International evidence on government support and risk-taking in the banking sector.*

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September 28, 2012

Abstract

Government support to banks through the provision of explicit or implicit guarantees can affect the willingness of banks to take on risk by reducing market discipline or by increasing charter value. We use an international sample of bank data and government support to banks for the periods 2003-2004 and 2009-2010. We find that more government support is associated with more risk-taking by banks, especially during the financial crisis (2009-10), even after controlling for several bank-specific and country-level factors. We use several measures of government support and bank risk-taking, and the results are robust to various possible misspecification issues. We also find that restricting banks’ range of activities ameliorates the moral hazard problem. We propose that policy measures to counteract this moral hazard problem should be geared towards strengthening market discipline in the banking sector.

*Preliminary and incomplete.
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1 Introduction

Government support to banks through the provision of explicit or implicit guarantees has long been the subject of debate both in the academia and in the public opinion arena. This support can influence banks’ willingness to take on risk through two channels: by reducing market discipline or by increasing the banks’ charter value. According to the first channel, government support of banks decreases the incentive of depositors or creditors to monitor or influence bank risk-taking. Risk-shifting may occur if deposit insurance is not fairly priced (Merton, 1977) or if governments provide explicit or implicit guarantees to holders of senior or subordinate bank debt (see Gorton and Santomero, 1990, and Flannery and Sorescu 1996 for opposing results). The second way government support can influence risk-taking is by decreasing banks’ funding costs as both depositors and creditors demand lower rates. This in turn increases their interest margin and raises banks’ charter values, which leads to banks taking fewer risks to protect future rents (Keeley, 1990).

We use a cross-country sample of banks to answer two questions: Do banks with more explicit or implicit government support take on more risk? Does bank regulation limit the effect of government support on bank risk-taking?\(^1\) Our main findings are twofold: first, after controlling for a number of factors, including the level of bank regulations, banks’ ownership structure, the quality of corporate governance, transparency, the health of the banking sector,\(^2\) the degree of market concentration in the bank sector, and country-specific macroeconomic conditions, we find that the intensity of government support is positively related to our measures of bank risk-taking. We find that this relationship is stronger for the 2009-2010 period relative to 2003-2004. Our results are also robust to several other checks, including the possible endogeneity of

\(^1\)Ratings-based measures of support have been used to assess the implicit benefit of government support on bank debt (Schich and Lindh, 2012), equity returns (Correa et al., 2012), and bank competition (Gropp et al., 2011).

\(^2\)The willingness of banks to take on risk may depend on how likely bankers perceive drastic government intervention to be, that is, the level of regulatory forbearance which depends on the health of the banking sector (see Brown and Dinç, 2011).
government support. Thus, in our sample, market discipline is the dominant factor in shaping the relationship between support and risk in the banking industry. Our second key result is that the adoption of regulatory impediments for banks to engage in activities involving security markets, insurance, real estate, and ownership of nonfinancial firms reduces the magnitude of the moral hazard problem associated with government support. Capital supervision and regulation were not enough to fully prevent additional risk taking by banks with more government support during the crisis, but banks that faced more restrictions in terms of the activities they were allowed to perform were less likely to take on more risk.

Recent studies have proposed that government bail-out guarantees should increase bank risk-taking by competitors because it decreases their charter value (Hakenes and Schnabel, 2010). Gropp et al. (2011) study the behavior of a large cross-section of banks across many countries and find that a measure of government support (weighted by market share) signals more risk-taking by competitors. They do not find however a consistent relationship between support and risk-taking by protected banks and, if anything, their study points to lower risk-taking, consistent with the charter value channel being dominant. Significant methodological differences between our study and theirs help explain why we reach opposite conclusions on the moral hazard of government support to banks. Furthermore, they do not study the post-financial crisis period, as we do.

Capital requirements, deposit insurance and regulations which restrict banks’ activities interact with the structure of bank ownership and governance in shaping bank risk-taking (Laeven and Levine, 2009). Forssbæck (2011) also explores the importance of deposit insurance and ownership on bank risk-taking but his work differs from ours along several dimensions. For instance, his paper focuses on the period from 1995 to 2005, and in contrast to our findings, finds no support to the proposition that market discipline strengthens during crises.

Studying and understanding bank risk-taking behavior is important for a variety of reasons. Excessive risk-taking by banks is often associated to bank failures and costly government-
financed rescues. Banking crises in turn are associated with sharp recessions, large drops in asset prices, protracted recoveries and big increases in government debt (Reinhart and Rogoff, 2009). This reason alone is enough to justify central banks’ concerns with and responsibilities in monitoring and influencing banks’ risk-taking, noted both across countries (Barth et al., 2006) and over time (Calomiris, 2010). In addition, banks subject to lower default frequency seem to better insulate their loan supply from monetary policy changes and to offer more credit (Altunbas et al., 2010). Furthermore, both theoretical and empirical studies of bank risk-taking have been used by both central banks and regulatory agencies to frame prudential policies. In the sense that our results provide an estimate of the magnitude of the moral hazard effect government support to banks, they are also useful as an input for researchers and regulators.

Our results have strikingly different policy implications from those of related papers. If the main channel through which government support impacts on bank’s risk taking is by increasing the charter value of guaranteed banks then it makes sense to apply a capital surcharge on protected banks to decrease their rents and their (unprotected) competitors’ incentives to take on more risk (Gropp et al., 2011). In as much as capital requirements also decrease bank charter value (Hellmann et al., 2000), this would be an additional prudential measure recommended under the former hypothesis. If however, as we find, the dominating channel is the “market-discipline” one, then measures to increase the incentives by depositors and subordinated creditors to monitor or influence banks’ attitudes towards risks are preferable. These include imposing more transparency and forcing more disclosure by bank managers, mandating periodic issuance of subordinated debt or using market information to improve the quality of supervision (Rochet, 2005). Moreover, the increase in bank complexity over the past decade may have decreased the effectiveness of investor monitoring, as it became more difficult for “outsiders” to assess the level and types of risks taken by banks. Our second finding provides evidence that investors may limit risk-taking by banks, even for those that have government support.

See Boyd and De Nicoló (2005) for an interesting discussion on policy responses to perceived links between competition and the risk of bank failures.
support, if these banks’ range of activities is restricted. Thus, simple rules like those that were included in the Glass-Steagall Act could potentially be reconsidered (Haldane, 2012).

The rest of this paper is organized as follows. The next section presents a short survey of related studies on bank risk-taking. In Section 3 we describe our sample and detail our data sources. We next discuss our hypothesis and methods after which, in Section 5 we present our results. Section 6 concludes.

2 Related Literature

Bank risk-taking has been the subject of several studies and this interest has naturally increased in recent years. Studies on the impact of government support on bank risk-taking have to a large extent looked at three dimensions or measures of support: deposit insurance (as an explicit guarantee; see Demirgurcu-Kunt and Detragiache, 2002, Gropp and Vesala, 2004, Morrison and White, 2011), bank size (as a proxy for being too-big-to-fail; see Boyd and Runkle, 1993, and O’Hara and Shaw 1990 on how it relates to deposit insurance), and state ownership (De Nicoló and Loukoianova, 2007, who find no connection to risk-taking).

A number of other explanations of banks’ attitude towards risk has been suggested and tested. Bank ownership structure has been shown to be an important explanation of the level of risk-taking by banks since it critically conditions the conflict over risk between bank managers and owners (Laeven and Levine, 2009), at least for privately held banks (Barry et al., 2011). In addition to ownership, the degree to which CEO incentives are aligned with the interests of shareholders seems to influence the amount of risk-taking even if the existing evidence is still inconclusive. For instance, there is some evidence that greater reliance on option compensation or cash bonuses did not have a negative impact on bank performance during 2008-09 crisis (Fahlenbrach and Stulz, 2011). However, incentive pay in banking may have led to acquisitions which increased default risk by acquiring banks (Hagendorff and Vallascas, 2011) even if M&A activity in general seems have an is ambiguous impact on bank risk taking (Amihud et al.,
The level of competition in banking markets is another factor which affects risk-taking. Some studies suggest competition among banks for deposits decreases charter value and therefore leads to riskier portfolios being held by banks (Keeley, 1990, Hellmann et al., 2000, Repullo, 2004, Jimenez et al., 2010). However, the degree of competition in lending markets also plays a role and may reverse the previous result, as suggested by Boyd and De Nicoló (2005) and Boyd et al. (2006).\(^4\)

Low monetary policy interest rates have been shown to be conducive to lower lending standards by banks (Maddaloni and Peydró, 2011). This effect is amplified by securitization and weak bank supervision. National bank regulation such as bank risk and capital regulations, deposit insurance policies (Demirguc-Kunt and Detragiache, 2002) and restrictions on bank activities also play an important role. Ceilings on deposit rates (Smirlock, 1984), the degree of financial openness (Cordella and Yeyati, 2002) and bank efficiency with respect to costs and revenues (Fiordelisi et al., 2011) have all been shown to shape risk taking in the banking sector.

3 Data

3.1 Bank risk taking

We use the z-score as our measure of bank risk. The z-score equals the return on assets (ROA) plus the capital asset ratio (CAR) of each bank divided by the banks’ standard deviation of return on assets. The z-score measures the distance from insolvency (Roy, 1952). Insolvency is defined as a state in which losses exceed equity. The probability of insolvency can thus be expressed as prob(-ROA<CAR), where ROA is the return on assets and CAR is the capital assets ratio. If profits are normally distributed, the inverse of the probability of insolvency

\(^4\)Their argument goes like this: if there is low competition among banks for loans to firms, interest rates charged will be higher and this will force entrepreneurs to choose riskier projects, thereby increasing credit risk borne by banks. More recent work by Martinez-Miera and Repullo (2010) however suggests a U-shaped relationship between competition and the risk of bank failure.
equals \((\text{ROA} + \text{CAR})/\sigma(\text{ROA})\), where \(\sigma(\text{ROA})\) is the standard deviation of ROA. Following the literature, we define the inverse of the probability of insolvency as the z-score, where a higher z-score indicates that the bank is more stable. As the z-score is highly skewed, we use the natural logarithm of the z-score, which is normally distributed. For simplicity, in the remainder of the paper we use the term “z-score” when referring to the natural logarithm of the z-score. We have data across 54 countries to calculate the z-score for 286 banks for the period 2003-2004, and for 321 banks in 2009-2010. These banks are also required to be rated by either Moody’s Investors Services (Moody’s) or Fitch Ratings (Fitch), two of the major rating agencies. As listed in Table 1, the number of banks per country varies from 1 to 30. The results in the paper are robust to excluding countries with less than 2 banks.

To calculate the z-score, we compute the standard deviation of ROA using 5 year rolling windows. Then we average the z-score for the years included in our two cross-sections, 2003-2004 and 2009-2010. We focus on a cross-sectional analysis due to a change in accounting standards that affected a large sample of European banks and banks in other regions. In the mid-2000s, some countries replaced local General Accepted Accounting Practices (GAAP) for International Financial Reporting Standards (IFRS) for publicly-traded banks based in these countries. The change in accounting standards had a notable impact on the way bank balance sheets are reported. For instance, under IFRS rules, derivative assets and liabilities are not netted, increasing the total value of assets of the bank. To avoid including biases due to the change in accounting treatment we focus on periods in which banks consistently use one or the other accounting methods, and focus on cross-section of results. The accounting data on banks are from Bankscope, a commercial database on major international banks.

### 3.2 Bank support

We measure bank support using bank-specific ratings information from Moody’s and Fitch. Since 1995, Moody’s has assigned bank financial strength ratings (BFSR) to banks in about 90
countries. According to Moody’s, BFSRs “are intended to provide investors with a measure of a bank’s intrinsic safety and soundness on an entity-specific basis” (Moody’s Investors Service, 2007). More importantly, this measure does not include any external support that a bank may receive from its parent, other institutions under a cooperative or mutual arrangement, or the government.

Moody’s also assigns a bank deposit rating to the banks it rates. This is the rating agency’s opinion on a bank’s ability to repay its deposit obligations punctually. As such, they incorporate both the bank’s BFSR rating and Moody’s opinion of any external support.

In the main specifications, the bank-specific government support measure is defined as the difference (in rating notches) between a bank’s BFSR and its long-term foreign currency deposit rating. As a robustness check, we also define support in terms of the probability of a government bailout as in Gropp et al. (2011). Fitch Ratings provides a similar measure of the probability of support which we use as an additional robustness check.

Figure 1 shows the evolution of average and median government support since 1996 for all banks included in the sample. Support tends to increase during periods of economic distress, as was the case during the East Asian and Russian crises of the late 1990s, and the recent financial crisis.

3.3 Control variables

We control for a series of characteristics at the bank and country levels. For the most part, we follow Laeven and Levine (2009). The bank-specific controls include revenue growth (measured as the growth in total revenues relative to the previous period), size (the bank’s log of total assets), and liquidity (bank’s liquid assets to liquid liabilities) and are all sourced from Bankscope. At the country level, we control for per capita income (data from the World Bank) and for bank concentration in the national banking sector as measured by the Hirsch-Herfindahl index (data from Bankscope). We also control for the quality of investor protection and for the
degree to which contracts are effectively enforced in a country (data from the World Bank’s “Doing Business” Project).

In terms of banking regulations, we control for the existence of a deposit insurance scheme and for the level of capital requirements (measured by the minimum capital-asset ratio requirement). Data on deposit insurance comes from Demirguc-Kunt et al. (2008), the Institute International Bankers (Global Surveys 2009 and 2010), the International Association of Deposit Insurers (IADI), the Central Bank of Egypt, and the Singapore Deposit Insurance Corporation Limited (SDIC).

Finally, we use as regressors several variables which measure the intensity and breadth of regulation in the banking sector and at the country level, as defined by Barth et al.’s (2006) bank regulatory database. We use the level of capital requirements and stringency, the level official bank supervisory power, and an index of activity restrictions (Barth et al., 2006, all defined in). Capital stringency measures the regulatory approach employed to determine and verify the extent of the capital at risk at banks. The variable reflects, among other information, whether the minimum capital-asset ratio (risk-weighted) requirement is based on Basel guidelines, whether market value of loan losses not realized in accounting books is deducted, or if the initial disbursement of capital can be done with borrowed funds. The official supervisory power variable measures the extent to which the regulatory or supervisory authorities have the authority to take specific actions to prevent and correct problems. This includes the right to meet with external auditors to discuss their report without the approval of the bank, the right to order the bank’s directors or management to constitute provisions to cover actual or potential losses, among other rights. Activity restrictions is an index measuring regulatory limitations to banks operating in securities markets, insurance activities, real estate, and engaged in the ownership of nonfinancial firms. For the 2003-2004 cross-section we use information from the 2003 regulatory database, and for the 2009-2010 cross-section we use the data compiled in the 2008 version of the database.
3.4 Summary statistics

Table 2 provides summary statistics for the key regression variables. Statistics are based on annual data for the periods 2003-2004 and 2009-2010 for our measure of risk-taking (z-score) and lagged by one year for the rest. The table indicates that there is ample variation in the bank risk taking measures and in the other relevant variables across banks in the sample periods. The table also shows a moderate decrease in the level of measured risk-taking (0.3 standard deviations of the z-score) and a somewhat more substantial increase in the average size of banks (0.5 standard deviations), when we compare 2003-2004 to 2009-2010. If we take previous studies at face value, these two facts in isolation are consistent with larger banks, possibly with more market power, taking on less risk. However, it is important to explore whether an increase in government support may have led to more risk-taking by banks.

In fact, regardless of the measure we use, the data shows a sizeable increase in the average level of support from 2002-2003 to 2008-2009. The increase is even more significant when we look at the median level of support. The median probability of support estimated by Moody’s increases from 0% to 40%, from the first sample period to the second one, signalling a widespread increase in government support to banks. This increase is much more pronounced in Moody’s measure than in Fitch’s (Figure 1).

This begs the question of which measure is preferrable. In Table 3 we can see that, while Moody’s and Fitch’s measures of support were only mildly correlated before the crisis, they become much more correlated after crisis. Therefore, choosing between one or the other is only relevant for the pre-crisis period. For this period we see that Moody’s measure was weakly correlated with size, whereas Fitch’s was more correlated with the banks’ size.\footnote{After the crisis, they are both correlated with size, as expected.} In our opinion, this shows Moody’s measure to be preferrable.
4 Hypothesis and Empirical Strategy

Our first hypothesis is that bank risk-taking is related to government support to the banks. The basic empirical specification to test the hypothesis is formulated as follows,

\[ Z_{b,c,t} = \beta_0 + \beta_1 \ast GS_{b,c,t-1} + \beta_2 \ast X_{b,c,t-1} + \beta_3 \ast W_{c,t-1} + \varepsilon_{b,c} \]

where \( Z_{b,c,t} \) is the z-score of bank \( b \) in country \( c \) for period \( t \), \( GS_{b,c,t-1} \) is government support for bank \( b \) from country \( c \), \( X_{b,c,t-1} \) is a matrix of bank level control variables, \( W_{c,t-1} \) are country-level regulations, \( \varepsilon_{b,c} \) is the error term, and \( \beta_1, \beta_2, \) and \( \beta_3 \) are vectors of coefficient estimates. The standard errors are adjusted to control for clustering at the country level.

The interaction between national regulations and government support, and the interaction between bank level ownership and government support, are considered in the second hypothesis. Our second hypothesis is that bank supervision and regulation affects the impact of government support on banks’ risk taking behavior, which we test using the following specification:

\[ Z_{b,c,t} = \beta_0 + \beta_1 \ast GS_{b,c,t-1} + \beta_2 \ast R_{c,t-1} + \beta_3 \ast GS_{b,c,t-1} \ast R_{c,t-1} + \beta_4 \ast X_{b,c,t-1} + \beta_5 \ast W_{c,t-1} + \varepsilon_{b,c} \]

where \( R_{c,t-1} \) are country-specific regulatory standards, so that \( GS_{b,c,t-1} \ast R_{c,t-1} \) captures the interaction between the bank-specific government support measure and national regulations, and \( \beta_3 \) is the coefficient estimate of the interaction effect.

5 Results

5.1 Benchmark Regression

The benchmark empirical results on the link between bank risk-taking and government support are reported in Table 4. The first main finding is that larger government support is associated
with greater risk taking by banks, as reflected in the negative coefficient for government support ($GS$) found for all the specifications. Another relevant result is that the relationship between government support and bank risk taking is present for both the 2003-2004 and 2009-2010 periods, but the coefficients are more statistically significant during the latter period across all specifications. Regressions 1 and 8 control for recent bank performance (revenue growth), and show that a one standard deviation increase in government support is associated with a 4.5 percent decrease on the average z-score for the 2003-2004 period, but the relationship is not statistically significant. For 2009-2010, the government support coefficient is negative and statistically significant, and its magnitude indicates that a one standard deviation increase in government support is associated to a 6.9 percent increase in bank risk taking, relative to the average z-Score. These findings are consistent with the view that increasing government support to banks tends to reduce market discipline, inducing further bank risk-taking. The positive association between $GS$ and risk holds when controlling for bank characteristics, country-level features, and after including country fixed effects.

To consider the possibility that the association between government support and bank risk-taking reflects other bank level differences instead of cross-bank differences in government support, the regression results shown in columns 2 and 9 control for the bank-specific characteristics of revenue growth, size and the liquidity ratio. The positive association across periods and the stronger link between $GS$ and banks’ risk-taking holds after including the bank-level controls.

To take into account the possibility that the link between government support and bank risk-taking captures cross-country heterogeneity instead of cross-bank differences in government support, regressions shown in columns 4 and 11 include country fixed effects. Alternatively, regressions in columns 5 and 12 control for several country-specific characteristics, including the level of economic development in each bank’s home-country (per capita income), indicators of capital requirements, the level of investment protection (measured by the World Bank$^6$), the

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$^6$Using Djankov et al.’s (2008) revised anti-directors index or their anti-self-dealing index does not change the
presence of deposit insurance, the degree to which the law is effectively and fairly enforced in a country, and the Herfindahl concentration index for the banking system. The results, as shown in regression 3 of Table 4, are robust to conditioning on either country controls or fixed effects.

We also considered instrumental variables and additional controls in the regressions to address any possible endogeneity and omitted variables concerns (i.e. to preclude the possibility that \( \text{cov}(Z_{b,c}, \varepsilon_{b,c}) \neq 0 \)). We use instrumental variables for each bank’s government support. For each bank \( n \), we employ the average \( GS \) of the other \( n-1 \) banks in the country, which reflects industry and country factors explaining \( GS \). The instrument has the benefit that an innovation in the risk taking of any given bank does not affect the government support of other banks. As shown in regressions 3 and 10, the instrumental variable results confirm that \( GS \) is positively and significantly associated with bank’s risk taking, at least for the crisis period. In fact, not only does the coefficient associated with \( GS \) remain statistically significant, but its magnitude does not change.

In regressions 6 and 13, in addition to the previous bank and country level controls, we control for cash-flow rights, and for ownership structure (as in Laeven and Levine, 2009) by looking at the extent to which there are large shareholders in the bank and by differentiating between government, institutions, individuals and others. The positive and significant association between bank risk taking and government support is robust to these additional controls.

A final specification issue we tackle is the one pertaining to the timing of support being given and risk materializing. Although in our benchmark specifications support is lagged by one period (we regress the 2003-2004 and 2009-2010 z-Scores on 2002 and 2008 supports, respectively), we decided to regress the z-Score averages on 2001 and 2007 support alone (using a longer lag would restrict severely our sample size). The results are on columns 7 and 14 and are basically the same as in the other regressions.

flavor of results, which are available from the authors if requested.
5.2 Robustness

We perform two robustness exercises which involve using alternate definitions for risk-taking and government support. In the first exercise, we substitute the individual components of the z-score (ROA, Capital to Assets, and the standard deviation of ROA) for the z-score proper. We regress these measures on bank controls and on country controls, as in the benchmark regression discussed before.\(^7\)

The results are available on Table 5 for the selected time periods: 2003-2004 and 2009-2010. The regressions show a strong and statistically significant effect of government support on ROA regardless of the time period. In the pre-crisis sample, government support was also positively and significantly related to the volatility of ROA. In the crisis sample, government support was negatively and significantly related to the capital to assets ratio. We interpret these findings as follows. Before the crisis, support tended to encourage riskier bets by banks which translated into more volatile returns. After the crisis, while that is still a possible interpretation, the risk taken by banks translated into more leverage and lower capital buffers to withstand shocks.

A second robustness test requires replacing our notches-based definition of government support with one where we assign probabilities of a government bailout as in Gropp et al. (2011). We then replicate the regressions presented in Table 4: two regressions with bank controls only, one with county fixed effects, and one with country controls for both time periods. Our findings are in Table 6. Most results are qualitatively the same as the ones for the benchmark regressions. During the crisis, using our preferred specification (country fixed effects), a

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\(^7\)We also tried using loan loss provisions as a percentage of assets as an alternative measure of risk. This measure presents two problems. First, the definition of what are loan losses and of how much and when to provision for those losses varies across countries by a great deal. This causes a misspecification problem. Second, a second problem with using loan loss provisions is that it provides a very incomplete measure of risks taken. Specifically, loan loss provisions (imperfectly) cover risks associated with loan portfolios and disregard other types of credit risks, let alone market risks which affect a broader set of assets held by banks and were more important during the recent financial crisis. Preliminary findings seem to confirm this and will be made available if requested.
one standard deviation increase in the probability of a bailout\textsuperscript{8} led to an 8 percent increase in risk (relative to the mean). This effect is significant at the 1 percent significance level.

We extend our robustness check by performing the exercise using probabilities of a government bailout derived from data collected by Fitch Ratings (the same data source used by Gropp et al., 2011, Forssbæck, 2011). We run the same regressions as in Table 6 and present the results in Table 7. The main difference in terms of results is that government support is not significant for the pre-crisis period. In fact, as in Gropp et al. (2011), we find that for that period (2003-2004), a higher probability of a government bailout is not associated with the supported bank taking on more risk.\textsuperscript{9} When we look at the crisis period however (2009-2010), we do find strong evidence of moral hazard in government support to banks, as we had in the regressions with the Moody’s-based measures of support.

5.3 Regulation and Government Support

Our research is the first attempt to explore the interactive effects of national regulations and bank-specific government support on the risk taking behavior of individual banks. We use data on regulation for 2003 and for 2008 from Barth et al. (2008). This data considers regulations emphasized by the Basel Committee, and that the theoretical literature has pinned down as affecting bank behavior (Laeven and Levine, 2009). We use an index of regulatory oversight of bank capital, \textit{capital stringency}, a measure of \textit{official supervisory power} and a measure of \textit{activity restrictions} (see Section 3.3 for detailed definitions).

Table 8 shows the interaction of government support with the various types of bank regulations in cross section regressions for the 2003-2004 and 2009-2010 periods. The regressions include all the bank and country level controls used in the previous tables. The results indicate that for the 2003-2004 period, seen in columns 1 to 4, \textit{government support} was not a significant

\textsuperscript{8}This would be equivalent to going from no support to a level slightly below the median level of support in the industry.

\textsuperscript{9}This is probably due, at least in our study, to this probability-based measure of government support not showing enough variation in the pre-crisis sample (see Figure 1).
factor for bank risk taking, and regulation did not play a significant role either. In contrast, in the crisis period government support is associated with more risk taking by banks. The interaction coefficient for activity restrictions and government support is positive and significant during the period of the recent crisis, indicating that limiting the scope of activities and markets where banks should be allowed to operate has limited their risk taking behavior. The magnitude of the interaction coefficient evidences that activity restrictions have not fully offset the moral hazard effect from government support. The announcement in May 2012 by J.P. Morgan that it took between USD 2 billion and USD 3 billion in first and second quarter trading losses due to large bets on derivatives gone wrong, highlights how current and relevant are our regulatory findings, especially when considering that the bank emerged from the financial crisis in better shape than most of its peers. The Wall Street Journal commented on May 10, 2012 on some of the implications of the announcement by J.P. Morgan.

The news comes as large banks are fighting efforts by regulators to rein in risky trading. J.P. Morgan Chief Executive Jamie Dimon on Thursday said “egregious and self-inflicted mistakes” were made with trades that were “poorly executed and poorly monitored.” The revelations will likely provide more ammunition for proponents of the Volcker rule, to limit bank proprietary trading. Fairly or not, every big bank will be faced with questions regarding their trading practices. Mr. Dimon maintained on the call the specific trading at issue wouldn’t be covered by the Volcker rule. J.P. Morgan’s announcement is “just the latest evidence that what banks call ‘hedges’ are often risky bets that so-called ‘too big to fail’ banks have no business making,” Senator Carl Levin (D., Mich.) said in a statement. “Today’s announcement is a stark reminder of the need for regulators to establish tough, effective standards... to protect taxpayers from having to cover such high-risk bets.”
6 Conclusion

Government support to banks through the provision of explicit or implicit guarantees is still the subject of vigorous debate.

We use two measures of government support to banks - in notches and in terms of probability of a bailout - from two sources (Moody’s and Fitch Ratings) to explain their attitudes towards risk. After controlling for bank-level and country-specific factors, we find that the intensity of government support is positively related to our measures of bank risk-taking. We find that this relationship is stronger for the 2009-2010 period relative to 2003-2004. Our results are robust to endogeneity as well as to the way we measure risk-taking. We conclude that market discipline, especially during the crisis, shaped the relationship between government support and risk in the banking industry.

Our results suggest that measures to increase the incentives by depositors and subordinated creditors to monitor or influence banks’ attitudes towards risks should decrease the moral hazard associated with government support to the financial system. Restricting banks’ ability to engage in activities involving security markets, insurance, real estate, and ownership of nonfinancial firms further weakens the link between government support and risk-taking by banks. The way through which restrictions on bank activities ameliorate the problem (either by reducing banks’ ability to engage in risky activities or by reducing banks’ complexity and therefore facilitating monitoring by outside investors and bank supervisors) will be the subject of further research.

An important extension to our paper is to investigate the role of bank governance variables besides ownership. For instance, large board sizes in banks may be optimal given the complexity of the banking business and the large size of many of these firms.\textsuperscript{10} This stands in sharp contrast to nonfinancial firms where board size is positively related to free-riding problems.\textsuperscript{10}

\textsuperscript{10}See Mehran et al. (2011) and Mehran and Mollineaux (2012) for a survey of the complexities of banks’ corporate governance.
Banks are also different from nonfinancials and other financial firms in that they have many outside investors (i.e. depositors), are highly leveraged, and are possible beneficiaries of government support. This translates into shareholders’ interests being often conducive to too much risk taking (Fahlenbrach and Stulz, 2011), at least from a systemic risk point of view. What the optimal bank governance structure should be, given a desired level of systemic risk, is still not totally understood and will certainly be the motivation for future research.
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Figure 1: Government Support, 1995-2011

The blue line represents median government support (by year) measured by the difference between a bank’s BFSR and its long-term foreign currency deposit rating, as measured by Moody’s. The red line (right scale) represents the median of the same measure converted to probabilities of default as in Gropp et al. (2011). The green line is the equivalent measure of probability of government support but using data from Fitch Ratings.
Table 1: Sample by Country and Period

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Sample statistics for main variables of interest. z-Score is the ROE plus Capital-Asset ratio divided by the standard error of ROE. Revenue growth is the annual growth rate of gross revenues. Size is the logarithm of total assets. Liquidity is ratio of liquid assets to liquid liabilities. Moody’s support (in rating notches) is the difference in notches between Moody’s foreign currency deposit rating and Moddy’s BFSR. Moody’s support (in probability) is the conversion of Moody’s support (in rating notches) into probabilities of support as in Gropp et al. (2011).

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<td>0.66</td>
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Table 3: Correlations

Correlations among main variables of interest. *Score is the ROE plus Capital-Asset ratio divided by the standard error of ROE. Revenue growth is the annual growth rate of gross revenues. Size is the logarithm of total assets. Liquidity is ratio of liquid assets to liquid liabilities. Moody’s support (in rating notches) is the difference in notches between Moody’s foreign currency deposit rating and Moddy’s BFSR. Moody’s support (in probability) is the conversion of Moody’s support (in rating notches) into probabilities of support as in Gropp et al. (2011).

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Robust standard errors in brackets

* p<0.10, ** p<0.05, *** p<0.01
Table 4: Bank risk-taking and government support (notches): z-Scores

Dependent variable for all cross-section regressions is the z-Score of each bank’s individual score. The z-Score is ROE plus Capital-Asset ratio divided by the standard error of ROE. Revenue growth is the annual growth rate of gross revenues. Size is the logarithm of total assets. Liquidity is ratio of liquid assets to liquid liabilities. Government support is the difference in notches between Moody’s foreign currency deposit rating and Moddy’s BFSR.

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Robust standard errors in brackets
*p<0.10, **p<0.05, ***p<0.01

28
Table 4 (continued): Bank risk-taking and government support (notches): z-Scores

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Robust standard errors in brackets
* p<0.10, ** p<0.05, *** p<0.01

29
Table 5: Bank risk-taking and government support (notches): z-Score components

Dependent variable for each regression defined at top of each column. Revenue growth is the annual growth rate of gross revenues. Size is the logarithm of total assets. Liquidity is ratio of liquid assets to liquid liabilities. Government support is the difference in notches between Moody’s foreign currency deposit rating and Moddy’s BFSR.

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Observations: 198, 183, 198, 312, 306, 312
R-squared: 0.43, 0.55, 0.65, 0.32, 0.41, 0.61
Countries: 45, 44, 45, 53, 53, 53

Robust standard errors in brackets
*p<0.10, **p<0.05, ***p<0.01
Table 6: Bank risk-taking and probability government support measured by Moody’s

Dependent variable for all cross-section regressions is the z-Score of each bank’s individual score. The z-Score is ROE plus Capital-Asset ratio divided by the standard error of ROE. Government support is measured as probability of bailout (Gropp et al., 2011) using data from Moody’s.

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Robust standard errors in brackets

* p<0.10, ** p<0.05, *** p<0.01
Table 7: Bank risk-taking and probability government support measured by Fitch Ratings

Dependent variable for all cross-section regressions is the z-Score of each bank’s individual score. The z-Score is ROE plus Capital-Asset ratio divided by the standard error of ROE. Government support is measured as probability of bailout (Gropp et al., 2011) using data from Fitch Ratings.

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Robust standard errors in brackets
* p<0.10, ** p<0.05, *** p<0.01
Table 8: Bank risk-taking, government support, bank supervision and regulation

Cross-section regressions. Government support is measured as probability of bailout (Gropp et al., 2011). Specifications (3) and (6) include country fixed effects. z-Score is the ROE plus Capital-Asset ratio divided by the standard error of ROE.

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