system. In Europe, in 2009 downsizing of some of the largest banks that have received public assistance during the financial crisis, such as Lloyds and Royal Bank of Scotland in the UK, Commerzbank in Germany and ING in the Netherlands, has been imposed by the European Commission that has ruled that public assistance has disturbed bank competition. Thus, although the Commission's motivation has been to prevent a future

occurrence of public assistance that would bring unfair competitive advantages to the recipients, the effect will be to reduce the size of some of Europe's largest banks.

In the US the Obama administration has suggested regulation which would limit any bank's share of national bank liabilities to 10 percent, and in addition it has proposed taxing non-deposit bank liabilities at a rate of 0.15 cent per dollar per year for banks with assets in excess of $50 billion. In 2008, Switzerland already adopted a regime of higher capital requirements for its largest banks, i.e. UBS and Credit Suisse, which provides an incentive to these banks to downsize. Policy steps to downsize very large banks that have not received assistance during the financial crisis have so far not been undertaken in the EU, even though politicians in countries such as the UK and the Netherlands have at times voiced their desire to reduce their countries' contingent liabilities on account of large banks and large banking systems. Recently, Germany and the UK have shown themselves supportive of opening discussion in the G20 on international coordination on additional taxation on banks that could easily be slanted towards large-size banks, limiting the 'too big to fail' and 'too big to save' phenomena. In April 2010, the IMF completed a report advocating additional taxation of banks which will be a reference point in this debate.

Even in the absence of additional regulation and taxation, the percentage of banks that is systemically large already declined in 2008 relative to the two previous years. Our paper shows that this trend may reflect private incentives to downsize in the face of a too-big-to-save effect in fiscally constrained countries. Additional regulation or taxation aimed at very large banks could serve to strengthen this trend.

References

Acharaya, Viral V. and Timothy C. Johnson, 2007, Insider trading in credit derivatives, *Journal of Financial Economics* 84, 110-141.

Altunbas, Yener, Leonardo Gambacorta, and David Marques-Ibanez, 2010, Does monetary policy affect bank risk-taking, mimeo, Bank for International Settlements.

Benston. George J., William C. Hunter and Larry D. Wall, 1995, Motivations for bank mergers and acquisitions: Enhancing the deposit insurance put option versus earnings diversification, *Journal of Money, Credit, and Banking* 27, 777-788.

Berger, Allen N. and Loretta J. Mester, 1997, Inside the box: What explains differences in the efficiencies of financial institutions?, 21, 895-947.

Blanco, R., S. Brennan and I.W. Marsh, 2005, An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps, *Journal of Finance* 60, 2255-2281.

Brown, Craig O. and I. Serdar Dinç, 2009, Too many to fail? Evidence of regulatory forbearance when the banking sector is weak, *Review of Financial Studies*, forthcoming.

Demirgüç-Kunt, Asli, Edward Kane, and Luc Laeven (eds.), 2008, *Deposit insurance around the world: issues of design and implementation* (Cambridge, MA: MIT Press).

Flannery, Mark J. and Sorin M. Sorescu, 1996, Evidence of bank market discipline in subordinated debenture yields: 1983-1991, *Journal of Finance* 51, 1347-1377.

Gonzalez, Francisco, 2005, Bank regulation and risk-taking incentives: An international comparison of bank risk, *Journal of Banking and Finance* 29, 1153-1184.

Gropp, R., J. Vesala and G. Vulpes, 2006, Equity and bond market signals as leading indicators of bank fragility, *Journal of Money, Credit and Banking* 38, 399-428.

Hart, Oliver, and Luigi Zingales, 2009, A new capital regulation for large financial institutions, mimeo, University of Chicago.

Jorion, Philippe and Gaiyan Zhang, 2007, Good and bad credit contagion: Evidence from credit default swaps, *Journal of Banking and Finance* 84, 860-883.

Kane, Edward J., 2000, Incentives for banking megamergers: What motives might regulators infer from event-study evidence?, *Journal of Money, Credit, and Banking* 32, 671-701.

Knaup, Martin, and Wolf Wagner, 2009, A market-based measure of credit quality and banks' performance during the subprime crisis, EBC working paper, Tilburg University.

Laeven, Luc and Fabian Valencia, 2008, Systemic banking crises: A new database, IMF WP/08/224.

Longstaff, Francis A., Sanjay Mithal and Eric Neis, 2005, Corporate yield spreads: Default risk or liquidity? New evidence from the credit default swap market, *Journal of Finance* 60, 2213-2253.

Norden, Lars and Martin Weber, 2004, Informational efficiency of credit default swap and stock markets: The impact of credit rating announcements, *Journal of Banking and Finance* 28, 2813-2843.

O'Hara, Maureen and Wayne Shaw, 1990, Deposit insurance and wealth effects: The value of being 'too big to fail', *Journal of Finance* 45, 1587-1600.

Penas, Maria Fabiana, and Haluk Unal, 2004, Gains in bank mergers: Evidence from bond markets, *Journal of Financial Economics* 74, 149-179.

Sironi, Andrea, 2003, Testing for market discipline in the European banking industry: Evidence from subordinated debt issues, *Journal of Money, Credit, and Banking* 35, 443-472.

Appendix. Variable definitions and data sources

Variable	Description	Sources
Market-to-book	Market value of common equity divided by book value of common equity	Bankscope and Datastream
CDS	Annual average of daily credit default spreads for 5-year contracts	Markit
Public debt	Central government debt divided by GDP	IMF and OECD
Residual public debt	Residual of regression of public debt on GDP per capita	IMF, OECD and WDI
Fiscal balance	Ratio of central government revenues minus expenses and minus depreciation of public capital to GDP	IMF
Liabilities	Bank liabilities divided by GDP	Bankscope and WDI
Sum liabilities	Sum of bank liabilities in a country divided by GDP	Bankscope and WDI
Other liabilities	Sum of the liabilities of other banks in a country divided by GDP	Bankscope and WDI
Liabilities sq	Square of ratio of bank liabilities to GDP	Bankscope and WDI
Big0.1	Dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.1 and zero otherwise	Bankscope and WDI
Big0.25	Dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.25 and zero otherwise	Bankscope and WDI
Big0.5	Dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.5 and zero otherwise	Bankscope and WDI
Big1.0	Dummy variable that equals one if ratio of bank liabilities to GDP exceeds 1.0 and zero otherwise	Bankscope and WDI
Bank stock risk	Annualized standard deviation of weekly dividend-inclusive bank stock returns	Datastream
Z-score	Index of bank solvency constructed as $\frac{ROA + CAR}{SROA}$, where ROA is return on assets, CAR represents capital assets ratio and SROA stands for standard deviation of return on assets	Bankscope
Assets	Log of assets in millions of US dollars	Bankscope
Pre-tax profits	Pre-tax profits divided by assets	Bankscope
Earning assets	Earning assets divided by assets	Bankscope
Leverage	Liabilities divided by assets	Bankscope
GDP per capita	GDP per capita in thousands of 2000 constant US dollars	WDI
Past crisis	Dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero	Laeven and Valencia (2008)

	otherwise	
Past fiscal cost	Fiscal cost of resolving most recent but not current banking crisis divided by GDP	Laeven and Valencia (2008)

Table 1. Systemically large banks in 2008

This table lists banks with a liabilities-to-GDP ratio exceeding 0.5. Liabilities is the liabilities-to-GDP ratio. Absolute liabilities is the amount of bank liabilities in billions of US dollars.

Bank Name	Country	Liabilities	Absolute liabilities (US$B)
UBS AG	Switzerland	3.723	1,852
ING Groep NV	Netherlands	2.218	1,813
Credit Suisse Group	Switzerland	2.126	1,058
Danske Bank A/S	Denmark	1.972	652
Dexia	Belgium	1.904	900
HSBC Holdings Plc	United Kingdom	1.707	2,437
Barclays Plc	United Kingdom	1.412	2,939
Royal Bank of Scotland Plc (The)	United Kingdom	1.282	2,669
BNP Paribas	France	1.042	2,824
KBC Group-KBC Groep NV/ KBC Groupe SA	Belgium	1.011	478
Bank of Ireland	Ireland	0.991	302
DBS Group Holdings Ltd	Singapore	0.919	164
Banco Santander SA	Spain	0.910	1,387
Allied Irish Banks plc	Ireland	0.896	240
Deutsche Bank AG	Germany	0.870	3,021
Crédit Agricole S.A.	France	0.825	2,235
Skandinaviska Enskilda Banken AB	Sweden	0.767	311
DnB Nor ASA	Norway	0.690	250
Erste Group Bank AG	Austria	0.670	265
Svenska Handelsbanken	Sweden	0.659	267
United Overseas Bank Limited UOB	Singapore	0.658	118
Oversea-Chinese Banking Corporation Limited OCBC	Singapore	0.648	116
BOC Hong Kong (Holdings) Ltd	Hong Kong	0.634	137
UniCredit SpA	Italy	0.631	1,374
Standard Bank Group Limited	South Africa	0.617	151
Société Générale	France	0.563	1,526

National Australia Bank	Australia	0.555	503
Swedbank AB	Sweden	0.549	222
Millennium bcp-Banco Comercial Português, SA	Portugal	0.538	124
Anglo Irish Bank Corporation Limited	Ireland	0.505	139

Table 2. Top 20 Countries with the largest system-wide liabilities-to-GDP ratio in 2008

This table contains the list of top 20 countries with the largest sum of bank liabilities to GDP ratio, denoted Sum liabilities.

Country	Sum liabilities
Switzerland	6.293
United Kingdom	5.498
Belgium	2.916
France	2.737
Netherlands	2.469
Ireland	2.393
Denmark	2.330
Singapore	2.266
Australia	2.132
Sweden	1.982
Canada	1.799
Spain	1.749
Japan	1.657
South Africa	1.625
Greece	1.482
Italy	1.432
Israel	1.377
Germany	1.350
Hong Kong	1.301
Austria	1.251

Table 3. Systemically large banks and public finances in 2008

This table presents information on the size and number of large banks and the public finances for individual countries. Sum liabilities is the sum of bank liabilities in a country divided by GDP. Max of Liabilities is the maximum of any bank's liabilities divided by GDP. No. of banks with Liabilities ≥ 0.1 is number of banks with a liabilities-to-GDP ratio exceeding 0.1. Public debt is central government debt divided by GDP. Fiscal balance is the ratio of central government revenues minus expenses and minus depreciation of public capital to GDP.

Country	Sum liabilities	Max of Liabilities	No. of Banks	No. of banks with Liabilities ≥ 0.1	No. of banks with Liabilities ≥ 0.25	No. of banks with Liabilities ≥ 0.5	No. of banks with Liabilities ≥ 1.0	Public debt	Fiscal balance
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Australia	2.132	0.555	12	6	4	1	0	0.051	0.026
Austria	1.251	0.670	7	3	2	1	0	0.595	-0.006
Belgium	2.916	1.904	3	2	2	2	2	0.902	-0.013
Brazil	0.865	0.203	20	5	0	0	0		
Canada	1.799	0.465	13	5	4	0	0	0.286	0.007
Chile	0.759	0.221	6	3	0	0	0		
Czech Republic	0.172	0.172	1	1	0	0	0	0.270	-0.022
Denmark	2.330	1.972	15	2	1	1	1	0.323	0.035
Finland	0.181	0.166	4	1	0	0	0	0.292	0.047
France	2.737	1.042	9	4	4	3	1	0.542	-0.027
Germany	1.350	0.870	13	2	1	1	0	0.389	
Greece	1.482	0.390	11	5	3	0	0	1.079	-0.065
Hungary	0.337	0.313	2	1	1	0	0	0.684	-0.043
Ireland	2.393	0.991	3	3	3	3	0	0.271	-0.027
Israel	1.377	0.408	6	5	2	0	0		-0.016
Italy	1.432	0.631	16	3	2	1	0	0.977	-0.024
Korea	0.548	0.271	4	2	1	0	0	0.291	
Lithuania	0.235	0.117	4	1	0	0	0		-0.005
Luxembourg	0.023	0.023	1	0	0	0	0	0.088	0.047
Mexico	0.059	0.044	2	0	0	0	0	0.245	
Morocco	0.184	0.131	2	1	0	0	0		0.064
Netherlands	2.469	2.218	4	2	1	1	1	0.502	0.014
Norway	0.866	0.690	10	1	1	1	0	0.138	0.194

Poland	0.446	0.095	10	0	0	0	0	0.450	-0.009
Portugal	1.217	0.538	3	3	2	1	0	0.713	-0.035
Romania	0.089	0.089	1	0	0	0	0		-0.016
Slovakia	0.177	0.154	2	1	0	0	0	0.262	-0.001
Slovenia	0.137	0.137	1	1	0	0	0		0.011
Spain	1.749	0.910	9	3	2	1	0	0.335	-0.018
Sweden	1.982	0.767	5	3	3	3	0	0.360	0.032
Switzerland	6.293	3.723	15	2	2	2	2	0.229	
Turkey	0.533	0.101	14	1	0	0	0	0.400	
United Kingdom	5.498	1.707	25	6	6	3	3	0.607	-0.036
USA	0.939	0.144	464	3	0	0	0	0.404	-0.055
Total			717	81	47	25	10		

Table 4. Summary statistics on bank and country variables

This table presents summary statistics of variables. Market-to-book is market value of common equity divided by book value of common equity. CDS is annual average of daily credit default spreads for 5-year contracts. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Fiscal balance is ratio of central government revenues minus expenses and minus depreciation of capital to GDP. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Z-score is Index of bank solvency constructed as $\frac{ROA + CAR}{SROA}$ where ROA is return on assets, CAR represents capital assets ratio and SROA stands for standard deviation of return on assets. Liabilities is bank liabilities divided by GDP. Sum liabilities is sum of bank liabilities in a country divided by GDP. Other liabilities is sum of the liabilities of other banks in a country divided by GDP. Liabilities sq is square of ratio of bank liabilities to GDP. Big 0.1, Big 0.25 and Big 1 are dummy variables. They are equal to 1 if Liabilities-to-GDP ratio is greater than or equal to 0.1, 0.25, and 1 respectively, and they otherwise equal 0.

Variable	Observations	Mean	Std. Dev.	Min	Max
Market-to-book	10,961	1.449	0.768	0.000	4.983
CDS	249	0.004323	0.006639	0.000552	0.056026
Assets	10,981	21.685	2.122	14.947	28.550
Pre-tax profits	10,966	0.013	0.032	-0.893	0.416
Earning assets	10,971	0.901	0.100	0.000	0.999
Leverage	10,981	0.894	0.107	0.005	1
GDP per capita	10,980	32.724	7.704	1.693	56.189
Past crisis	10,982	0.790	0.407	0	1
Past fiscal cost	10,982	0.043	0.053	0	0.32
Public debt	10,841	0.494	0.334	0.008	1.638
Fiscal balance	4,751	-0.021	0.034	-0.168	0.194
Bank stock risk	10,975	0.303	0.197	0.000	3.795
Z-score	10,391	26.836	23.118	0.247	146.529
Liabilities	10,982	0.037	0.217	0.000	4.725
Sum of liabilities	10,982	1.112	0.905	0.000	8.319
Other liabilities	10,982	1.075	0.849	0.000	7.661
Liabilities sq	10,982	0.049	0.587	0.000	22.323
Big 0.1	10,982	0.055	0.228	0	1

Big 0.25	10,982	0.029	0.167	0	1
Big 0.5	10,982	0.017	0.128	0	1
Big 1	10,982	0.009	0.093	0	1

Table 5. Summary statistics for CDS 5-year spreads by year

This table contains summary statistics for CDS 5-year spreads by year between 2001 and 2008

Year	N	Mean	Std. dev.	Min	Max
2001	2	0.003469	0.000019	0.003456	0.003482
2002	8	0.005399	0.002402	0.003021	0.009548
2003	13	0.004239	0.003052	0.001686	0.010744
2004	34	0.002278	0.001235	0.000786	0.006375
2005	47	0.002859	0.005682	0.000795	0.02927
2006	57	0.002317	0.006094	0.000552	0.046864
2007	78	0.004061	0.006721	0.001132	0.056026
2008	59	0.012005	0.007324	0.002469	0.051421

Table 6. Means of variables for systemically large and small banks in 2008

This table lists the means of variables for all banks, and separately for banks with a liabilities-to-GDP ratio less than 0.5 and with a liabilities-to-GDP ratio equal to or more than 0.5. The last column contains the t-statistics of mean comparison tests for systemically large and small banks. Market-to-book is market value of common equity divided by book value of common equity. CDS is annual average of daily credit default spreads for 5-year contracts. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Fiscal balance is ratio of central government revenues minus expenses and minus depreciation of capital to GDP. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Z-score is index of bank solvency constructed as $\frac{ROA + CAR}{SROA}$ where ROA is return on assets, CAR represents capital assets ratio and SROA stands for standard deviation of return on assets. Liabilities is bank liabilities divided by GDP. Sum liabilities is sum of bank liabilities in a country divided by GDP. Other liabilities is sum of the liabilities of other banks in a country divided by GDP. Liabilities sq is square of ratio of bank liabilities to GDP. Big 0.1, Big 0.25 and Big 1 are dummy variables. They are equal to 1 if liabilities-to-GDP ratio is greater than or equal to 0.1, 0.25, and 1 respectively, and they otherwise equal 0.

Variables	Total		Liabilities < 0.5		Liabilities ≥ 0.5		Mean comparison test
	Observations	Mean	Observations	Mean	Observations	Mean	t-Statistics
Market-to-book	1,045	1.532	1,015	1.526	30	1.736	-1.538
CDS	59	0.012005	46	0.012932	13	0.008726	3.298
Assets	1,047	22.383	1,017	22.250	30	26.902	-21.327
Pre-tax profits	1,047	0.006	1,017	0.006	30	0.003	1.586
Earning assets	1,047	0.892	1,017	0.891	30	0.928	-4.359
Leverage	1,047	0.890	1,017	0.888	30	0.959	-13.220
GDP per capita	988	29.423	958	29.485	30	27.418	1.410
Past crisis	1,047	0.787	1,017	0.802	30	0.267	6.449
Past fiscal cost	1,047	0.047	1,017	0.049	30	0.006	10.052
Public debt	677	0.422	652	0.420	25	0.465	-0.919
Fiscal balance	643	-0.039	621	-0.040	22	0.000	-3.651
Bank stock risk	1,047	0.555	1,017	0.553	30	0.616	-1.484
Z-score	973	23.931	945	23.953	28	23.214	0.197
Liabilities	988	0.061	958	0.029	30	1.083	-8.125
Sum of liabilities	1,047	1.206	1,017	1.162	30	2.692	-5.460
Other liabilities	988	1.217	958	1.204	30	1.609	-1.922

Liabilities sq	988	0.056	958	0.006	30	1.661	-3.401
Big 0.1	1,047	0.109	1,017	0.083	30	1	-110
Big 0.25	1,047	0.059	1,017	0.031	30	1	-180
Big 1	1,047	0.010	1,017	0.000	30	0.333	-3.808

Table 7. Determinants of the market-to-book ratio and the CDS spread

The dependent variable is the market-to-book ratio in columns 1 to 5 and the CDS spread in columns 6 to 10 in both Panel A and Panel B. Market-to-book is the market value of common equity divided by the book value of common equity. CDS is the annual average of daily credit default spreads on a 5-year contract. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Liabilities is bank liabilities divided by GDP. Sum liabilities is sum of bank liabilities in a country divided by GDP. Other liabilities is sum of the liabilities of other banks in a country divided by GDP. Liabilities sq is square of ratio of bank liabilities to GDP. All regressions are estimated with year and country fixed effects and clustering at the bank level. Standard errors are in parentheses. *, ** and *** denote significance at 10%, 5% and 1% respectively.

Panel A: Basic regressions

	Market-to-Book	Market-to-Book	Market-to-Book	Market-to-Book	Market-to-Book	CDS	CDS	CDS	CDS	CDS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Assets	0.071***	0.069***	0.070***	0.078***	0.078***	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public debt	-0.770***	-0.763***	-0.764***	-0.786***	-0.781***	-0.018	-0.019	-0.019	-0.017	-0.017
	(0.105)	(0.105)	(0.105)	(0.105)	(0.105)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Bank stock risk	0.127*	0.125*	0.126*	0.128*	0.128*	0.029***	0.029***	0.029***	0.029***	0.029**
	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Liabilities	-0.035		-0.021	-0.570***	-0.555***	0.000		0.000	-0.004	-0.004
	(0.130)		(0.133)	(0.171)	(0.172)	(0.002)		(0.002)	(0.005)	(0.005)
Sum liabilities		0.020					0.000			
		(0.027)					(0.001)			
Other liabilities			0.023		0.021			0.000		0.000
			(0.027)		(0.027)			(0.001)		(0.001)
Liabilities sq				0.190***	0.189***				0.002	0.002
				(0.044)	(0.044)				(0.002)	(0.002)
N	10,815	10,815	10,815	10,815	10,815	249	249	249	249	249
R-sq	0.184	0.184	0.184	0.187	0.187	0.587	0.587	0.587	0.589	0.589
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Panel B: Regressions with additional control variables

	Market-to-book	Market-to-book	Market-to-book	Market-to-book	Market-to-book	CDS	CDS	CDS	CDS	CDS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Assets	0.070***	0.070***	0.070***	0.077***	0.076***	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pre-tax profits	3.298***	3.293***	3.290***	3.270***	3.263***	-0.182	-0.171	-0.182	-0.185	-0.185
	(0.896)	(0.897)	(0.897)	(0.898)	(0.899)	(0.140)	(0.142)	(0.140)	(0.138)	(0.138)
Earning assets	-0.517***	-0.514***	-0.514***	-0.498**	-0.495**	-0.010	-0.010	-0.010	-0.010	-0.010
	(0.195)	(0.194)	(0.194)	(0.194)	(0.194)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Leverage	0.167	0.167	0.169	0.176	0.178	0.008	0.004	0.008	0.005	0.005
	(0.229)	(0.228)	(0.229)	(0.232)	(0.232)	(0.027)	(0.027)	(0.027)	(0.025)	(0.025)
GDP per capita	0.039	0.044*	0.044*	0.041*	0.046*	0.000	0.000	0.000	0.000	0.000
	(0.024)	(0.025)	(0.025)	(0.024)	(0.026)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Past crisis	0.004	-0.011	-0.011	0.005	-0.009	-0.008*	-0.008*	-0.008*	-0.008*	-0.008*
	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Past fiscal cost	-0.083	0.028	0.030	-0.078	0.035	0.223	0.220	0.223	0.232*	0.237*
	(0.570)	(0.576)	(0.577)	(0.568)	(0.576)	(0.138)	(0.139)	(0.140)	(0.139)	(0.142)
Public debt	-0.707***	-0.690***	-0.690***	-0.721***	-0.704***	0.000	-0.000	0.000	0.003	0.004
	(0.109)	(0.110)	(0.110)	(0.109)	(0.110)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Bank stock risk	0.124*	0.122*	0.122*	0.126*	0.125*	0.025***	0.025***	0.025***	0.025***	0.025***
	(0.067)	(0.067)	(0.067)	(0.067)	(0.067)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Liabilities	-0.004		0.013	-0.463***	-0.445***	-0.002		-0.002	-0.008**	-0.009*
	(0.118)		(0.122)	(0.161)	(0.163)	(0.002)		(0.002)	(0.004)	(0.005)
Sum liabilities		0.027					-0.000			
		(0.028)					(0.001)			
Other liabilities			0.028		0.028			-0.000		-0.000
			(0.027)		(0.027)			(0.001)		(0.001)
Liabilities sq				0.162***	0.162***				0.003	0.004
				(0.041)	(0.041)				(0.002)	(0.002)
N	10,791	10,791	10,791	10,791	10,791	248	248	248	248	248
R-sq	0.208	0.208	0.208	0.210	0.210	0.642	0.640	0.642	0.647	0.648
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 8. The impact of systemic bank size defined by a liabilities-to-GDP ratio exceeding 0.5

The dependent variable is the market-to-book ratio in columns 1 to 5 and the CDS spread in columns 6 to 10 in both Panel A and Panel B. Market-to-book is the market value of common equity divided by the book value of common equity. CDS is the annual average of daily credit default spreads on a 5-year contract. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Fiscal balance is ratio of central government revenues minus expenses and minus depreciation of capital to GDP. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Big0.5 is a dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.5 and zero otherwise. All regressions are estimated with year and country fixed effects and clustering at the bank level. *, ** and *** denote significance at 10%, 5% and 1% respectively.

Panel A: Basic regressions

	Market-to-book	Market-to-book	Market-to-book	Market-to-book	Market-to-book	CDS	CDS	CDS	CDS	CDS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Assets	0.073***	0.073***	0.073***	0.073***	0.044***	-0.000	-0.000	-0.000	-0.000	-0.001
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Public debt	-0.773***	-0.770***	-0.775***	-0.772***		-0.018	-0.019	-0.020*	-0.021*	
	(0.105)	(0.106)	(0.105)	(0.106)		(0.011)	(0.011)	(0.012)	(0.012)	
Fiscal balance					7.096***					0.023
					(1.359)					(0.054)
Bank stock risk	0.129*	0.129*	0.122*	0.122*	0.274***	0.029***	0.029***	0.030***	0.030***	0.031**
	(0.066)	(0.066)	(0.066)	(0.066)	(0.084)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
Big0.5	-0.222	-0.031	-0.454**	-0.256	-0.360**	-0.000	-0.000	0.004**	0.003*	0.004*
	(0.146)	(0.310)	(0.193)	(0.340)	(0.158)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Big0.5 * Public debt		-0.449		-0.475			0.000		0.002	
		(0.564)		(0.559)			(0.003)		(0.002)	
Big0.5 * Bank stock risk			0.763*	0.778*	0.316			-0.013***	-0.013***	-0.011**
			(0.414)	(0.409)	(0.353)			(0.005)	(0.005)	(0.004)
Big0.5 * Fiscal balance					-1.436					-0.007
					(2.591)					(0.015)
N	10,815	10,815	10,815	10,815	4,746	249	249	249	249	192
R-sq	0.185	0.185	0.185	0.185	0.263	0.587	0.587	0.601	0.602	0.644
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Panel B: Regressions with additional control variables

	Market-to-book	Market-to-book	Market-to-book	Market-to-book	Market-to-book	CDS	CDS	CDS	CDS	CDS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Assets	0.073***	0.073***	0.073***	0.073***	0.030***	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pre-tax profits	3.284***	3.288***	3.271***	3.275***	4.836***	-0.174	-0.175	-0.132	-0.133	-0.233
	(0.896)	(0.898)	(0.896)	(0.897)	(1.328)	(0.141)	(0.141)	(0.135)	(0.135)	(0.153)
Earning assets	-0.515***	-0.516***	-0.516***	-0.517***	-0.661***	-0.011	-0.011	-0.015	-0.016	0.005
	(0.194)	(0.195)	(0.194)	(0.195)	(0.212)	(0.014)	(0.015)	(0.015)	(0.015)	(0.011)
Leverage	0.174	0.181	0.173	0.180	1.065***	0.006	0.006	0.009	0.009	-0.009
	(0.230)	(0.231)	(0.230)	(0.231)	(0.195)	(0.027)	(0.027)	(0.026)	(0.026)	(0.028)
GDP per capita	0.040	0.038	0.039	0.037	0.029	0.000	0.000	0.000	0.000	-0.000
	(0.024)	(0.025)	(0.024)	(0.025)	(0.059)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Past crisis	0.008	0.007	0.011	0.010	-0.353***	-0.008*	-0.008*	-0.010**	-0.010**	-0.008*
	(0.048)	(0.048)	(0.049)	(0.049)	(0.079)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)
Past fiscal cost	-0.085	-0.103	-0.147	-0.167	14.287***	0.223	0.223	0.294*	0.296*	0.267*
	(0.570)	(0.573)	(0.575)	(0.578)	(2.345)	(0.138)	(0.138)	(0.152)	(0.153)	(0.137)
Public debt	-0.713***	-0.712***	-0.713***	-0.711***		0.000	-0.001	0.002	0.001	
	(0.109)	(0.109)	(0.109)	(0.109)		(0.009)	(0.009)	(0.010)	(0.010)	
Fiscal balance					4.096***					-0.028
					(1.487)					(0.033)
Bank stock risk	0.126*	0.127*	0.120*	0.120*	0.390***	0.025***	0.025***	0.029***	0.030***	0.025***
	(0.067)	(0.067)	(0.067)	(0.067)	(0.099)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Big0.5	-0.174	-0.012	-0.380**	-0.211	-0.202	-0.001	-0.002	0.004**	0.003	0.004**
	(0.138)	(0.299)	(0.186)	(0.329)	(0.154)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Big0.5 * Public debt		-0.381		-0.407			0.001		0.004	
		(0.551)		(0.546)			(0.003)		(0.003)	
Big0.5 * Bank stock risk			0.678*	0.692*	-0.242			-0.018**	-0.018**	-0.014***
			(0.405)	(0.401)	(0.335)			(0.007)	(0.007)	(0.005)
Big0.5 * Fiscal balance					-0.256					-0.014
					(2.263)					(0.019)
N	10,791	10,791	10,791	10,791	4,729	248	248	248	248	191
R-sq	0.208	0.208	0.209	0.209	0.306	0.641	0.641	0.664	0.665	0.739
Country Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 9. Determinants of the market-to-book ratio and the cds spreads during 2007-2008

Dependent variable is market-to-book ratio in regressions 1-2 and 4-5 and the CDS spread in regressions 3 and 6. Market-to-book is market value of common equity divided by book value of common equity. CDS is annual average of daily credit default spreads for 5-year contracts. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Fiscal balance is ratio of central government revenues minus expenses and minus depreciation of capital to GDP. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Big0.5 is a dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.5 and it is zero otherwise. Big0.5, 2007 is a dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.5 in 2007 and it is zero otherwise. Regressions 1 and 4 are estimated with clustering at the country level. Regressions 2-3 and 4-5 contain bank fixed effects. *, ** and *** denote significance at 10%, 5% and 1% respectively.

	Market-to-book	Market-to-book	CDS	Market-to-book	Market-to-book	CDS
	(1)	(2)	(3)	(4)	(5)	(6)
Sample period	2008	2007 and 2008	2007 and 2008	2008	2007 and 2008	2007 and 2008
Assets	-0.008	-1.007***	-0.002	-0.002	-0.968***	0.000
	(0.024)	(0.136)	(0.008)	(0.025)	(0.138)	(0.004)
Pre-tax profits	1.336***	-0.754	0.182	1.385***	-0.350	0.033
	(0.469)	(0.635)	(0.205)	(0.437)	(0.631)	(0.115)
Earning assets	-0.781**	-0.871	-0.141*	-0.658*	-0.191	-0.024
	(0.334)	(0.665)	(0.074)	(0.357)	(0.718)	(0.048)
Leverage	0.687***	5.784***	-0.149	0.626***	5.634***	-0.150**
	(0.178)	(0.872)	(0.119)	(0.197)	(0.877)	(0.062)
GDP per capita	-0.040***	0.229**	0.003	-0.036***	0.205*	0.001
	(0.014)	(0.113)	(0.004)	(0.012)	(0.120)	(0.003)
Past crisis	0.047			0.019		
	(0.178)			(0.231)		
Past fiscal cost	-2.471*			-1.942		
	(1.420)			(1.430)		
Public debt	-0.142	-1.383*	-0.012			
	(0.479)	(0.788)	(0.055)			
Fiscal balance				-1.135	6.003***	-0.098**
				(1.454)	(2.013)	(0.045)
Bank stock risk	0.303***	-0.243***	0.018*	0.283***	-0.138	0.012**
	(0.083)	(0.086)	(0.010)	(0.088)	(0.090)	(0.005)
Big0.5	-0.478			-0.384**		
	(0.811)			(0.185)		
Big0.5 * Public debt	0.395					

	(1.325)					
Big0.5 * Fiscal balance				5.214***		
				(1.727)		
Big0.5 * Bank stock risk	0.394			0.500		
	(0.577)			(0.394)		
Big0.5, 2007 * Public debt		2.085	0.027			
		(2.159)	(0.065)			
Big0.5, 2007 * Fiscal balance					-1.272	-0.001
					(6.707)	(0.113)
Big0.5, 2007 * Bank stock risk		0.260	-0.013		0.421	-0.006
		(0.394)	(0.011)		(0.440)	(0.008)
Constant	2.987***	11.654***	0.314*	2.602***	10.347**	0.098
	(0.865)	(4.506)	(0.185)	(0.676)	(4.519)	(0.173)
N	676	1670	107	642	1,467	91
R-sq	0.139	0.907	0.889	0.142	0.903	0.959
Year fixed effect	No	Yes	Yes	No	Yes	Yes
Bank fixed effect	No	Yes	Yes	No	Yes	Yes
Clustering Level	Country	None	None	Country	None	None

Table 10. The impact of systemic bank size as measured by different thresholds for the liabilities-to-GDP ratio

The dependent variable is the market-to-book ratio in columns 1 to 4 and the CDS spread in columns 5 to 8. Market-to-book is the market value of common equity divdided by the book value of common equity. CDS is the annual average of daily credit default spreads on a 5-year contract. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Fiscal balance is ratio of central government revenues minus expenses and minus depreciation of capital to GDP. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Big is a dummy variable that equals one if ratio of bank liabilities to GDP exceeds a threshold set equal to 0.1 in columns 1 and 5, to 0.25 in columns 2 and 6, to 0.5 in columns 3 and 7, and to 1.0 in columns 4 and 8. All regressions are estimated with year and country fixed effects and clustering at the bank level. *, ** and *** denote significance at 10%, 5% and 1% respectively.

	Market-to-book	Market-to-book	Market-to-book	Market-to-book	CDS	CDS	CDS	CDS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Threshold in definition of Big	0.1	0.25	0.5	1	0.1	0.25	0.5	1
Assets	0.072***	0.072***	0.073***	0.071***	-0.000	-0.000	-0.000	-0.000
	(0.010)	(0.010)	(0.010)	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)
Pre-tax profits	3.289***	3.273***	3.271***	3.289***	-0.175	-0.113	-0.132	-0.163
	(0.896)	(0.895)	(0.896)	(0.896)	(0.117)	(0.124)	(0.135)	(0.143)
Earnings assets	-0.512***	-0.516***	-0.516***	-0.518***	-0.009	-0.016	-0.015	-0.011
	(0.195)	(0.195)	(0.194)	(0.195)	(0.013)	(0.014)	(0.015)	(0.014)
Leverage	0.169	0.166	0.173	0.167	0.002	0.011	0.009	0.003
	(0.230)	(0.229)	(0.230)	(0.229)	(0.021)	(0.024)	(0.026)	(0.027)
GDP per capita	0.039	0.037	0.039	0.039	0.001	0.000	0.000	0.000
	(0.024)	(0.024)	(0.024)	(0.024)	(0.001)	(0.001)	(0.001)	(0.001)
Past crisis	0.004	0.008	0.011	0.002	-0.010**	-0.011**	-0.010**	-0.008*
	(0.048)	(0.049)	(0.049)	(0.048)	(0.004)	(0.005)	(0.005)	(0.004)
Past fiscal cost	-0.100	-0.183	-0.147	-0.103	0.333**	0.379**	0.294*	0.223
	(0.574)	(0.580)	(0.575)	(0.572)	(0.139)	(0.173)	(0.152)	(0.138)
Public debt	-0.711***	-0.711***	-0.713***	-0.708***	0.007	0.015	0.002	-0.001
	(0.109)	(0.109)	(0.109)	(0.109)	(0.009)	(0.011)	(0.010)	(0.010)
Bank stock risk	0.124*	0.114*	0.120*	0.119*	0.034***	0.033***	0.029***	0.026***
	(0.068)	(0.067)	(0.067)	(0.067)	(0.007)	(0.008)	(0.008)	(0.007)
Big	-0.050	-0.252*	-0.380**	-0.416	0.004*	0.004*	0.004**	0.004*
	(0.105)	(0.136)	(0.186)	(0.341)	(0.002)	(0.002)	(0.002)	(0.002)
Big * Bank stock risk	0.022	0.682**	0.678*	1.242	-0.021***	-0.020**	-0.018**	-0.012*
	(0.185)	(0.287)	(0.405)	(0.857)	(0.007)	(0.008)	(0.007)	(0.007)
N	10791	10791	10791	10791	248	248	248	248

R-sq	0.208	0.208	0.209	0.208	0.717	0.683	0.664	0.643
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clustering level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 11. Alternative specifications with respect to public debt and bank risk variables

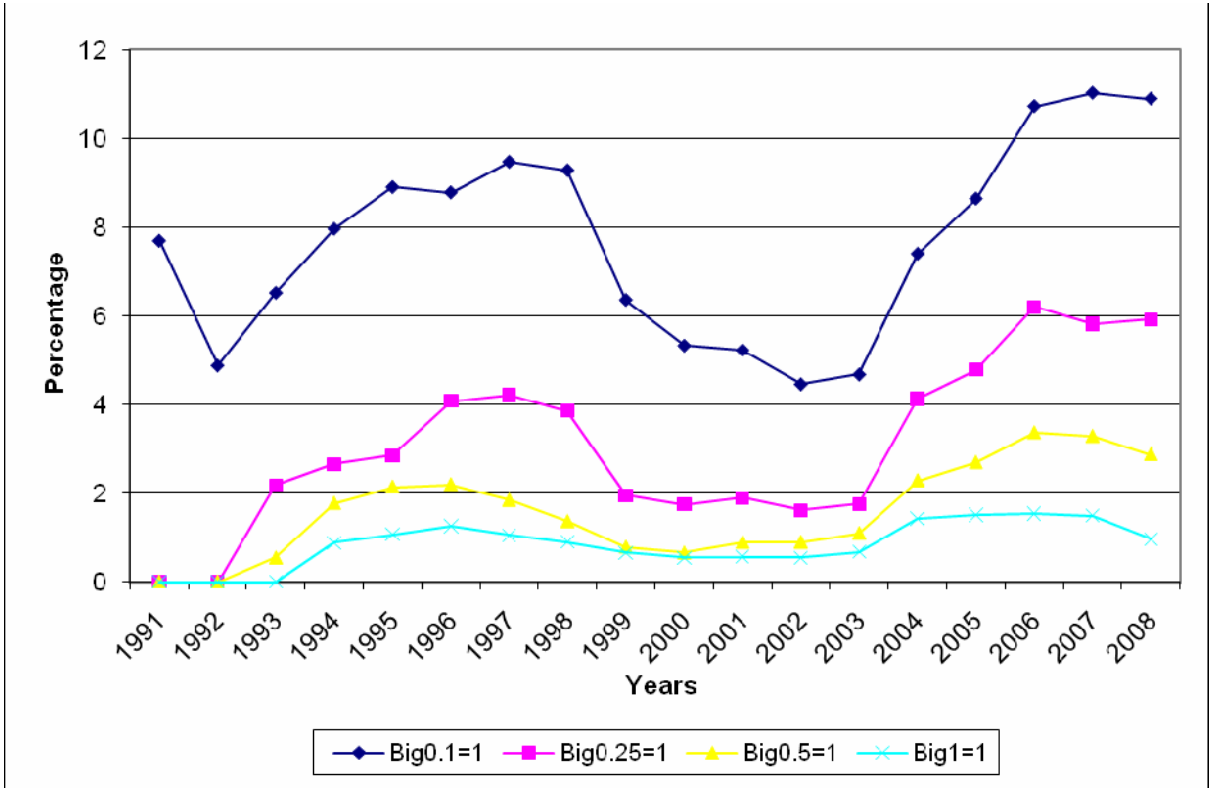
The dependent variable is the market-to-book ratio in columns 1, 3 and 5, and it is the CDS spread in columns 2, 4 and 6. Market-to-book is the market value of common equity divided by the book value of common equity. CDS is the annual average of daily credit default spreads on a 5-year contract. Assets is natural logarithm of total assets in constant 2000 US dollars. Pre-tax profits is pre-tax profits divided by total assets. Earning assets is earning assets divided by total assets. Leverage is liabilities divided by total assets. GDP per capita is GDP per capita in constant 2000 dollars. Past crisis is dummy variable that is one if country is not currently experiencing a banking crisis but has experienced a banking crisis before and zero otherwise. Past fiscal cost is fiscal cost of resolving most recent but not current banking crisis divided by GDP. Public debt is central government debt divided by GDP. Public debt (t-1) is the lagged value of Public debt. Bank stock risk is annualized standard deviation of weekly dividend-inclusive bank stock returns. Residual public debt is residual of regression of public debt on per GDP per capita. Z-score is index of bank solvency constructed as $\frac{ROA + CAR}{SROA}$ where ROA is return on assets, CAR represents capital assets ratio and SROA stands for standard deviation of return on assets. Big0.5 is a dummy variable that equals one if ratio of bank liabilities to GDP exceeds 0.5 and zero otherwise. All regressions are estimated with year and country fixed effects and clustering at the bank level. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

	Market-to-book	CDS	Market-to-book	CDS	Market-to-book	CDS
	(1)	(2)	(3)	(4)	(5)	(6)
Assets	0.073***	-0.000	0.073***	-0.000	0.074***	-0.000
	(0.010)	(0.000)	(0.010)	(0.000)	(0.010)	(0.001)
Pre-tax profits	3.271***	-0.132	3.521***	-0.052	3.733***	-0.409*
	(0.896)	(0.135)	(0.978)	(0.104)	(1.083)	(0.228)
Earning assets	-0.516***	-0.015	-0.368*	-0.013	-0.404*	-0.005
	(0.194)	(0.015)	(0.202)	(0.019)	(0.214)	(0.024)
Leverage	0.173	0.009	0.177	0.002	0.087	-0.025
	(0.230)	(0.026)	(0.237)	(0.028)	(0.259)	(0.035)
GDP per capita	0.036	0.000	0.041	0.000	0.043*	0.001
	(0.024)	(0.001)	(0.027)	(0.002)	(0.025)	(0.002)
Past Crisis	0.011	-0.010**	0.003	-0.009*	0.026	-0.005
	(0.049)	(0.005)	(0.043)	(0.005)	(0.050)	(0.005)
Past fiscal cost	-0.147	0.294*	-0.549	0.229*	-0.350	0.123
	(0.575)	(0.152)	(0.568)	(0.123)	(0.552)	(0.137)
Public debt					-0.703***	0.000
					(0.110)	(0.009)
Residual public debt	-0.713***	0.002				
	(0.109)	(0.010)				
Public debt (t-1)			-0.670***	-0.004		
			(0.103)	(0.005)		
Bank stock risk	0.120*	0.029***	0.080	0.029***		

	(0.067)	(0.008)	(0.069)	(0.009)		
Z-score					-0.001	-0.000
					(0.001)	(0.000)
Big0.5	-0.380**	0.004**	-0.342	0.005**	-0.083	-0.001
	(0.186)	(0.002)	(0.215)	(0.002)	(0.200)	(0.003)
Big0.5 * Bank stock risk	0.678*	-0.018**	0.682*	-0.018**		
	(0.405)	(0.007)	(0.411)	(0.007)		
Big0.5 * Z-score					-0.004	-0.000
					(0.008)	(0.000)
N	10791	248	9225	226	10221	239
R-sq	0.209	0.664	0.224	0.682	0.207	0.542
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Figure 1. Percentages of systemically large banks during 1991-2008

This figures shows the percentages of banks with a liabilities-to-GDP ratio exceeding various thresholds. Specifically, Big0.1 displays the percentage of banks with a liabilities-to-GDP ratio exceeding 0.1. Big0.25 displays the percentage of banks with a liabilities-to-GDP ratio exceeding 0.25. Big0.5 displays the percentage of banks with a liabilities-to-GDP ratio exceeding 0.5. Big1.0 displays the percentage of banks with a liabilities-to-GDP ratio exceeding 1.0



.