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International Evidence on Government Support
and Risk Taking in the Banking Sector

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Abstract

Government support to banks through the provision of explicit or implicit guarantees affects 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). We also find that restricting banks' range of activities ameliorates the moral hazard problem. We conclude that strengthening market discipline in the banking sector is needed to address this moral hazard problem.

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I. INTRODUCTION

Bank bailouts during and after the 2007–2009 financial crisis have reignited the debate on the effect of government support on banks' management incentives and on the distortions it causes in competition in the banking sector. Explicit and implicit government support can influence banks' willingness to take on risk through two channels: by reducing market discipline and/or by increasing the banks' charter value.

According to the *market discipline* hypothesis, government support of banks decreases the incentive of outside investors (depositors, creditors, and shareholders) to monitor or influence bank risk taking. Risk-shifting may occur if deposit insurance is not fairly priced (Merton, 1977) or if governments provide guarantees to holders of bank debt (Flannery and Sorescu, 1996). Under the *charter value* hypothesis, government support decreases banks' funding costs as both depositors and creditors demand lower rates. The decline in funding costs increases their interest margin and raises banks' charter values, which leads to banks taking fewer risks to protect future rents (Keeley, 1990).

The goal of this paper is to determine which channel dominates. Since, for the most part, this is an empirical issue, we use two cross-country samples 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?

To answer these questions we define bank risk as the z-score (return on assets plus capital to asset ratio, divided by the standard deviation of return on assets) which is a measure of distance to default. In addition, we measure government support as the difference between each bank's deposit rating and bank financial strength rating assigned by Moody's Investors Service, which, as we show later in this study, is able to predict actual bank bailouts.[1] We test these hypothesis using an sample of bank and ratings data covering several developed and emerging countries, for the periods 2003-2004 (before the crisis) and 2009-2010 (during the crisis).[2]

We have two main findings. First, after controlling for a number of factors, including bank size and liquidity, the level of bank regulations, banks'ownership structure, the degree of market concentration in the banking sector, and country-specific macroeconomic conditions, we

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[1]Ratings-based measures of support have been used to assess the implicit benefit of government support on bank debt (Schich and Lindh, 2012) and equity returns (Correa and others, 2013).

[2]The choice of the pre-crisis period is driven by data availability and to allow comparison with other related studies (e.g. Gropp, Hakenes, and Schnabel, 2011).

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. This result is also robust to several other checks, including the possible endogeneity of government support. Thus, in our sample, market discipline is the dominant factor 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 non-financial 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.

Previous studies on the impact of government support on bank risk taking have to a large extent looked at either measures of explicit support such as deposit insurance (Demirguc-Kunt and Detragiache, 2002) and state ownership (De Nicoló and Loukoianova, 2007) or indirect measures of implicit support such as bank size ("too-big-to-fail"; see Boyd and Runkle, 1993; O'Hara and Shaw, 1990), with mixed results. More recently, Forssbaeck (2011) 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 the market discipline channel becomes more important during crises. Dam and Koetter (2012) also find support for the market discipline channel for the 1995–2006 period but their study is restricted to German banks and they derive a measure of probability of support from actual bailouts. In related work, other authors have found a positive effect of actual government support on bank risk taking.[3] We instead focus on *expected*, not actually received, government support and use a sample of banks from many countries.

Unlike the previously mentioned studies, Gropp, Hakenes, and Schnabel (2011) find that a measure of expected government support to a given bank induces more risk taking by the bank's competitors.[4] However, they do not find a consistent relationship between support and risk taking by protected banks. In fact, their study suggests that protected banks take on less risk, which is consistent with the charter value channel being dominant. Our conclusions on the moral hazard effects of government support to banks are opposite to those of Gropp,

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[3]See, for instance, Black and Hazelwood (2012) for the effect of TARP on U.S. banks.

[4]Government bail-out guarantees to a given bank may increase risk taking by its competitors because they decrease their charter value (Hakenes and Schnabel, 2010).

Hakenes, and Schnabel (2011). The different findings can be explained by our use of a different measure of risk and of additional bank and country-specific controls. The z-score, our measure of risk taking, is a broader measure of risk since it encompasses both credit risk and market risk and summarizes some of the measures used by Gropp, Hakenes, and Schnabel (2011).[5] Furthermore, our sample excludes bank subsidiaries but includes the post-financial crisis period.

Studying and understanding bank risk-taking behavior is important for a variety of reasons. Excessive risk taking by banks is often associated with bank failures and costly government-financed rescues. Banking crises are in turn associated with sharp recessions, large drops in asset prices, protracted recoveries and big increases in government debt (Reinhart and Rogoff, 2009). In addition, banks exposed to lower default risk seem to better insulate their loan supply from monetary policy changes and to offer more credit (Altunbas, Gambacorta, and Marques-Ibanez, 2010). For these reasons, theoretical and empirical studies of bank risk taking have been used by both central banks and regulatory agencies to frame prudential policies.[6] In the sense that our results provide an estimate of the magnitude of the moral hazard effect of 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 affects 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, Hakenes, and Schnabel, 2011). Increased capital requirements would also reduce gambling incentives by putting more bank equity at risk.[7] However, we do not find empirical evidence in favor of the charter value hypothesis. Furthermore, we provide direct

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[5]The z-score is a widely used measure of risk, especially in cross-country banking studies (Laeven and Levine, 2009). Gropp, Hakenes, and Schnabel (2011) use four different measures: the problem loans ratio (problem loans over total assets), the risk asset ratio (risky assets over total assets), the liquidity ratio (liquid assets over short-term liabilities), and the equity ratio (book capital over total assets). However, the first two measures are difficult to compare across countries due to regulatory differences (European Bank Coordination Initiative, 2012), while the third measure is not an actual measure of risk taking. Finally, the equity ratio is a component of the z-score and we test its direct relation to government support, in this study, as a robustness check.

[6]See Boyd and De Nicoló (2005) for a discussion on policy responses to perceived links between competition and the risk of bank failures.

[7]However, in as much as uniform capital requirements decrease the charter value of all banks, Hellmann, Murdock, and Stiglitz (2000) suggest using deposit-rate controls as an additional prudential measure.

evidence that pre-crisis capital requirements did not weaken the link between government support and risk taking by banks.[8]

If, as we find, the dominating channel is "market-discipline" and pre-crisis capital requirements proved to be ineffective in reducing moral hazzard, 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 and regulators may limit risk taking by banks, even for those that have government 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. In Section II, we describe our sample and detail our data sources and in Section III discuss our hypothesis and methods. In Section IV, we present our results on support and risk taking, as well as several robustness checks and, in Section V, we discuss how regulation may affect this result. Section VI concludes.

II. DATA

A. 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 (σ(ROA)). The z-score measures the distance to insolvency since it is the inverse of the probability that losses exceed equity (that is, prob(-ROA>CAR); see Laeven and Levine, 2009). A higher z-score therefore indicates that the bank is less risky.

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[8]The ineffectiveness of pre-crisis capital requirements does not imply that much higher capital requirements and wider risk coverage (such as the ones in Basel III) could not weaken the link between government support and risk taking by banks (see, for instance, Admati and Pfleiderer, 2010). However, the quantity and quality of required capital, before the crisis, did not prevent the build-up of excessive on- and off-balance sheet leverage by banks (Basel Committee on Banking Supervision, 2009).

A characteristic of the z-score is that it is highly skewed. For this reason, we use 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 Service (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) with 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 method, and focus on cross-sections of results.[9] The accounting data on banks are from Bankscope, a commercial database with extensive information on banks across the globe.

B.   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. Since this

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[9]The use of a panel is therefore impossible because of the 2005 IFRS shift, in conjunction with the five year window needed to calculate $\sigma(ROA)$.

measure includes any type of external support, including that of parent companies, not just that of goverenments, we exclude from the sample all bank subsidiaries. This reduces the size of the sample considerably but eliminates an important source of measurement error.

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, Hakenes, and Schnabel (2011). This amounts to assigning a default probability to each bank according to the BFSR (the default probability in the absence of a bailout, d) and another according to the deposit rating (the total default probability, taking account bailouts, td), using historical one-year ahead default frequencies collected by Moody's. The bailout probability is $p = 1 - td/d$. 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.

C.   Control Variables

We control for a series of characteristics at the bank, industry, 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. We also control for bank ownership by including a variable of cash flow rights of large shareholders (Laeven and Levine, 2009, see) and dummy variables which signal government, institutional, individual, or other type of ownership (data from Capital IQ, SNL Financial and banks' websites). All bank-specific data is from Bankscope.

At the country level, we control for per capita income, inflation, inflation variability (data from the World Bank Development Indicators), the quality of investor protection and the degree to which contracts are effectively enforced in a country (both from the 2003 and 2009 Doing Business Report of the World Bank).

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 (for instance Hellmann, Murdock, and Stiglitz, 2000; Keeley, 1990). For this reason, we control for bank concentration at the industry and country level using the Hirsch-Herfindahl index (data from Bankscope).

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, Kane, and Laeven (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 in Barth, Caprio, and Levine's (2006) bank regulatory database. We use the level of capital stringency, the level of official bank supervisory power, and an index of activity restrictions (all defined in Barth, Caprio, and Levine, 2006). *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 power 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 non-financial 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.

D. Summary Statistics

Table 2 provides summary statistics for the key regression variables. Statistics are based on averages for the periods 2003–2004 and 2009–2010 using annual data for our measure of risk taking (z-score). For for the other variables we use annual data for 2002 and 2008. 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 slight increase 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 sizable increase in the average level of support from 2002 to 2008. 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, signaling a widespread increase in government support to banks. This increase is much more pronounced in Moody's measure than in Fitch's (Figure 1).

INSERT FIGURE 1

E. Predictive Power of Government Support

The relevance of the empirical work we present in this study relies on the adequacy of our measures of government support. In addition, we want to settle on one measure of government support - Moody's or Fitch's - for the baseline regressions. In Table 3 we can see that Moody's and Fitch's probability-based measures of support were mildly correlated before the crisis and become more correlated with the crisis. For the period before the crisis we also see that Moody's measure was uncorrelated with size while Fitch's was significantly correlated with banks' total assets.[10] These two facts suggest that, for the period when the two measures were the most different from each other (before the crisis), Moody's measure was capturing, to a larger extent than Fitch's, other aspects of government support besides the "too-big-to-fail" hypothesis.

A more definitive way of settling the issue is to test whether these measures are able to predict actual bail-outs. One way of doing this is to run a probit regression of actual government interventions in banks on our measures of support. To this effect we define a binary variable y_{it} which takes value 1 if bank i either received a capital injection by its government or was partially or totally nationalized between 2008 and 2010. We start with data on capital injec-

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[10]After the crisis, they are both correlated with size, as expected.

tions in Europe from Brei, Gambacorta, and von Peter (2011) and complement those with information retrieved from Laeven and Valencia (2012) and FT.com. The data include 238 banks but there is ratings information for only 137, of which roughly one third were intervened (Table 4).

We posit that the likelihood of a bank being actually rescued by its government depends on the amount of ex-ante government support and on how distressed the bank was prior to the crisis, as well as on other characteristics such as size, capital, and liquidity. We use loan loss provisions as a percentage of average assets as a measure of bank distress.[11] Since the impact of support will certainly depend how distressed the bank was to start with, we include an interaction of support with loan loss provisions. In order to make the interpretation of the effect of interacted variables easier, we replace our main variable of support by a dummy variable which takes value 1 if the Moody's-based support measure (in notches) was positive (support) and 0 otherwise (no support). We also condition for the state of the economy using the average GDP growth rate for 2007–2009. To address any concerns of endogeneity, all controls (except for GDP growth) correspond to 2007 values.

We estimate the following model:

$$y_{it}^* = \alpha_0 + \alpha_1 GS_{it-1} \alpha_2 LLP_{it-1} + \alpha_3 GS_{it-1} \times LLP_{it-1} + \Gamma z_{it-1} + u_{it},$$

where $y_{it}^* > 0$ ($y_{it} = 1$) if bank i was the target of a government intervention between 2008 and 2010. LLP is loan loss provisions as a percentage of average total assets and z a vector with the other controls mentioned above. The estimation results are in Table 5. Estimates of coefficients in probit models do not have an economic interpretation, especially when interaction terms are present. For this reason we focus on the pairwise comparison of marginal effects. This measure estimates the average predicted probabilities of having a capital injection conditional on being in each of the two support groups (no support or some suppport) and unconditional on the other control variables. We find that banks who enjoyed support in 2007 were more likely to be rescued in 2008–2010 by 30 percentage points and that the difference is highly significant. We take this as strong evidence in favor of the predictive ability of our measure of support and therefore of its economic significance.The same estimation using the equivalent Fitch measure shows insignificant marginal effects of government support (available from the authors upon request). Therefore, we use Moody's measure in our baseline empirical specifications.

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[11]By including these controls we are controlling for systemic importance since size, leverage, and asset risk (e.g. loan loss provisions) are the main drivers of systemic risk (Hovakimian, Kane, and Laeven, 2012).

III. 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,

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

where $Z_{b,c,t}$ is the natural logarithm of 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 controls, $\varepsilon_{b,c}$ is the error term, and β_1, β_2, and β_3 are slope coefficients or vectors of coefficients. The standard errors are adjusted to control for clustering at the country level. Because we are using government support lagged by at least one period, we claim that support causes risk taking by banks.

The approach just outlined may be compromised if *GS* is endogenous or if there are omitted variables (i.e. the possibility that $cov(Z_{b,c}, \varepsilon_{b,c}) \neq 0$). We used two approaches to deal with the problem. The first is to saturate the regression with many bank and country specific measures to capture as much of the error term as possible (Bitler, Moskowitz, and Vissing-Jørgensen, 2005; Laeven and Levine, 2009). The second approach we consider is to use instrumental variables. In addition to the benchmark regression above (without instruments), we instrument each bank's government support as follows. 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's validity relies on the assumption that an innovation in the risk taking of any given bank does not affect government support to other banks.

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:

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

where $R_{c,t-1}$ are country-specific regulatory standards, so that $GS_{b,c,t-1} \times R_{c,t-1}$ captures the interaction between the bank-specific government support measure and national regulations, and β_3 is the coefficient estimate of the interaction effect.

IV. RESULTS

A. Benchmark Regression

The benchmark empirical results on the link between bank risk taking and government support are reported in Table 6. 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 almost all specifications. The second important 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 generally more statistically significant during the latter period. 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 and country-level features, and after including country fixed effects, as we show next.

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. We have three comments on the results. First and foremost, the positive association between *GS* and banks' risk-taking remains significant for the 2009–2010 period and insignificant for 2003–2004. Our results are therefore robust to the inclusion of bank-specific characteristics. Second, while revenue growth seems to capture well the charter value effect (in as much as banks with faster growth are better able to generate rents), size on its own does not seem to impact risk taking (the variable is almost never significant).[12] Third, banks with higher liquidity take (significantly) more risks. Our interpretation is that liquidity is capturing a bank-specific appetite for risk: banks with a riskier business model (for instance, more securities' trading) keep more liquidity at hand in case of losses or margin calls.

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[12]One explanation for the low significance of growth as a determinant of risk taking is that the too-big-to-fail effect and the charter value hypothesis cancel each other out. Another explanation is that larger banks are better at risk diversification but also harder to monitor because of increased complexity.

We also 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 by running regressions with country fixed effects (columns 4 and 11). 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,[13] 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 yield two comments. First, for both cross-sections, the result that government support leads to riskier banks is robust to conditioning on either country controls or fixed effects. Second, of all country controls, only per capita income and inflation volatility are significant for both time periods. While an increase in inflation volatility always causes riskier banks, the change in the sign of the coefficient associated with income per capita reflects the fact that advanced economies were the most affected by the 2007–2009 crisis.[14]

It is possible that our results are affected by a possible endogeneity of goverment support. We expicitly tackle this using an instrumental variables approach. 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.

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). 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.

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[13]Using Djankov and others's (2008) revised anti-directors index or their anti-self-dealing index does not change the flavor of results, which are available from the authors if requested.

[14]Since the two time periods reflected different macroeconomic and financial sector conditions, we checked whether controlling for equity market volatility made a difference. For this effect, we used the previous year's average daily volatility of the banking sector stock index from Datastream for each country (when available). The (untabulated) results were unchanged. We also tried to control for financial sector soundness (which would proxy for regulatory forbearance), using the Bank Soundness index from the Global Competitiveness Report but this did not affect results either.

A final specification issue we tackle is the one pertaining to the timing of support being given and risk materializing. 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). Since investment and credit decisions (possibly affected by government support) may take longer than one year to affect results, we regress the z-Score averages on 2001 and 2007 support (using a longer lag would restrict severely our sample size). The results, shown in columns 7 and 14, are basically the same as in the other regressions.

B.   Robustness

We perform three robustness exercises which involve using alternative definitions for risk taking and government support or considering bank valuation. In the first exercise, instead of the z-Score, we use the individual components of the z-score (ROA, Capital to Assets, and the standard deviation of ROA). We regress these measures on bank controls and on country controls, as in the benchmark regression discussed before.[15]

The results are available on Table 7 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, two additional interpretations arise. On the one hand, it is possible that banks took more risk by increasing leverage. On the other hand, it could also be the case that banks took more risks, which led to more losses and lower capital buffers to withstand shocks.

Interestingly, opposite to what we find for the z-Score itself, size matters for each individual component of the z-Score, particularly for the second time period. In fact, larger banks tend to be more leveraged - "too-big-to-fail" effect - but also to have less volatile returns on assets - diversification effect. The combination of the two countervailing two effects in the z-Score

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[15]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. 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 are available upon request.

explains why, in the benchmark specification, bank size does not significantly impact bank risk.

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, Hakenes, and Schnabel (2011). We then replicate the regressions presented in Table 6: 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 8. Most results are qualitatively the same as the ones for the benchmark regressions. During the crisis, using our preferred specification (country fixed effects), a one standard deviation increase in the probability of a bailout[16] 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 Forssbaeck, 2011; Gropp, Hakenes, and Schnabel, 2011). We run the same regressions as in Table 8 and present the results in Table 9. The main difference in terms of results is that government support is not significant for the pre-crisis period. In fact, as in Gropp, Hakenes, and Schnabel (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.[17] However, when we look at the crisis period (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.

So far, we have only implicitly considered the hypothesis of bank charter value determining the link between support and risk taking. We did this by including the degree of market concentration (measured by the Hirsch-Herfindahl index) as one of the industry-country controls. Results on columns 5 through 7 and 12 through 14 in Table 6 show that market concentration is never significant.[18] This does not mean that the charter value channel is irrelevant since competition can affect charter value in more than one way (Martinez-Miera and Repullo, 2010, suggest a U-shaped relationship between competition and the risk of bank failure). For

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[16]This would be equivalent to going from no support to a level slightly below the median level of support in the industry.

[17]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).

[18]We also tried to capture the charter value effect with variables representing barriers to entry such as Barth, Caprio, and Levine's (2006) index of barriers to entry and either the number or the change in the number of banks in the country (normalized by GDP). Changing the variables had no impact on our results (available from the authors upon request).

instance, competition in lending markets may be negatively related to bank risk taking, as suggested by Boyd and De Nicoló (2005).[19]

The final robustness exercise is therefore to explicitly consider the charter value channel. We do this by allowing for the joint determination of bank risk and bank valuation and then testing for the link between risk and government support independent of bank value. We expand our baseline specification with bank and country controls by including Tobin's Q as an endogenous explanatory variable. We calculate the Tobin's Q as total assets plus market value of equity (data from Bankscope) minus book value of equity divided by total assets. We estimate the model using two-stage GMM and two excluded instruments in the first stage regression: a dummy variable for the bank's stock being widely held (Widely) and the number of banks normalized by the country's gross domestic product.[20] We are only able to do it for the second period due to data availability. The results in Table 10 show that when it comes to explaining bank risk taking (second stage regression), our variable of government support is still significant (albeit at the ten percent level only) but bank value is not.

V. 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, Caprio, and Levine (2008). These data consider 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, *capital stringency*, a measure of *official supervisory power* and a measure of *activity restrictions* (see Section II.C for detailed definitions).

Table 11 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, *government support* was not a significant 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.

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[19]Their argument is that 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.
[20]We tried using Laeven and Levine's (2009) excluded instruments - share of assets, being listed on the New York Stock Exchange, and the country having barriers to entry to the banking industry - but these proved to be weak instruments.

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, however, suggests 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 had taken between two and three billion U.S. dollars in first and second quarter trading losses due to large bets on derivatives gone wrong, highlights the timeliness and relevance of 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."

VI. Conclusion

Government support to banks through the provision of explicit or implicit guarantees, in theory, has an ambiguous effect on banks' risk-taking. On the one hand, by providing support, governments can encourage banks to take more risk because of a moral hazard effect, i.e., the *market discipline* hypothesis. On the other hand, support can make banks more conservative because it increases their charter value, i.e., the *charter value* hypothesis.

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 capture 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 the lack of market discipline, especially during the crisis, shaped the relationship between government support and risk in the banking industry.[21] Moreover, capital requirements regulation and enhanced supervisory powers failed to curb risk taking due to government support to banks.

Our results suggest that measures to increase the incentives by depositors, small shareholders, and subordinated creditors to monitor or influence banks' attitudes towards risks should decrease the moral hazard associated with government support to the financial system. This should start with the creation of regulatory environments which do not hinder private monitoring of banks, but could ultimately lead to limits on the amount of support that governments can pledge.[22] Alternatively, restricting banks' ability to engage in activities involving security markets, insurance, real estate, and ownership of non-financial firms 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.

The degree to which CEO incentives are aligned with the interests of shareholders influences the amount of risk taking in non-financial firms. However, the existing evidence on banks is still inconclusive.[23] 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. This stands in sharp contrast to non-financial firms where board size is positively related to free-riding problems. Banks are also different from non-financials and other financial firms in that they have many outside investors (i.e. depositors), are highly leveraged, and are possible

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[21]In fact, one can argue that the lack of effective market discipline was one of the main triggers of the crisis. Therefore, enhancing market discipline should be an important goal for financial regulatory reforms (Levine, 2011).

[22]Nier and Baumann (2006) found that, in the 1990's, market discipline mechanisms, such as increased disclosure and uninsured funding, were effective in inducing banks to limit default risk by increasing capital buffers. However, the effect is reduced when banks enjoy a high degree of support.

[23]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) but may have led to acquisitions which increased default risk by acquiring banks (Hagendorff and Vallascas, 2011).

beneficiaries of government support. This translates into shareholders' interests being often conducive to too much risk taking, 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, Hakenes, and Schnabel (2011). The green line is the equivalent measure of probability of government support but using data from Fitch Ratings.

Government support in notches, Moody's (left-hand scale)
Probability of government support, Moody's (right-hand scale)
Probability of government support, Fitch (right-hand scale)
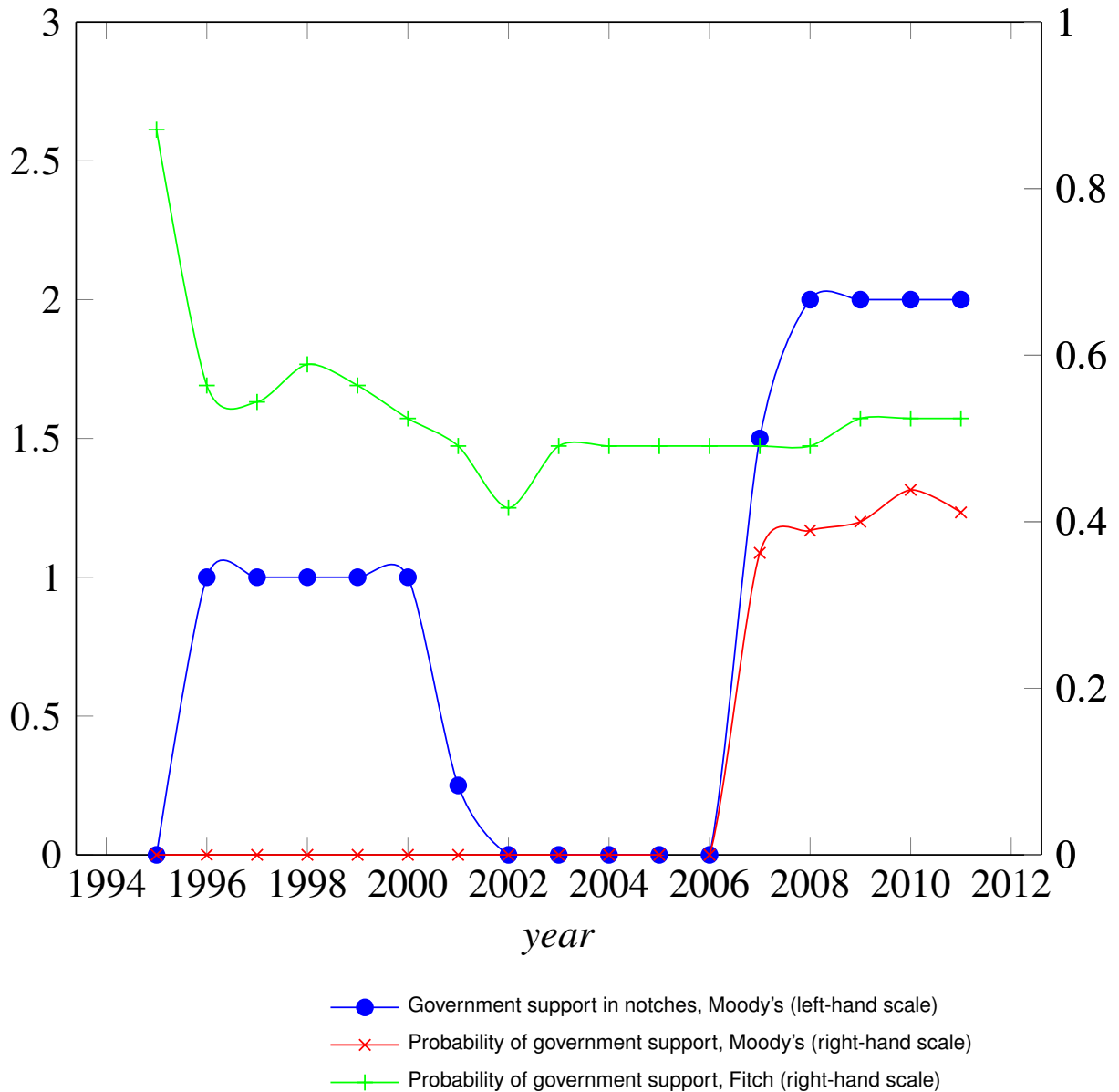
Table 1. Sample by Country and Period

This table shows the number of banks in our sample, by country and period. The sample is restricted to bank holding companies or banks who are heads of banking groups with BFSR and deposit ratings from Moody's available.

	2003–2004	2009–2010		2003–2004	2009–2010
Argentina	5	5	Kuwait	5	6
Australia	8	9	Malaysia	4	5
Austria	8	9	Morocco	1	1
Bahrain	5	6	Netherlands	7	7
Belgium	3	3	Norway	6	5
Brazil	1	6	Pakistan	3	3
Canada	6	6	Panama	1	1
Chile	3	2	Peru	2	2
China	7	7	Philippines	5	5
Colombia	4	2	Poland	9	9
Czech Republic	1	1	Portugal	2	2
Denmark	3	8	Qatar	2	2
Egypt	4	2	Russian Federation	2	6
Finland	1	1	Saudi Arabia	9	9
France	10	9	Singapore	2	2
Germany	24	21	Slovakia	1	2
Greece	7	8	Slovenia	1	2
Hong Kong	6	7	South Africa	1	1
Hungary	1	1	Spain	9	12
Iceland	2	3	Sweden	3	5
India	9	13	Switzerland	4	8
Indonesia	3	4	Taiwan	2	3
Ireland	6	5	Thailand	8	8
Israel	5	5	Turkey	8	10
Italy	20	18	United Arab Emirates	4	7
Japan	30	19	United Kingdom	14	12
Jordan	3	3	United States Of America	24	23
Korea Republic Of	5	6	Venezuela	1	0
			Total	330	347

Table 2. Summary Statistics

Sample statistics for main variables of interest. N refers to number of banks, countries, or bank-sector pairs in sample for bank, country, or country and sector-specific variables, respectively. z-Score is the ROA plus Capital-Asset ratio divided by the standard deviation of ROA. Revenue growth is the annual growth rate of gross revenues. Size is total assets in billions of U.S. dollars. 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 Moody's BFSR. Moody's support (in probability) is the conversion of Moody's support (in rating notches) into probabilities of support as in Gropp, Hakenes, and Schnabel (2011).

		2003–2004				2009–2010		
	N	Mean	Median	Std. dev.	N	Mean	Median	Std. dev.
Bank-specific variables								
z-Score	286	3.30	3.41	1.14	321	3.02	3.17	0.94
Return on assets (percent)	313	0.99	0.81	1.03	332	0.66	0.56	2.44
Std. dev. return on Assets	288	0.68	0.27	1.67	323	1.06	0.38	6.94
Equity to assets ratio (percent)	313	7.53	6.48	5.94	332	8.29	7.43	15.88
Revenue growth	311	0.20	0.18	1.00	329	-0.07	0.11	4.70
Size (in $ billions)	313	128.61	32.49	240.61	332	225.02	49.29	456.03
Liquidity	314	18.02	11.23	20.05	332	32.96	20.09	65.23
Moody's support (in ratings notches)	331	1.03	0.00	2.60	348	1.66	2.00	2.64
Moody's support (in probability)	331	0.26	0.00	0.36	348	0.42	0.40	0.36
Fitch support (in probability)	137	0.54	0.62	0.39	205	0.55	0.61	0.37
Country-specific variables								
Per capita income	61	9.51	9.88	1.02	61	9.82	10.12	0.92
Inflation	62	4.79	3.24	6.19	62	1.31	1.95	7.33
Inflation volatility	62	3.74	1.82	4.5	62	3.52	1.73	4.2
Capital requirements	54	0.09	0.08	0.01	63	0.09	0.08	0.01
Investor protection index	63	5.74	5.62	1.5	63	5.74	5.62	1.5
Deposit insurance	63	0.78	1	0.42	63	0.84	1	0.37
Enforce	63	69.49	60	53.34	63	69.49	60	53.34
Cash flow rights	54	34	35.26	24.8	57	42.23	41.83	22.82
Government ownership	54	0.14	0.00	0.22	57	0.17	0.11	0.21
Institutional ownership	54	0.1	0.00	0.15	57	0.14	0.09	0.19
Individual ownership	54	0.05	0.00	0.13	57	0.06	0.00	0.17
Country and sector-specific variables								
Herfindahl index	177	0.36	0.27	0.29	177	0.38	0.36	0.27

Table 3. Correlations

Correlations among main variables of interest. z-Score is the ROA plus Capital-Asset ratio divided by the standard error of ROA (in logs). 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 Moody's BFSR. Moody's support (in probability) is the conversion of Moody's support (in rating notches) into probabilities of support as in Gropp, Hakenes, and Schnabel (2011).

	Size	Liquidity	Moody's support (notches)	Moody's support (probability)	Fitch support (probability)
Panel A: 2003–2004					
Size	1				
Liquidity	-0.034	1			
Moody's support (notches)	0.153***	-0.003	1		
Moody's support (probability)	0.030	0.007	0.843***	1	
Fitch support (probability)	0.289***	0.030	0.439***	0.270***	1
Panel B: 2009–2010					
Size	1				
Liquidity	-0.019	1			
Moody's support (notches)	0.306***	0.023	1		
Moody's support (probability)	0.413***	0.097*	0.714***	1	
Fitch support (probability)	0.184***	0.027	0.521***	0.371***	1

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

Table 4. Government Interventions in Banks in 2008–2010 in Europe, by Country

This table shows the number of intervened and not intervened banks for which there is ratings data available. $Y_i = 1$ if bank i was intervened and 0 otherwise. Data is from Brei, Gambacorta, and von Peter (2011), Laeven and Valencia (2012), and FT.com.

Country	Intervened		Total
Austria	3	4	7
Belgium	1	2	3
Denmark	3	3	6
Finland	1	0	1
France	5	4	9
Germany	19	3	22
Greece	1	6	7
Iceland	0	3	3
Ireland	1	4	5
Italy	15	6	21
Netherlands	5	2	7
Norway	6	0	6
Portugal	2	0	2
Spain	9	2	11
Sweden	4	1	5
Switzerland	7	1	8
United Kingdom	11	3	14
Total	93	44	137

Table 5. Government Support and Intervention in Banks

This table shows the results of a probit regression where the limited dependent variable is $Y_i = 1$ if bank i was intervened and 0 otherwise. Data on interventions is from Brei, Gambacorta, and von Peter (2011), Laeven and Valencia (2012), and FT.com. Size is the logarithm of total assets. Liquidity is ratio of liquid assets to liquid liabilities. Output growth is the average GDP growth in 2007–2009. Loan loss provisions is expressed as percentage of total average assets. Government support is 1 if the difference in notches between Moody's foreign currency deposit rating and Moody's BFSR is positive and zero otherwise. Standard errors corrected for country-level clustering.

Variables	Intervention	
Size	0.327***	[0.112]
Liquidity	-0.000	[0.005]
Equity to assets	1.630	[4.933]
Output growth	-0.141	[0.175]
Government support in 2007	22.694*	[13.423]
Loan loss provisions	3,865.50	[2,351.445]
Support in 2007 X Loan loss provisions	-3,798.37	[2,370.847]
Observations	123	
Countries	17	
Marginal effect of government support	0.273***	[0.0735]
Robust standard errors in brackets: *** p<0.01, ** p<0.05, * p<0.1		

Table 6. Bank Risk Taking and Government Support (Notches): z-Scores

Dependent variable for all cross-section regressions is the natural logarithm of each bank's individual z-Score. z-Score is ROA plus Capital-Asset ratio divided by the standard deviation of ROA. 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 Moody's BFSR. Standard errors corrected for country-level clustering.

Variables	(1)	(2) Bank controls	(3) Instrumental variables	(4) Fixed effects	(5) Country controls	(6) Ownership controls	(7) Support in 2001
Government support	-0.048	-0.068	0.003	-0.133***	-0.127***	-0.123***	-0.101***
	[0.052]	[0.051]	[0.094]	[0.034]	[0.028]	[0.031]	[0.036]
Revenue growth	0.101	0.227	0.292	0.686**	0.806***	0.264	0.263
	[0.668]	[0.600]	[0.607]	[0.329]	[0.294]	[0.556]	[0.578]
Size		0.156**	0.127*	-0.008	0.029	0.033	0.035
		[0.064]	[0.069]	[0.053]	[0.044]	[0.076]	[0.084]
Liquidity		-0.011***	-0.011***	-0.017***	-0.008**	-0.008**	-0.008**
		[0.003]	[0.004]	[0.003]	[0.004]	[0.003]	[0.004]
Per capita income					0.691***	0.632***	0.658***
					[0.176]	[0.178]	[0.180]
Inflation					-0.002	0.003	0.004
					[0.021]	[0.034]	[0.036]
Inflation volatility					-0.131***	-0.139**	-0.144**
					[0.041]	[0.060]	[0.065]
Capital requirements					22.177**	15.804	13.367
					[8.745]	[11.320]	[11.695]
Investor protection index					-0.017	-0.013	0.020
					[0.079]	[0.090]	[0.091]
Deposit insurance					-0.427**	-0.395**	-0.410**
					[0.167]	[0.193]	[0.198]
Enforce					0.003**	0.004*	0.005**
					[0.001]	[0.002]	[0.002]
Herfindahl index					-0.379	-0.226	0.000
					[0.247]	[0.339]	[0.361]
Cash flow rights						-0.001	-0.002
						[0.003]	[0.003]
Government ownership						0.416	0.528
						[0.312]	[0.345]
Institutional ownership						0.152	0.323
						[0.247]	[0.265]
Individual ownership						0.442	0.446
						[0.408]	[0.382]
Observations	286	286	275	286	250	183	177
R-squared	0.01	0.1	0.06	0.58	0.38	0.34	0.34
Countries	54	54	44	54	49	44	44

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

Table 6 (continued). Bank Risk Taking and government support (notches): z-Scores

Variables	(8)	(9) Bank controls	(10) Instrumental variables	(11) Fixed effects	(12) Country controls	(13) Ownership controls	(14) Support in 2007
				2009–2010			
Government support	-0.081***	-0.080***	-0.082**	-0.134***	-0.079***	-0.068**	-0.046*
	[0.030]	[0.028]	[0.038]	[0.037]	[0.028]	[0.027]	[0.027]
Revenue growth	0.017***	0.018***	0.018***	0.013***	0.018***	0.018***	0.018***
	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.005]
Size		-0.002	-0.004	0.004	-0.011	-0.035	-0.049
		[0.043]	[0.044]	[0.044]	[0.043]	[0.049]	[0.048]
Liquidity		-0.002**	-0.002**	-0.001**	-0.001*	-0.001**	-0.001**
		[0.001]	[0.001]	[0.000]	[0.001]	[0.001]	[0.001]
Per capita income					-0.341***	-0.366***	-0.376***
					[0.112]	[0.126]	[0.121]
Inflation					-0.044*	-0.043**	-0.035*
					[0.023]	[0.021]	[0.020]
Inflation volatility					-0.071*	-0.066*	-0.054
					[0.041]	[0.037]	[0.035]
Capital requirements					-4.927	-6.712	-7.757
					[8.608]	[8.423]	[8.262]
Investor protection index					-0.002	-0.013	-0.008
					[0.052]	[0.050]	[0.051]
Deposit insurance					-0.183	-0.168	-0.095
					[0.212]	[0.209]	[0.200]
Enforce					0.000	-0.000	-0.000
					[0.002]	[0.002]	[0.002]
Herfindahl index					-0.115	-0.150	-0.135
					[0.248]	[0.274]	[0.284]
Cash flow rights						-0.005**	-0.005**
						[0.002]	[0.002]
Government ownership						0.052	0.044
						[0.169]	[0.169]
Institutional ownership						0.359**	0.335**
						[0.146]	[0.147]
Individual ownership						-0.266	-0.267
						[0.172]	[0.170]
Observations	321	320	310	320	317	305	302
R-squared	0.06	0.07	0.08	0.4	0.13	0.17	0.17
Countries	54	54	48	54	53	53	53

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

Table 7. 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 Moody's BFSR. Standard errors corrected for country-level clustering.

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	2003–2004			2009–2010		
	ROA	Std. ROA	Equity /Assets	ROA	Std. ROA	Equity /Assets
Government support	-0.087***	0.050**	-0.075	-0.119**	-0.001	-0.495***
	[0.027]	[0.020]	[0.094]	[0.054]	[0.026]	[0.152]
Revenue growth	0.049	0.838	-3.334**	0.006**	-0.002	0.014
	[0.147]	[0.515]	[1.416]	[0.003]	[0.004]	[0.027]
Size	-0.173**	-0.027	-1.625***	-0.150*	-0.170***	-1.972***
	[0.076]	[0.036]	[0.524]	[0.083]	[0.045]	[0.516]
Liquidity	0.001	-0.001	-0.014	0.011**	0.009**	0.079***
	[0.004]	[0.003]	[0.014]	[0.004]	[0.003]	[0.015]
Per capita income	0.129	-0.578***	0.883*	-0.382**	0.154	0.047
	[0.143]	[0.163]	[0.510]	[0.160]	[0.101]	[0.640]
Inflation	0.04	-0.033	0.178	0.006	-0.002	-0.092
	[0.026]	[0.023]	[0.119]	[0.034]	[0.017]	[0.103]
Inflation volatility	-0.002	0.204***	0.114	0.066	0.029	0.113
	[0.065]	[0.048]	[0.211]	[0.056]	[0.033]	[0.232]
Capital requirements	-3.916	-7.469	79.866**	-18.600*	3.39	-29.972
	[14.395]	[10.929]	[38.889]	[9.722]	[6.480]	[34.843]
Investor protection index	0.041	-0.065	0.083	-0.013	0.104*	0.467
	[0.060]	[0.050]	[0.196]	[0.127]	[0.055]	[0.412]
Deposit insurance	-0.638*	0.299	-0.794	-0.577	0.07	-1.364
	[0.318]	[0.211]	[1.040]	[0.345]	[0.226]	[1.447]
Enforce	0.002	-0.003*	-0.002	-0.002	-0.001	-0.01
	[0.002]	[0.002]	[0.007]	[0.002]	[0.001]	[0.009]
Herfindahl index	0.42	0.261	1.799	0.138	-0.028	0.878
	[0.404]	[0.338]	[1.610]	[0.347]	[0.280]	[2.148]
Cash flow rights	-0.002	-0.001	-0.025**	-0.004	0.003	-0.01
	[0.002]	[0.002]	[0.010]	[0.003]	[0.002]	[0.011]
Government ownership	0.288	-0.129	1.818	-0.014	0.402	1.336
	[0.230]	[0.181]	[1.226]	[0.460]	[0.269]	[1.376]
Institutional ownership	-0.006	-0.159	2.229*	0.218	-0.035	1.659
	[0.176]	[0.156]	[1.280]	[0.177]	[0.100]	[1.459]
Individual ownership	0.739*	-0.307	1.776	0.677**	0.711**	4.105*
	[0.418]	[0.328]	[1.365]	[0.279]	[0.308]	[2.357]
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 8. Bank Risk Taking and Probability of Government Support Measured by Moody's

Dependent variable for all cross-section regressions is the natural logarithm of each bank's individual z-Score. The z-Score is ROA plus Capital-Asset ratio divided by the standard deviation of ROA. Government support is measured as probability of bailout (Gropp, Hakenes, and Schnabel, 2011) using data from Moody's. Standard errors corrected for country-level clustering.

Variables	2003–2004				2009–2010			
	(1)	(2) Bank controls	(3) Fixed effects	(4) Country controls	(5)	(6) Bank controls	(7) Fixed effects	(8) Country controls
Government support	-0.468*	-0.499**	-0.522**	-0.494***	-0.448***	-0.434***	-0.474**	-0.314**
	[0.245]	[0.214]	[0.222]	[0.182]	[0.160]	[0.154]	[0.192]	[0.147]
Revenue growth	0.127	0.252	0.620*	0.796**	0.019***	0.019***	0.012**	0.019***
	[0.678]	[0.610]	[0.343]	[0.314]	[0.005]	[0.005]	[0.005]	[0.004]
Size		0.144**	-0.01	0.031		0.004	0.039	0.006
		[0.065]	[0.058]	[0.047]		[0.045]	[0.049]	[0.042]
Liquidity		-0.011***	-0.018***	-0.009**		-0.002**	-0.001*	-0.001
		[0.003]	[0.003]	[0.003]		[0.001]	[0.000]	[0.001]
Per capita income				0.608***				-0.353***
				[0.176]				[0.105]
Inflation				0.02				-0.023
				[0.019]				[0.020]
Inflation volatility				-0.133***				-0.035
				[0.041]				[0.038]
Capital requirements				19.277**				-4.757
				[9.304]				[8.684]
Investor protection				-0.006				0.003
				[0.080]				[0.056]
Deposit insurance				-0.518***				0.025
				[0.182]				[0.188]
Enforce				0.003*				0.0000
				[0.001]				[0.002]
Herfindahl index				-0.345				-0.107
				[0.253]				[0.249]
Observations	286	286	286	250	321	320	320	317
R-squared	0.02	0.1	0.56	0.35	0.04	0.05	0.39	0.11
Countries	54	54	54	49	54	54	54	53

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

Table 9. Bank Risk Taking and Probability of Government Support Measured by Fitch Ratings

Dependent variable for all cross-section regressions is the natural logarithm of each bank's individual z-Score. The z-Score is ROA plus Capital-Asset ratio divided by the standard deviation of ROA. Government support is measured as probability of bailout (Gropp, Hakenes, and Schnabel, 2011) using data from Fitch Ratings. Standard errors corrected for country-level clustering.

Variables	2003–2004				2009–2010			
	(1)	(2) Bank controls	(3) Fixed effects	(4) Country controls	(5)	(6) Bank controls	(7) Fixed effects	(8) Country controls
Government support	-0.213	-0.372*	-0.260	-0.092	-0.274	-0.234	-0.458***	-0.277*
	[0.240]	[0.198]	[0.172]	[0.195]	[0.199]	[0.174]	[0.159]	[0.165]
Revenue growth	-0.056	0.076	0.992	1.110*	0.024***	0.024***	0.010**	0.023***
	[0.765]	[0.714]	[0.710]	[0.568]	[0.004]	[0.004]	[0.004]	[0.005]
Size		0.107	0.014	0.138**		-0.011	0.075	-0.013
		[0.073]	[0.105]	[0.058]		[0.041]	[0.054]	[0.038]
Liquidity		-0.006**	-0.005**	-0.015***		-0.004	-0.001	-0.003
		[0.002]	[0.002]	[0.004]		[0.004]	[0.001]	[0.003]
Per capita income				0.639***				-0.375***
				[0.170]				[0.128]
Inflation				0.017				-0.030
				[0.019]				[0.034]
Inflation volaitility				-0.082***				-0.061
				[0.024]				[0.061]
Capital requirements				26.458***				6.139
				[8.456]				[8.006]
Investor protection index				0.002				-0.011
				[0.103]				[0.081]
Deposit insurance				-0.363**				-0.084
				[0.176]				[0.203]
Enforce				0.004*				0.000
				[0.002]				[0.002]
Herfindahl index				0.446				0.147
				[0.390]				[0.418]
Observations	175	175	175	127	269	268	268	261
R-squared	0.01	0.06	0.57	0.38	0.03	0.05	0.44	0.11
Countries	43	43	43	39	50	50	50	49

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

Table 10. Bank Risk, Valuation, and Government Support

z-Score is ROA plus Capital-Asset ratio divided by the standard deviation of ROA. Tobin's Q is total assets plus market value of equity minus book value of equity divided by total assets. Government support is the difference in notches between Moody's foreign currency deposit rating and Moody's BFSR. Widely takes value one if there is no single shareholder with at least 25% of the voting shares and zero otherwise. Number of banks is the number of banks in the country divided by the country's GDP in U.S. dollars. Standard errors corrected for country-level clustering.

	Second stage		First stage	
Dependent variable	z-Score		Tobin's Q	
Tobin's Q	-1.078			
	[3.258]			
Government support	-0.062	*	-0.006	*
	[0.036]		[0.003]	
Revenue growth	-0.006		0.002	
	[0.098]		[0.004]	
Size	0.015		0.005	
	[0.047]		[0.005]	
Liquidity	-0.001		0.000	*
	[0.001]		[0.000]	
Per capita income	-0.327	*	-0.011	
	[0.140]		[0.010]	
Inflation	-0.025		0.001	
	[0.018]		[0.002]	
Inflation volatility	-0.041		0.011	*
	[0.050]		[0.003]	
Capital requirements	-5.605		0.014	
	[8.992]		[0.921]	
Investor protection index	0.029		0.006	*
	[0.060]		[0.003]	
Deposit insurance	-0.073		0.017	
	[0.196]		[0.022]	
Enforce	0.001		0.000	
	[0.002]		[0.000]	
Herfindahl index	-0.162		0.084	*
	[0.332]		[0.050]	
Widely			-0.019	
			[0.013]	
Number of Banks			-0.047	*
			[0.016]	
Observations	244		244	
Hansen's J statistic for over-identification			1.364	
Angrist-Pischke multivariate F test of excluded instruments			3.84	**

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

Table 11. Bank Risk Taking, Government Support, Bank Supervision and Regulation

Cross-section regressions with bank-specific, control-specific controls, and variables for country-level banking regulation and supervision (from Barth, Caprio, and Levine, 2006, 2008). Government support is measured as probability of bailout (Gropp, Hakenes, and Schnabel, 2011). z-Score is the ROA plus Capital-Asset ratio divided by the standard deviation of ROA. Standard errors corrected for country-level clustering.

| | 2003–2004 | | | | 2009–2010 | | | |
	(1) Capital stringency	(2) Official supervisory powers	(3) Activity restrictions	(4) All	(5) Capital stringency	(6) Official supervisory powers	(7) Activity restrictions	(8) All
Government support	0.031 [0.083]	-0.338 [0.301]	-0.118 [0.215]	-0.093 [0.413]	-0.017 [0.103]	-0.373* [0.186]	-0.432*** [0.082]	-0.481** [0.183]
Capital stringency	-0.020 [0.087]			-0.016 [0.088]	-0.000 [0.041]			0.022 [0.050]
Support x Capital stringency	-0.039 [0.024]			-0.038 [0.023]	-0.013 [0.027]			-0.002 [0.020]
Official supervisory power		0.026 [0.069]		0.043 [0.072]		-0.026 [0.041]		-0.013 [0.045]
Support x Official supervisory power		0.020 [0.024]		0.015 [0.025]		0.029* [0.016]		0.006 [0.014]
Activity restrictions			-0.057 [0.074]	-0.061 [0.084]			0.034 [0.023]	0.037 [0.028]
Support x Activity restrictions			0.002 [0.023]	-0.004 [0.022]			0.035*** [0.007]	0.033*** [0.009]
Observations	148	148	148	148	246	246	246	246
R-squared	0.43	0.43	0.42	0.45	0.15	0.17	0.25	0.26
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Countries	41	41	41	41	48	48	48	48

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