

# **Implicit Guarantees, Governance and Banks' Risk-Taking through the Crisis**

**Apanard (Penny) Prabhavivadhana**  
Milken Institute, Santa Monica, CA  
e-mail: [pprabha@milkeninstitute.org](mailto:pprabha@milkeninstitute.org)

**Clas Wihlborg**  
Argyros School of Business and Economics, Chapman University, Orange, CA  
e-mail: [wihlborg@chapman.edu](mailto:wihlborg@chapman.edu)

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## Abstract:

Using bank level data for industrialized and emerging market economies we estimate how explicit deposit insurance and factors contributing to implicit insurance affect banks' risk-taking; possibly in interaction with governance characteristics of banks and countries. The empirical analysis for 764 banks in 34 countries covers the years 2001-2009. Proxies for banks' risk are strongly influenced by the exclusion or inclusion of the crisis years. Implicit insurance of banks' creditors is captured both by an expected U-shaped relationship between explicit deposit insurance coverage and banks' risk-taking, and by factors influencing the likelihood of bail-outs of individual banks. Country and bank specific institutional factors, including governance characteristics, are expected to affect the sensitivity of risk-taking to explicit and implicit insurance. We analyze specifically the roles of ownership-concentration, shareholder rights and creditor rights in risk-taking.

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# **Implicit Guarantees, Governance and Banks' Risk-Taking through the Crisis**

## **1. Introduction**

Deposit insurance and implicit guarantee of banks' creditors have been pointed to among the many explanations for the financial crises offered in the policy debate. Shareholders have incentives to shift risk to tax payers and deposit insurance funds to the extent creditors do not require a risk premium for lending to banks with relative high likelihood of default, or regulators charge a risk-based insurance premium.

Banking crises, as a result of excessive risk taking, tend to occur without much warning. Policy makers are generally obliged to act very quickly to stave off any threat to the financial system as a whole and to the payment system. As we have seen in the recent crises, governments cannot allow themselves to bide the time to see whether one bank's distress will lead to systemic repercussions through the system. They provide liquidity assistance to banks in distress and extend blanket guarantees on the part of banks' liabilities which are not explicitly insured by deposit insurance system. The presence of implicit guarantee is deemed necessary when there is the difficulty in distinguishing between illiquidity and solvency of banks and particularly in banking systems where short-term wholesale funding becomes increasingly used to supplement banks' funding sources from insured deposits due to fear of contagion.

In this paper we analyze the impact of implicit protection of banks' creditors and banks' governance characteristics on risk-taking through the crisis period. We consider two dimensions of implicit insurance of banks' creditors. First, implicit insurance is expected to decrease with explicit deposit insurance coverage on the grounds that greater coverage strengthens the credibility of non-insurance of some creditors. On these grounds, Angkinand and Wihlborg (2010) established a U-shaped relationship between explicit deposit insurance coverage and risk-taking in the country-level data. This hypothesis will be tested on bank level data. Second, the impact of the presence of implicit insurance of an individual bank' risk-taking is expected to be based on (lack of) the ability of creditors to provide market discipline. Bank borrowing from capital or interbank lending markets can be a source of market discipline when uninsured lenders require a higher yield in responding to an increase in bank's risk. Implicit protection on bank

creditors' funds particularly in too-big or too-connected to fail banks generally considered to reduce the effectiveness of market discipline on risk-taking.

The financial crisis has been linked to various aspects of governance in the financial sector. Governance structures on the bank and the country levels may be more or less effective from the point of view of shareholder wealth maximization. Caprio, Laeven and Levine (2007) show that the ownership share of controlling shareholders in individual banks as well as shareholder rights on the country level increase bank valuation.

Since the argument for risk-shifting with insurance of banks' creditors is based on shareholder wealth maximization it should be expected that the degree of risk-shifting depends on the corporate governance system on the country and bank levels, as well as on the extent of explicit and implicit insurance. If banks' creditors require a risk premium for high risk-taking, shareholder wealth maximization would contribute to market discipline on risk-taking. On the other hand, excessive risk-taking may lie in shareholders' interest if there is extensive implicit or explicit insurance of banks' creditors. Laeven and Levine (2009) confirm this observation in a cross-country study of how the sign and magnitude of the relation between risk-taking, deposit insurance policies and regulation of banks' activities depends on ownership concentration. Other papers analyzing the interaction between market discipline and governance characteristics of banks are Forssbaeck (2011) and Nier and Baumann (2006).

This study covering the same conceptual ground as the mentioned papers differs theoretically by allowing a U-shaped relationship between depositor protection and risk-taking, and in empirical terms by including the crisis period. It is possible that much risk-taking was not revealed during the relatively stable years prior to the crisis.

The data set includes 764 banks in 34 industrial and emerging market economies during the period 2001-2009 to analyze how explicit and implicit protection of banks' creditors affect risk-taking in banks with different corporate governance characteristics. European banks are analyzed separately using the results obtained for all countries. We draw on the corporate governance literature to identify characteristics that can serve as proxies for degree of shareholder maximization. Banks' Risk-taking is measured by the market-based indicator so called z-scores as well as by non-performing loans. Our sample is limited by the availability of the data for listed banks and bank governance and ownership on the level of individual banks.

Inclusion of the crisis years allows us to incorporate consequences of bank behavior that are not revealed during periods of relatively stable growth but accumulate until the economy is hit by a negative shock. The hypotheses with respect to risk-taking will be tested on data for the years prior to the crisis (2001-2006), as well as on data for the whole period (2001-2009) and for the specific crisis years (2007-2009).

In Section 2, we review existing evidence on the impact on risk-taking and market discipline of deposit insurance schemes and bank governance characteristics. Hypotheses with respect to risk-taking are developed in Section 3 with an emphasis on the role of implicit protection of banks' creditors and the effect of governance characteristics on risk-taking. In section 4 the empirical methodology and data are described. Results are presented and discussed in Section 5. Robustness checks follow in Section 6. Risk-taking in Europe is discussed in Section 6. Conclusions and implications follow in Section 7.

## **2. Deposit insurance, implicit guarantee and bank's risk-taking**

Many countries including the United States and members of the European Union have adopted partial deposit guarantee schemes in order to reduce the risk of runs of such magnitude that banks must be closed while retaining an element of market discipline. The explicit insurance coverage limit, as well as the types of deposits covered by insurance, varies considerably from country to country. The empirical evidence in Angkinand (2009) indicates that costs of crises are relatively high in countries with low explicit deposit insurance coverage. Thus, the governments' incentives to intervene quickly to protect banks from the risk of runs are particularly strong in these countries. Accordingly, implicit insurance can be expected to be relatively strong in countries with a relatively low explicit deposit insurance coverage because non-insurance of relatively large deposits and creditors would not be credible.<sup>1</sup>

This discussion implies that the effect of explicit insurance schemes on bank's risk-taking incentives depends on three factors: the coverage of the explicit deposit insurance system, the credibility of non-insurance of those not covered by the explicit system and the relation between the coverage of explicit insurance and the credibility of non-insurance. Figure 1 from Angkinand and Wihlborg (2010) illustrates our argument and the hypothesis that there is a partial level of

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<sup>1</sup> The run on Northern Rock in the UK in the fall of 2007 indicates that the explicit deposit insurance coverage in the UK is not sufficient to prevent substantial bank runs. The UK deposit insurance system is also characterized by co-insurance.

explicit coverage that minimizes banks' risk-taking in a country. On the horizontal axis we have the extent of explicit insurance coverage (EC) of deposits and other claims on banks. On the vertical axis we have the incentives of banks to take excessive risk given macroeconomic conditions, governance structure, capital requirements, efficiency of supervision and other institutional characteristics affecting the credibility of a government's deposit insurance system. We interpret excessive risk-taking (RT) as the probability of a bank's capital buffer being exhausted within a certain timeframe.

In Figure 1 the line denoted "Explicit" shows how market discipline declines and risk-taking (RT) increases as explicit insurance coverage (EC) expands at a constant level of credibility of non-insurance. As EC increases depositor monitoring declines and the ability of banks to shift risk to a deposit insurance fund or tax payers increases.

Turning to the effects on risk-taking behaviors of implicit insurance, we assume that the extent of implicit insurance depends on the credibility of non-insurance and the share of deposits that are not covered by explicit insurance. The line denoted "Implicit" is drawn to show that the effect of implicit insurance on excessive risk-taking declines as the explicit coverage increases and credibility of non-insurance increases.

Under reasonable assumptions a vertical summation of the lines "Explicit" and "Implicit" gives us the U-shaped curve describing the relationship between risk-taking and explicit deposit insurance coverage. A critical assumption is that the effect on risk-taking incentives of the credibility effect dominates the effect of an increasing share of explicitly insured as EC increases. In other words, market discipline on banks' risk-taking incentives depends strongly on the existence of a relatively small group of creditors without explicit as well as implicit insurance.<sup>2</sup>

Several empirical studies show that explicit deposit insurance is associated with increased banks' risk-taking due to moral hazard, but this effect depends on ownership, governance factors and other institutional characteristics of a country. Demirgüç-Kunt and Detragiache (2002), Barth, Caprio and Levine (2004) and Cull, Senbet and Sorge. (2005) find that high quality of domestic institutions and legal systems reduces the moral hazard effect of deposit insurance. Hovakimian, Kane and Laeven (2003) emphasize that effects of explicit deposit insurance

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<sup>2</sup> Formal conditions are shown in Angkinand and Wihlborg (2008). Although the U-shaped relationship described in Figure 1 constitutes one hypothesis to be tested below, it is clear that the U-shape is not a mathematical necessity.

depend on its design and credibility. Fernández and González (2005) find that the adverse effect on risk taking can be reduced by enhancing the effectiveness of accounting and auditing systems. González (2005) suggests that the observation in some papers that deposit insurance reduces risk-taking can be explained by the positive impact of deposit insurance on banks' charter values in a strictly regulated environment. Laeven and Levine (2009) find that explicit deposit insurance is associated with greater risk only in countries where banks have a large owner since these banks have incentives and power to increase bank risk.

Other studies including Gropp and Vesala (2004), Nier and Baumann (2006) and Angkinand and Wihlborg (2010) emphasize the role of implicit insurance as a contributing factor to failing market discipline on risk taking of banks. Based on a sample of European banks, Gropp and Vesala (2004) find that explicit deposit insurance is associated with lower moral hazard and reduced risk taking if banks have large uninsured liabilities and small assets relative to the total assets of a banking system. Nier and Baumann (2006) study the market discipline effect for individual banks. Bank's risk taking is captured by the standard deviation of equity returns, loan loss provisions and the amount of capital banks hold as a buffer against risk. Market discipline has several dimensions including the extent of explicit deposit protection on the country level while implicit protection is captured by the amount of uninsured funding of a bank, interbank positions and Fitch ratings of the extent of government support of a bank. Their results indicate that lack of explicit deposit insurance, as well as high amounts of uninsured deposits and high likelihood of government support are likely to increase market discipline, thereby reduce excessive risk-taking of banks.

Angkinand and Wihlborg (2010) hypothesize and discover a U-shaped relationship between explicit deposit insurance coverage and banks' risk-taking using country-level data. The U-shaped relationship captures that market discipline is likely to be weak at low as well as high levels of explicit deposit insurance coverage. The weak discipline at low levels is caused by a market expectation that governments find themselves compelled to issue blanket guarantees to creditors of distressed banks, or to bail them out in times of distress. Thus, banks' incentives to shift risk to a deposit insurance fund is minimized by a deposit insurance system offering a partial deposit insurance coverage.

The discussion can be summarized in the following hypothesis:

*Hypothesis 1: Banks' excessive risk-taking (reflecting strength of moral hazard incentives) depends on the coverage of explicit deposit insurance schemes in such a way that risk-taking is relatively high for very low and very high levels of coverage, and minimized when there is positive but partial coverage when controlling for the capital ratio, macroeconomic factors, institutional factors affecting credibility of non-insurance and governance factors.*

Another way to examine the impact of implicit guarantee on risk-taking behaviors is by examining a degree of market discipline which is provided by uninsured bank debts and equity. Existing studies observe market discipline from the responsiveness of the cost of funding, measured by yields of uninsured bank debt and equity returns, of banks and other financial institutions (FIs) to their riskiness. If yields do not respond to changes in the risk of a bank, market discipline is lacking either because market participants are unable to become informed about risk of individual FI's or because there is implicit protection of debt.

Flannery (1998) reviews the early literature on private investors' ability to assess risk in U.S. banking industry. He concludes that banks' share prices generally behave similarly to equity prices of non-financial firms and that bank liability investors also respond to changes in conditions of banks. The evidence refers to yields on CDs as well as bank debentures. Even retail depositors seem to respond to insolvency problems of banks. He concludes that "there is little evidence that broadly contagious runs would be a problem for banks even in the absence of the federal safety net protection for depositors". This conclusion refers only to the traditional source of contagion in banking and has no bearing on contagion through securities markets of the kind the world experienced during the recent crisis. Flannery and Sorescu (1996) come to similar conclusions with respect to subordinated debentures in the United States.

A more recent literature focuses on the price of different types of bank's debt as an instrument for imposing market discipline. The price sensitivity of debt instrument to insolvency risk would depend on the instrument's priority in insolvency. Subordinated debt holders are next in line after shareholders to take losses; therefore, they have strong incentives to monitor bank's risk since they must bear the losses once there is no equity capital. The question with respect to implicit protection is whether subordinated debt is credibly uninsured. If so, subordinated debt would contribute to market discipline assuming it substitutes for other debt. If subordinated debt is not credibly non-insured it obtains implicit protection like other debt instruments.

Calomiris (1999), Evanoff and Wall (2000, 2001), Federal Reserve Board (1999), Jagtiani, Kaufman and Lemieux (2002) and Levonian (2000) can be mentioned among subordinated studies from a U.S. perspective. Sironi (2003) uses evidence from subordinated debt issues by European Banks. The general conclusion for the United States as well as for Europe is that investors in this kind of debt are sensitive to bank risk in the sense that they require a higher yield for banks that are perceived as relatively risky. These results do not imply that default risk of banks is efficiently priced, however. Evanoff, Jagtiani and Nakata (2007) show that the sensitivity of subordinated yield spreads depend on the development of markets for the instruments. In a fully implemented mandatory subordinated debt program, liquidity of the markets would increase and, thereby, the sensitivity of yield spreads to rise.

There is evidence that the sensitivity of debt yields depends on the degree of implicit protection of banks' creditors. The results in Sironi (2003) indicate that subordinated debt yields of large "too-big-to-fail banks" are less sensitive to risk proxies than the yields of other banks. The similar conclusion is pointed out by Stephanou (2010) and Angkinand, Wihlborg and Willett (2011) who examine the performance of market instruments of large FIs during the recent global financial crisis. They show that subordinate debt yield spreads fail to timely indicate the solvency risk of trouble large FIs.

From the too-big-to-fail doctrine, it would be difficult to argue against the existence of implicit support of large FIs where uninsured large depositors and creditors are protected from risk of loss by government guarantees. Too-big-to-fail should be evaluated relative to the size of a particular banking system, and individual banks in the system are likely to face different degrees of implicit protection of their creditors. With the internationalization of financial markets and cross-border banking there is some ambiguity with respect to the boundary of a particular banking system. In the empirical analysis we assume that "too-big-to-fail" for a bank must be evaluated relative to the economic size of the bank's home country.

Interbank borrowing is another factor which is examined in existing studies as a source of market discipline since interbank liabilities are generally not covered by deposit insurance systems in most countries. Furfine (2001) and King (2008) study the sensitivity of the U.S. federal funds rate to banks' activities in the interbank market. Both studies find substantial sensitivity indicating that banks monitor each others' risk. King also finds that banks ration lending to relatively risky banks. Dinger and von Hagen (2009) study a sample of Eastern and



Central European banks with long term interbank exposures. They find that loan loss provisions, loan loss reserves and charge-offs to equity as risk proxies are negatively associated with interbank borrowing. However, interbank borrowing also indicates the interconnectedness of banks in a banking system, and banks with a large amount of interbank lending and borrowing may be considered “too-connected” or “too systemically important”. The distress of these banks is likely to have repercussions for other banks, leading to the provision of implicit guarantees to uninsured interbank liabilities.

From above discussion, we formulate the following hypotheses with respect to the impact of factors affecting implicit protection of creditors and risk-taking:

*Hypotheses 2 a-c) Banks’ risk-taking (reflecting strength of moral hazard incentives caused by implicit protection of creditors) is expected to be relatively high in a) in banks with no or a relatively small share of subordinated debt at a given level of equity relative to total asset, b) in banks with a high degree of interconnectedness as shown by a relatively large share of interbank liabilities, and c) banks considered “too-big-to-fail”.*

As noted, the effect of these factors on banks’ risk-taking incentives can be opposite to the hypotheses depending on whether the subordinated and interbank debts are credibly uninsured. The existence of implicit government guarantee of these debts due to fear of contagion can reduce disciplinary effects imposed by subordinated and interbank liabilities’ holders; thereby, encourage banks to take excessive risk. Specifically, a positive sign of the subordinated debts and interbank liabilities proxies in bank’s risk-taking regressions suggests the presence of implicit guarantee, while a negative sign indicates market discipline associated with these uninsured liabilities. In addition, their effects also depend on the governance structures of banks, country-specific governance characteristics of bank government and existing level of explicit deposit insurance coverage.

### **3. Implicit guarantee and risk-taking: the role of bank governance and regulation**

Risk-taking incentives of bank managers can be expected to depend on the objectives and, therefore, on the governance structures of banks. In the corporate governance literature, it is usually assumed that managers in a “high quality” governance structure maximize shareholders’ wealth while the incentives to serve the interests of other stakeholders are provided by market forces, law, and regulation. Managers’ interest is more oriented towards their own reputation and

job security. It is safe to assume that there is a degree of stigma to being the manager of a failed bank. Therefore, managers can be expected to be less willing to take risk if their own interests weigh stronger than shareholders' at any level of deposit insurance coverage. Different ways of securing a bank's survival have different implications for shareholders. Issuing implicit guarantee to creditors' fund tend to benefit shareholders as well, while nationalization and temporary public administration can cause shareholders to lose their entire stake.<sup>3</sup> In case the distressed bank is merged with another bank, shareholders would typically obtain some stake in the merged entity. The question we ask is how the relationship between implicit protection of creditors and bank's risk-taking depends on the quality of governance with respect to shareholder wealth maximization. A similar question is how the impact of bank governance on risk taking behavior depends on the existence of implicit government guarantee.

Existing research in the corporate governance literature generally test the direct relationship between governance characteristics and risk taking of banks. Early studies on this subject were limited to the U.S. data. For instance, Saunders, Strock and Travlos (1990) using a sample of 38 bank holding companies in the U.S. during 1978-85 find a positive relation between managerial ownership (wherein managers own stocks) and risk-taking. On the other hand, Chen, Steiner and Whyte (1998) find a negative relation between managerial ownership and the level of risk taking in a larger sample of 302 banks and savings institutions during the period 1988-1993. Their explanation is that managers become more risk-averse when their ownership stake increases. Risk-taking is measured by the volatility in daily stock returns and market interest rates.<sup>4</sup>

Related studies focus on the impact of bank ownership within the bank governance structure on risk-taking and performance. Banks with high concentration of ownership tend to take more risk as managers are more closely aligned with controlling shareholders and protected from market discipline. However, legally imposed and enforced the rights of minority shareholders are expected to improve the governance structures of banks from a shareholder

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<sup>3</sup> In the USA the FDIC becomes the receiver or conservator of a bank when its capital ratio falls below two percent. Few other countries have laws specifying how authorities should act relative to a bank approaching or in distress.

<sup>4</sup> Anderson and Fraser (2000) argue that the different results can be explained by changes in the regulatory environment between the 80s and the 90s. These changes affected banks' charter values in the USA. In the Japanese banking sector Konoshi and Yasuda (2004) observe that the relationship "between the stable shareholders' ownership and bank risk is nonlinear".

perspective. Caprio, Laeven and Levine (2007) and Barth, Caprio and Levine (2006) analyze whether the quality of bank governance across countries is influenced by rules with respect to shareholder rights and disclosure. They use the market to book values of banks as a proxy for bank's risk. Their results show that greater transparency and stronger minority shareholder rights are associated with higher market values but also that concentration of ownership substitutes for shareholder protection.

Several other studies focus on the effects of state and foreign ownership. General conclusions indicate that state ownership of banks leads to inefficiency and poor performance and are inclined towards higher risk-taking as captured by the ratio of non-performing loans to total loans and bank failure rates as a result of reduced exposure to market discipline in equity markets (see, for example, La Porta et al, 1998, Barth, Caprio and Levine (2004) and Berger et al., 2005). The evidence with respect to effects of foreign ownership on banks' risk taking is rather mixed. This is not surprisingly since market discipline on foreign owned banks would depend on host as well as home country factors. According to Lensink and Hermes (2004), the entry of foreign banks improves the performance of domestic banks although costs increase as well.

The quality of governance can be expected to have an indirect impact on risk-taking by influencing management's response to capital regulation, deposit insurance coverage and restrictions on banks' activities. Only few studies consider these interactive effects, particularly between implicit guarantee and governance structures in explaining risk taking. Laeven and Levine (2009) ask whether the marginal effects of these variables on risk-taking depend on concentration of ownership. They find that the interactions between concentrated ownership and these variables have relatively large marginal effects. The impact on market discipline on risk-taking of, for example, deposit insurance becomes less pronounced for banks with high ownership concentration. Deposit insurance is not associated with greater bank risk for banks with dispersed owners. Forssbaeck (2011) uses a composite index of market discipline based on explicit deposit insurance as well as proxies for implicit insurance to analyze the possibly non-linear interaction between market discipline and concentration of ownership in risk-taking. He finds that market discipline is most effective at a low but not a minimum level of ownership concentration.

We expect that the impact of implicit protection of creditors in reducing market discipline and increasing bank's risk-taking incentives will be stronger in banks with high quality governance from shareholder perspective (wherein managers' incentives being aligned with shareholders' objective to maximize shareholder's value). The relationship between EC and RT, described in Figure 1, should be relatively flat and lower if managers' interests have strong weight relative to shareholder wealth maximization. Strong capital regulation and supervision should also reduce the incentives of banks' managers to shift risk to a deposit insurance fund and tax payers. If capital regulations are binding and bank supervisions are effective, they affect banks' risk-taking incentives shown by the curve denoted "Implicit × Regulation" in Figure 1 and their effects can be hypothesized as the following:

*Hypothesis 3. Incentives for risk-taking due to the presence of implicit guarantee decline with an increase in bank's equity capital and better capital regulation and supervision in the banking system.*

However, shareholders prefer relatively high risk-taking at low and high levels of EC because they have incentives to shift risk to tax payers and deposit insurance funds at high levels of explicit and implicit protection of creditors. Thus, from the relationship between EC and RT we expect greater quality of governance from the point of view of shareholders to induce relatively more risk-taking at low and high levels of EC. At an intermediate level of EC, shareholders' incentives to shift risk are relatively weak as a result of market discipline exerted by creditors. Thus, in an intermediate range, where market discipline on risk-taking is strong, shareholders might actually prefer less risk-taking than managers. Overall, higher quality of bank governance from a shareholder perspective is expected to lead to a more pronounced U-shape for the relationship between risk-taking and explicit deposit insurance coverage as described in Figure 2.<sup>5</sup> In the case that implicit guarantee is captured by the existence of protection of uninsured liabilities (as stated in Hypothesis 2), the effect on risk-taking of reduced market discipline due to implicit protection of creditors is expected to be stronger in banks with high quality governance. The interactive effects of implicit guarantee and bank governance on risk-taking can be summarized as the following:

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<sup>5</sup> This hypothesis is tested on country level data in Angkinand and Wihlborg (2010).

*Hypothesis 4. Higher quality of bank governance in terms of shareholder wealth maximization is expected to increase risk-taking incentives at relatively high levels of explicit and implicit protection of banks' creditors. The impact is expected to be particularly greater when factors contributing to implicit guarantee are present.*

#### 4. Model Specification and data.

We test the above hypotheses with respect to effects of explicit deposit insurance, implicit guarantee and bank governance on banks risk-taking using a standard panel regression approach. The model specification is as follow:

$$\begin{aligned} \text{Risk}_{j,i,t} = & \alpha_0 + \beta_1 \text{EC}_{i,t-1} + \beta_2 (\text{EC}_{i,t-1})^2 \\ & + \beta_3 \sum \text{Implicit}_{j,i,t-1} + \beta_4 \text{Governance}_{j,i,t} \\ & + \beta_5 \sum \text{Bank}_{j,t-1} + \beta_6 \sum \text{Macro}_{i,t-1} + \beta_7 \sum_{i=1}^{34} \text{Country}_{i,t-1} + \beta_8 \sum_{t=2001}^{2009} \text{Year}_t + \varepsilon_{j,i,t} \end{aligned}$$

where  $\text{Risk}_{j,i,t}$  is one of three proxies for risk taking in bank  $j$  in country  $i$  and year  $t$  (the proxies of each variable are discussed below and summarized in Table 1). EC is the explicit coverage of deposit insurance, which is entered in the quadratic functional form. Hypothesis 1 referring to a U-shaped relationship between risk-taking and the degree of explicit protection is supported if the estimated coefficient for the squared term ( $\beta_2$ ) is positive and significant, and if the estimated coefficient for the linear term ( $\beta_1$ ) is negative and significant. Reduced implicit creditor protection caused by increasing explicit coverage is captured by the downward sloping part of the quadratic function.

Proxies for implicit creditor protection (*Implicit*) are introduced in order to test Hypotheses 2 and 3. We refer to implicit guarantee variables as those capturing the extent to which banks' creditors expect to be bailed out in case of bank insolvency. The variable *Implicit* is captured by three bank-specific proxies for factors believed to strengthen implicit guarantees. The variables are described below.

In order to test Hypothesis 3 with respect to quality of bank governance, proxies for governance quality are allowed to interact with explicit and implicit insurance proxies, e.g. (EC

$\times Governance$ ) and ( $Implicit \times Governance$ ). “Governance” is a vector of both bank-specific and country-specific governance variables. They are described below.

To isolate the effect of explicit and implicit insurance and governance variables, we control for other bank-specific and country-specific characteristics that may affect bank risk-taking.  $Bank_{j,t-1}$  is a vector of bank-specific control variables, which include the equity/total assets ratio, the cost/income ratio, the liquid assets/total assets ratio, and market beta.  $Macro_{i,t-1}$  is a vector of macroeconomic control variables for country characteristics including GDP per capita, real GDP growth, inflation and real interest rates. The descriptive statistics of all variables are presented in Table 1.

In the panel estimations, we include both the country- and year-fixed effects.  $Country_i$  is a vector of country-specific dummy variables to control for unobservable country characteristics, and  $Year_t$  is a vector of time-specific dummies included to control for aggregate shocks. We do not introduce bank-specific fix-effect dummies since our bank governance data is cross-sectional variables, i.e. one observation per bank, and the time-invariant bank governance variables cannot be used with fixed-effect models. For regressions including country-level time-invariant governance variables, country-fixed effects are excluded as well. Lastly,  $\varepsilon_{i,t}$  is the disturbance term.

Each regression is estimated with robust standard errors clustered at the bank level to correct for within-bank serial correlation. Since the number of banks in each countries varies substantially (see Appendix 1), clustering standard errors at the country level will lead to uneven cluster size and therefore could lead to imprecise estimates.

To reduce a potential simultaneity bias between risk-taking and deposit insurance, in particular, the mentioned independent variables are lagged one year. Another reason for the one year lag is that the risk-taking proxies are not ex ante measures of risk but the result of risk-taking decisions made prior to the observations of risk. We return to the specification of risk proxies below.

#### *Data*

The consolidated balance sheet and income statement data are obtained from the BankScope database. The data for daily stock prices are taken from Bloomberg. The sample of banks is limited to publicly traded banks because we use market data for two risk measures. Furthermore, important governance variables are available only for these banks. Our data set

covers 764 banks in 34 industrial and emerging market countries for the period of 2001-2009. We limit the sample of banks that have total assets above 100 million U.S. dollars. However, the reduced sample size is mainly due to the missing observations of some bank- and country-specific control variables and unavailability of bank-specific governance data. BankScope lists more than 1,400 publicly traded banks for the sample of 46 industrial and emerging market countries, which are the sample size we started with. The panel is unbalanced as not every bank operates or has the data available every year in the sample period coverage.

Listed banks in the sample are referred to either bank holding companies (BHCs) or stand-alone commercial banks. When banks are organized as BHCs, we use the balance sheet and income statement data of BHCs due to two reasons. First, when banks are organized as BHCs, generally only the holding companies are publicly traded in the national stock market while their bank subsidiaries do not. Second, regardless of the availability of market data, the identification of bank ownership, which we use to proxy bank governance, is significantly different between the holding company and its largest bank subsidiary. For example, Bank of America National Association, the commercial bank, is identified as having only one controlling shareholder, namely Bank of America Corporation, its holding company. Bank of America Corporation, on the other hand, has dispersed ownership. With this type of organization, we are interested in the effect of ownership of the BHCs on risk-taking.

#### *Bank risk measures*

The three measures of risk-taking used in the analysis are the market z-score, Stock Volatility (the annualized standard deviation of stock returns) and the ratio of bank non-performing loans relative to equity capital (NPL/CAP). These variables are commonly used as proxies for risk-taking. The market z-score is employed as a proxy for “distance to default” defined as the ratio of the annual returns on stock plus one over the annualized standard deviation of daily stock returns.<sup>6</sup>

The market z-score and Stock Volatility are the market-based proxies of risk-taking, and both variables reflect the overall risk of a bank. A higher value of the z-score corresponds to a

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<sup>6</sup> An alternative proxy for incentive effects of deposit insurance is the Implicit Insurance Premium (IPP) representing an implicit premium on a put option on a bank’s assets. IPPs for banks in a number of countries have been estimated by Hovakimian et al (2003). We do not use this proxy because it depends not only on the probability of exhausting equity capital at a point in time but also on expected government support to shareholders or costs imposed on shareholders when a bank approaches distress (Pennacchi,1987). Our hypotheses are based on the assumption that risk-taking at any time is equivalent to the probability of exhausting the current equity capital.

lower probability of bank's default. The value of z-score in the regressions is actually  $1/z$  so that a higher value of all risk-taking proxies indicates higher risk-taking. A higher value of Stock Volatility also indicates increased risk-taking. NPL/CAP measures bank's credit risk. It is an accounting-based indicator and capture actual losses or ex-post risk-taking by a bank. Stock prices, on the other hand, generally provide forewarning of bank's risk. The correlations between the two market-based risk-taking proxies and NPL/CAP are positive but not high (correlations = 0.34-0.37, see Table 2). In regressions, we use the natural logarithm of all risk-taking proxies to reduce the weight of relatively extreme values. If capital is low, extreme values of NPL/CAP are likely to exist.

The risk-taking proxies should reflect the risk attitude of the banks at the time credit decisions are made. In the regressions all independent variables are lagged one period relative to the risk proxy but it may take longer before the risk associated with decisions in a particular period is revealed by the proxy. This is particularly true for non-performing loans. For this reason we run separate regressions for the pre-crisis period 2001-2006, the crisis period 2007-2009 and full period 2001-2009. The early period had stable growth in the global economy. Our measures of risk may underestimate the risk bank managers perceived during this period when losses were realized at a lower rate than anticipated. On the other hand, risk may be overestimated by the proxies during the crisis period when losses were realized with a higher frequency than anticipated.

Another type of evidence indicating that market discipline is relatively weak for "too big to fail" banks comes from literature analyzing how risk-taking depends on explicit and implicit insurance of banks' creditors. This literature uses proxies for riskiness such as non-performing loans/capital, the volatility of equity returns, z-scores and the incidence of banking crises. These proxies are regressed on bank-specific variables, country-specific macro variables and country-specific institutional variables such as explicit deposit insurance coverage, proxies for implicit protection of creditors and governance variables on the country as well as the bank level. In the empirical analysis below we employ the market z-scores as proxies for banking risk and we include subordinated debt as well as a "too big to fail" proxy as factors possibly affecting implicit insurance of creditors.

#### *Explicit deposit insurance coverage*



The proxy for explicit deposit insurance coverage limits per GDP per capita is constructed based on the data for coverage limits from the Database of Deposit Insurance Around the World, published by Demirgüç-Kunt et al. (2005) at the World Bank, which are available up to 2003. Coverage limit is the maximum coverage per deposit account within each deposit insurance system. We updated the data to 2009 using various sources including Schich (2008) and the Report to Financial Stability Board (2010) for OECD countries. Federal Reserve Bank of San Francisco (2008) is the source for deposit insurance coverage for Asian countries. The data for the rest of countries are from the International Association of Deposit Insurers (IADI) and various country websites on their deposit insurance systems. On average, countries have explicit coverage limits 3.6 times of their GDP per capita with the maximum ratio of 18. We assigned a value of 20 for countries that offer full blanket guarantee.<sup>7</sup>

#### *Implicit guarantee proxies*

One aspect of implicit guarantees is captured by Hypothesis 1 describing a U-shaped relationship between explicit deposit insurance coverage, EC, and risk-taking, RT. We also include factors that should capture implicit guarantees of creditors explicitly. Banks differ in terms of funding from large uninsured depositors, interbank deposits, issues of subordinated debt and sheer size. These factors may be related to the degree of implicit guarantees of a bank's creditors. Interbank Liabilities and Subordinated Debt refer to implicit guarantees or lack thereof for uninsured funds while total assets relative to GDP (TA/GDP) captures implicit insurance under a "too-big-to-fail" policy. Fitch Support Ratings of strength of government guarantees exist only for a smaller sample of banks and years. This variable is only included in robustness tests and not in the main regressions. A few other studies such as Gropp, Vesala, and Vulpes (2002) and Nier and Baumann (2006) include the Fitch support ratings in their studies and generally find that market discipline weakens with expectation of government supports.<sup>8</sup>

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<sup>7</sup> Indonesia increased the coverage limits to 2 billion rupiah during 2008-2009, which account for more than 80 times of GDP per capita. Mexico temporarily increased the coverage limit to 10 million peso in 2003, or 134 times of GDP per capita and to 5 million peso in 2004, or 60 times of GDP per capita. We considered these observations as full coverage and assigned a value of 20 for the coverage limits per GDP per capita.

<sup>8</sup> Fitch rating agency assigns support ratings based on the propensity of federal state (or an institutional owner) to support a bank as well as its ability to support it. The support ratings range from 1 to 5 whether 1 is assigned for a bank for which there is an extremely high probability of receiving external financial support when necessary (, and the state has the ability of support, indicated by a minimum Fitch's Long-term rating floor of A-.)

The effects of bank's size on bank risk-taking are not as unambiguous. While large banks are more likely to receive supports and be bailed in a distress as stated in Hypothesis 2.a), they may benefit from potential greater diversification that reduces their riskiness.

Subordinated debt and Interbank deposits are usually excluded from explicit deposit insurance coverage. Therefore, relatively large amounts of these uninsured liabilities could preserve market discipline by exposing holders of these liabilities to potential losses, and, thereby, reduce bank's risk-taking due to increased monitoring by these stakeholders. If the holders of these uninsured funds do not expect to be bailed out during periods of distress we would expect the sign of subordinated debts and interbank deposits to be negative in regressions. The existence of interbank liabilities may be a source of implicit protection, however, as stated in Hypothesis 2.b). This hypothesis is supported by a positive sign for interbank liabilities.

We construct a Subordinated Debt dummy of one for a bank that issues subordinated debts and an Interbank Liabilities dummy for a bank that receives deposits from other banks according to Bankscope.<sup>9</sup>

#### *Bank governance*

All regressions include two bank-specific and three country-specific governance variables. For bank-specific governance, *Controlling Shareholders* is a dummy of one for any bank that has at least one of the recorded shareholders owning more than 50% of the bank's equity.<sup>10</sup> We do not use the actual percentage owned by controlling owners because such data are available only for a limited number of banks, whereas the information on the ownership concentration such as "wholly owned" (the percentage of ownership is above 98%) or "majority owned" (the percentage of ownership is above 50%) and categorical indicators identifying the degree of independence of a bank with regard to its shareholders are available for a large number of banks in BankScope.

Another bank-specific governance variable is *Foreign-Owned Bank*, which is a dummy variable with the value of 1 when the controlling shareholder with more than 50% ownership is a foreign block-holder.

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<sup>9</sup> The dummies are set to zero if subordinated debt and interbank deposits data are not revealed on bank's balance sheet in BankScope.

<sup>10</sup> As an alternative, we use the 25% cutoff to construct the controlling shareholders dummy (not included). Controlling Shareholders dummies are constructed based on the BankScope indicator of the degree of independence of a company with regards to its shareholders.

The country-specific governance variables are *Shareholder Rights*, *Creditor Rights*, and bank capital regulation and supervision (*CRS*). The first two variables are time-invariant and the data are from Djankov, McLiesh and Shleifer (2007) and Djankov, et al (2008), which updated the data in La Porta et al. (1998). Data on *CRS* are taken from Abiad, Detragiache and Tressel (2008)'s Financial Reforms Database. The potentially important advantage of the database is that it has time-series measures.<sup>11</sup> A higher value of each of the three country governance variables indicates a higher quality of governance, which reflects stronger protection of minority shareholders against managers of dominant shareholders, greater protection of secured creditors, and stronger capital regulation and supervision.

In the Financial Reform Database, we also construct the Total Financial Liberalization data to examine the effects of liberalization on bank's risk-taking and how the relationship between implicit insurance and bank' risk-taking depend on the degree of financial liberalization. The proxy for Financial Liberalization is strongly correlated with *CRS*, however. Therefore, we include only *CRS*. This correlation should be kept in mind when interpreting results.

Definitions of these governance variables can be found in the Table 1. Descriptive statistics and correlations among bank risk measures, explicit deposit insurance coverage, implicit guarantee proxies, and bank governance are reported in Tables 2 and 3, respectively.

## **5. Empirical analysis of banks' risk-taking**

Regression results for the impacts of implicit guarantee on banks' risk-taking are presented in Tables 4-5. Interaction terms, capturing how the effect of implicit guarantee depends on the structure of bank governance and regulation, are introduced in Tables 6-7. Only the results for the market z-score (Tables 4 and 6) and NPL/CAP (Tables 5 and 7) as dependent variables are presented. We do not report the regression results for Stock Volatility as this risk-taking proxy is highly correlated with z-score (their correlation is = 0.84, see Table 3) and their regression results are similar. As noted, these bank's risk-taking proxies enter regression in natural logarithm, and the z-score is defined as  $1/z$ . Therefore, a higher value for the z-score indicates higher risk-taking.

**Regression results in each table are further divided into three sub-periods:** the full period, 2001-2009, the pre-crisis period, 2001-2006, and the crisis period, 2007-2009. We use 2007 as

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<sup>11</sup> The data are available from 1973-2005 and we assume that there are no change in the data after 2005.

the starting year of the recent financial crisis because the average value of banks' equity prices went down sharply towards the end of 2007, causing large declines in the z-scores values in 2007. NPL/CAP did not show a large change in its value until 2008. As noted above banks' risk-taking may not be fully reflected in the risk-taking proxies during the stable pre-crisis period. Results for the full period may be dominated by relationships for one of the sub-periods.

A first result is that there is strong support in all four tables for Hypothesis 1 stating that there is a partial level of deposit insurance coverage that minimizes risk-taking. The coefficient for the linear Explicit Coverage (EC) term is negative and significant while the coefficient for the squared EC term is positive and significant in all z-score regressions for each sample period, and with and without interaction terms (Tables 4 and 6). The U-shaped relationship is supported in the NPL/CAP regressions for the full period and the crisis period. The two EC variables are insignificant in the pre-crisis regressions in Table 5, however. This result may be explained by the relatively small variation in non-performing loans during the stable pre crisis period. The variables have the wrong signs for the same period when interactions with EC are included in Table 7. In this case, much of the effect of EC is captured by interaction terms. We return to this issue.

Three implicit guarantee proxies, Subordinated Debt, Interbank Liabilities, TA/GDP, are included in the tables. Columns 1, 3 and 5 in all tables exclude TA/GDP since this variable is highly correlated with Interbank Liabilities (the correlation coefficient is 0.73, see Table 3), and one of the two implicit guarantee proxies becomes insignificant when both variables are included in the same regression. A high correlation also illustrates that interbank liabilities are held by large banks and lending and borrowing relationship between banks is more common among large banks.

The results indicate that the two types of uninsured liabilities have different effects on bank's risk-taking behavior. Dividing the sample into the pre-crisis and crisis periods allows us to assess the perception of implicit protection to those uninsured debts, and circumstances in which the holders of those uninsured debts provide market discipline on risk-taking.

Specifically, issues of subordinated debt seem to be associated with increased market discipline and reduced risk-taking as hypothesized only during the stable pre-crisis period and only when risk-taking is proxied by z-score in Tables 4 and 6. The coefficient of subordinated debt for the crisis sample period and in most NPL/CAP regressions is positive and significant

indicating that subordinated debt may contribute to risk-taking <supporting H.2a = there is implicit guarantee of subordinated debts, particularly during the crisis period> in contradiction to Hypothesis 2.c). It seems that banks with subordinated debt were hit most severely by credit losses during the crisis period. Proposals to require banks to issue subordinated debt to enhance market discipline do not seem promising according to these results.

The coefficients for Interbank Liabilities have a consistently negative sign in all regressions with and without interaction terms. The negative coefficients are significant in most regressions in all four tables. Thus, Hypothesis 2.b. stating that there is implicit protection for interbank liabilities is rejected. Instead, interbank liabilities enhance market discipline as suggested in the reviewed literature as well.

TA/GDP is insignificant in most regressions in all tables but significant and negative for the pre-crisis period in z-score regressions (Tables 4 and 6). Thus, Hypothesis 2.c) capturing “too big to fail” is not supported. One explanation could be that all banks in the sample are “too big to fail” in most countries. The negative sign for TA/GDP during the pre-crisis period is consistent with Demirgüç-Kunt and Detragiache (2002) and Nier and Baumann (2006).

In sum, the results from Hypotheses 1 and 2 suggest evidence of the existence of implicit guarantee, which generally increase incentives of banks to take excessive risk. This conclusion is mainly driven by the negative slope of the U-shaped relationship which indicates that risk-taking is high and excessive for countries with an absence or low coverage of explicit deposit insurance (i.e., presence of implicit guarantee). Implicit guarantee exists when there is a formal announcement or perception that guarantees will expand and cover uninsured liability holders. We find that this expectation is likely to be true for uninsured subordinated debt holders but not for interbank liabilities. Banks that have interbank liabilities take less risk than banks with no interbank liabilities, suggesting that interbank borrowers impose market discipline on lending banks. The evidence that large banks do not take excessive risk does not exclusively imply that there is no implicit guarantee of too-big-to-fail banks. The risk-taking behaviors of larger banks are driven by other factors such as the benefits from risk-diversification.

Among the bank-specific control variables in Tables 4-7, the equity capital ratio (Equity/TA), when it is significant, has a negative sign indicating that an increased capital ratio reduces risk-taking. A higher capital ratio reduces incentives to shift risk to tax payers and deposit insurance funds.

The Cost/Income ratio is strongly significant, and it is associated with increased risk. Thus, relatively weak cost controls in a bank seems to be associated with weak risk management as well.

The share of liquid assets (Liquid Asset/TA) seems to be associated mainly with the NPL/CAP measure of risk and in this case with significantly reduced risk. Risk measured by z-scores seem to be positively associated with liquidity even if only weakly. The market beta (relative to a world market portfolio) is only associated with the z-score measure of risk during the crisis period in particular. A relatively high market beta suggests that a bank offers relatively little portfolio diversification

Controlling Shareholders measuring ownership concentration is positively associated with risk measured by z-score during the pre-crisis period alone and has no impact on NPL/CAP. Thus, the losses during the crisis do not seem to be related to ownership concentration. Foreign ownership is insignificant in all regressions.

Country characteristics with respect to governance seem to affect risk-taking to a greater degree than the bank-specific variables. Shareholders rights in particular reduce risk taking with statistical significance in z-score regressions including the crisis period. NPL/CAP is negatively and significantly associated with shareholder rights during the pre-crisis period as well

The results for creditor rights are similar to the results for shareholder rights. Banks in countries with relatively strong creditor rights were exposed to less risk during the crisis period.

The CRS variable represents strength of capital regulation and supervision. As noted this variable is strongly correlated with financial liberalization in the form of interest-and credit controls, entry restrictions and liberalization of equity markets.<sup>12</sup> Therefore, CRS may capture effects of liberalization as well. CRS is positively and significantly associated with higher risk in terms of both z-scores and NPL/CAP during the crisis period. During the pre-crisis period CRS is either insignificant or it negatively associated with risk. These result may reflect that the financial crisis originated and affected countries with relatively strong supervisory regimes the strongest.

The macroeconomic control variables are generally significant for the 2001-2009 sample coverage, which includes the crisis years. GDP per capita is generally significant with the expected negative sign. This variable also reflects the general quality of domestic institutions and

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<sup>12</sup> See Angkinand, Wanwimol and Wihlborg (2009)

as expected, banks' risk-taking is lower in countries with a higher institutional quality. GDP Growth, Inflation, and Real Interest Rate control for macroeconomic conditions.

*Interaction between governance and implicit protection of creditors*

We turn now to the results for interaction variables in Tables 6 and 7 in order to evaluate Hypotheses 3 a)-d). Additional interactions between the governance variables (including Equity/TA) and EC, subordinated debt, interbank liabilities and TA/GDP were included initially. Interactions with no significant coefficients were removed before running the regressions presented in the tables.

Implicit protection is captured by the downward-sloping part of the U-shaped relationship between EC and the risk proxies, z-scores in Table 6 and NPL/CAP in Table 7. Each of the interactions with EC is significant in both tables for the crisis period in particular. The coefficient for EC standing alone is negative. This negative slope is decreasing with increasing CRS and increasing shareholder rights since the coefficients for the interactions are positive. Thus increased strength of regulation and supervision is associated with a flatter U-shaped relationship indicating that risk-shifting becomes less sensitive to changes in implicit protection. Increased shareholder rights are similarly reducing the effect of implicit protection on risk-taking. The latter result is contrary to Hypothesis 3.a).

The remaining interactions in Tables 6 and 7 include Equity/TA. None of the quality of governance variables (shareholder rights, creditor rights, ownweship variables) have significant interactions with the proxies for implicit protection and market discipline; Subordinated debt, Interbank Liabilities and TA/GDP. Thus, Hypothesis 3.b)-d) referring to quality of governance is not supported.

A higher level of Equity/TA should reduce incentives for risk-shifting. Thus, implicit protection should have a smaller impact on risk-taking at higher levels of Equity/TA. This implies that the signs for interactions with Equity/TA should be the opposite of the signs for the stand-alone variables Subordinated debt, Interbank liabilities and TA/GDP. In the tables, banks issuing subordinated debt have higher risk-taking as measured by both z-score and NPL/CAP during the crisis period. This positive sign is weakened by interaction with Equity/TA in Table 6 in particular. Thus, banks with relatively high equity ratios were less sensitive to issues of subordinated debt.

Interbank Liabilities standing alone are have a negative, disciplining effect on risk taking in all regressions in Tables 6 and 7. This disciplining effect of interbank liabilities is weakened in banks with relatively high equity ratios.

Finally, the interaction between the equity ratio and bank size (TA/GDP) is positive and significant in z-score regressions in Table 6 where the coefficient for TA/GDP is negative. Thus, the risk reducing effect of bank size is weaker for banks with relatively high equity ratios.

#### *Robustness Checks*

### **6. Implicit protection ratings and robustness**

Considering the equity ratio and risk-taking simultaneous we used instrumental variables to estimate the impact of implicit protection and governance variables on risk-taking.

We also substituted Fitch ratings of government support for the bank size variable (TA/GDP) as a proxy for implicit protection of banks' creditors as a result of "too big to fail" policies. This rating does not exist for a large proportion of our sample. The issue here is whether results are influenced by the inclusion of this proxy for the reduced sample.

Unlike Nier and Baumann (2006) we do not find significance for the Fitch ratings. Thus the included proxies for implicit creditor protection captures what Fitch ratings possibly capture. To analyze this further we run a regression for Fitch ratings with deposit insurance coverage (EC), the subordinated debt and the interbank dummies and the bank market share variable (TA/GDP).

(INCOMPLETE)

### **7. Conclusions**

Using bank level data from 764 banks in 34 countries during the period 2001-2009 we find strong evidence of a U-shaped relationship between risk-taking and deposit insurance coverage, reflecting that strong implicit insurance is associated with low explicit coverage. Thus, non-insurance of groups of creditors of banks is less credible the lower the level of explicit deposit insurance coverage.

The empirical evidence does not support the hypothesis that relatively large banks take more risk as a result of stronger implicit protection of their creditors. Banks with interbank liabilities indicating interconnectedness seem to be subject to market discipline in the sense of



weaker risk-taking incentives under some conditions. Subordinated debt on the balance sheet seems to be associated with more risk-taking during the crisis period.

Bank-specific governance variables referring to concentration of ownership and foreign ownership are not strongly associated with risk-taking. Country specific governance variables seem to be strongly associated with risk-taking, however. Both strong shareholder rights and strong creditor rights seem to contribute to reduced risk-taking during the crisis period in particular.

The variable for strength of capital regulation and supervision (CRS) is also associated with relatively high risk during the crisis. Most of the European countries score relatively high with respect to CRS.

Since the strongest evidence with respect to implicit insurance is obtained through the U-shaped relationship between risk-taking and explicit coverage, the interaction between explicit coverage and governance variables are particularly interesting. The results with respect to interaction with shareholder rights are contrary to the hypothesis that increased shareholder rights would increase the incentives for risk-shifting. Both increased shareholder rights and strength of capital regulation and supervision seem to flatten the U-shaped relationship between explicit protection of creditors and risk-taking. However, the U-shaped relationship became more pronounced during the crisis years with the implication that bank risk increased during the crisis in countries with relatively low and relatively high explicit coverage.

Many countries strengthened explicit protection during the crisis. Most likely implicit protection has increased as well. Our analysis implies that these policy measures, and failure to come to grips with implicit protection of creditors, contribute to the likelihood of banking crises in the future.

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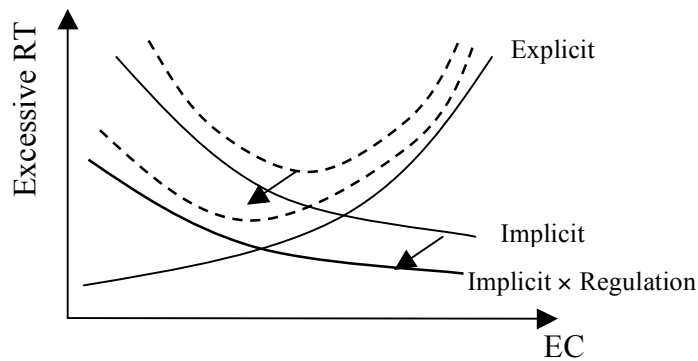
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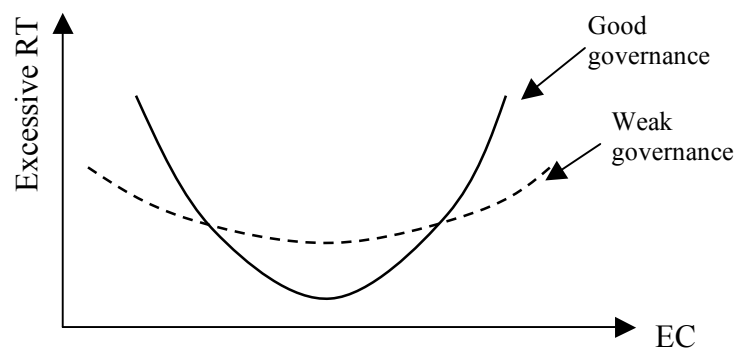
Figure 1 Hypothesized relationships between explicit deposit insurance coverage (EC) and risk-taking (RT) and the impact of institutional and banks' ownership variables.



This figure shows the relationship between bank's excessive risk-taking (RT) and explicit deposit insurance coverage (EC). The line "Explicit" is drawn at a constant degree of credibility of non-insurance; an upward slope reflects the moral hazard incentives become stronger at high levels of EC. The line "Implicit" is drawn at a constant level of risk taking caused by explicit deposit insurance coverage; a negative slope shows how RT caused by implicit insurance decline with increasing EC as a result of credibility of non-insurance (CNI). The two lines are added vertically. The total effect of EC on risk taking is shown as a U-shaped curve.

The line Implicit  $\times$  Regulation shows how the curve Implicit shifts as a result of better quality of bank regulation and supervision enhancing the CNI. The top dotted line is the vertical sum of Explicit and Implicit. The lower dotted line is the vertical sum of Explicit and Implicit  $\times$  Regulation.

Figure 2 The U-shape relationship and the impact of bank governance

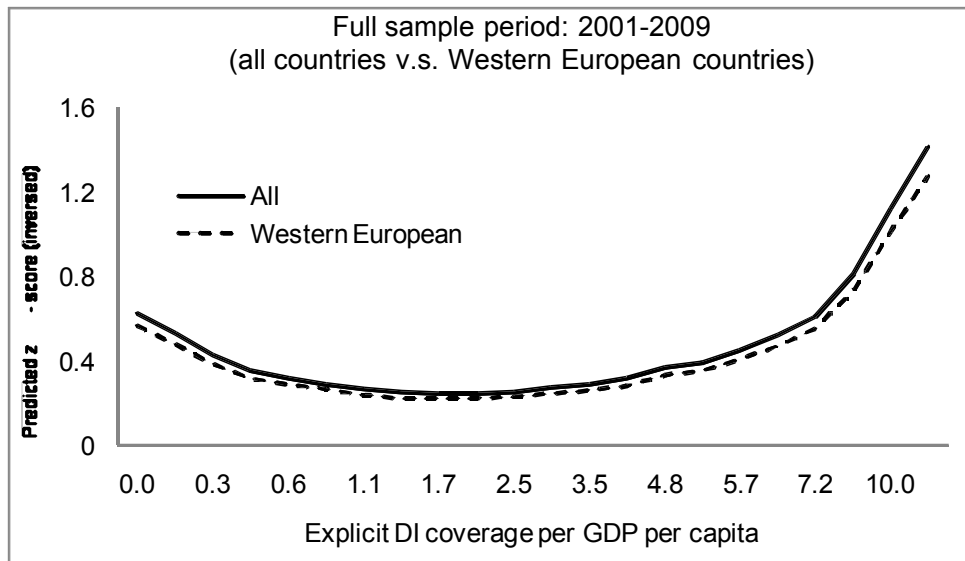


"Good" governance implies that shareholders' objectives have a large weight in managers' incentives.

Figure 3 Risk taking at different levels of deposit insurance coverage: the case of Western European countries

Figures below plot the predicted values of bank's z-score at different levels of explicit deposit insurance coverage limit of GDP per capita (EC). These predicted values are calculated by using the mean values of independent variables for either the sample of all countries or Western European countries. Both figures 3a and 3b use the values from regressions in Table 4.

3a. Comparison between all sample countries and Western European countries (based on regression 1, Table 4)



3b. Comparison between pre- and crisis period for the sample of Western European countries (based on regressions 3 and 5, Table 4)

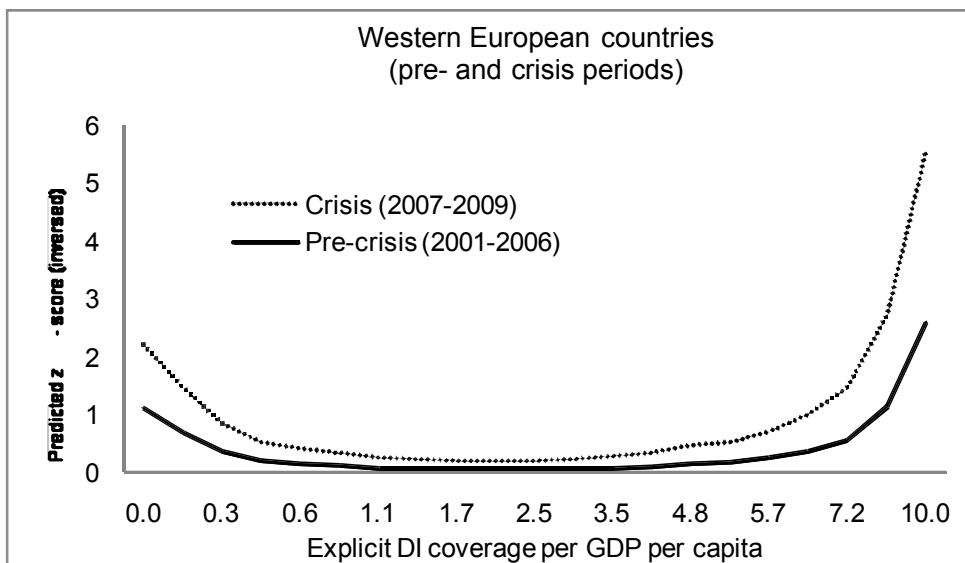


Table 1: Data descriptions and sources

Variable	Data Descriptions and Sources
<b>Dependent Variables (The bank-specific proxies of risk taking)</b>	
Market z-score	Bank's z-score based on market data defined as [(the annual rate of stock returns + 1) / annualized standard deviation of stock returns]. <i>Source:</i> Bloomberg
NPL/CAP	The ratio of non-performing loans (NPL) to bank's total equity capital. <i>Source:</i> BankScope
<b>Independent Variables</b>	
<i>Deposit Insurance and Implicit Guarantee variables</i>	
Explicit DI coverage (EC)	The ratio of explicit deposit insurance coverage per deposits per capita. This variable enters regressions as the natural logarithm of (EC+1) since there is a substantial variation of this ratio across countries. The EC variable obtains the value of one for countries with no explicit deposit insurance coverage. Countries with blanket guarantee are assigned a value above the maximum observed ratio in the sample. <i>Sources:</i> authors' compilation from various sources (see text)
Subordinated Debt	A dummy of one in a year that the bank issues subordinated debts, and zero otherwise. As a general rule, if no figure for subordinated debts is available in the bank' balance sheet, it is assumed that the bank does not issue subordinated debts. <i>Source:</i> BankScope
Interbank Liabilities	A dummy of one in a year that the bank borrows funds from other banks in the market place. As a general rule, if no figure for deposits from other banks is available in the bank' balance sheet, it is assumed that the bank does not borrow money from other banks. <i>Source:</i> BankScope.
TA/GDP	<i>Sources:</i> banks' total assets are from BankScope and nominal GDP are from World Economic Outlook, IMF
Fitch Support Rating	<i>Source:</i> BankScope
<i>Bank-Specific Governance Variables</i>	
Controlling Shareholders	<i>Source:</i> BankScope
Foreign Ownership	The dummy variable of foreign ownership of bank. This dummy has a value of 1 if the largest ownership is foreign and 0 otherwise. <i>Source:</i> BankScope
Shareholder Rights	An index aggregating six characteristics of shareholder rights: proxy by mail allowed, shares not blocked before meeting, cumulative voting or proportional representation allowed, oppressed minorities in place, percentage of share capital to call an extraordinary meeting, and preemptive right to new issues. The index ranges from 0 to 6 with a higher value indicating the increase in shareholder protection. <i>Source:</i> Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2008)†
Creditor Rights	An index aggregating four characteristics of creditor rights: no automatic stay on secured assets, secured creditors paid first, restrictions on going into reorganization, and management does not stay in reorganization. The index ranges from 0 to 4 with a higher value indicating the increase in creditor protection. <i>Source:</i> Djankov, McLiesh and Shleifer (2007)†
CRS (Capital Regulation & Supervision)	Enhancement of prudential regulations and supervision of the banking sector. This variable has a scale of 0-3, which is based on the following three questions: 1) Has a country adopted a capital adequacy ratio based on the Basle standard? (yes=1; no=0) 2) Is a banking supervisory agency independent from the executives' influence? 3) Does a banking supervisory agency conduct effective supervisions through on-site and off-site examinations? <i>Source:</i> Abiad, Detragiache and Tressel (2008)
Total FL (Total Financial Liberalization)	The aggregate financial liberalization based on the extent of elimination of interest rate controls, elimination of credit controls and excessively high reserve requirements, liberalization of security market policy, elimination of bank entry barriers, elimination of



capital account restrictions, and reduction in state ownership in the banking sector. The scale is 0-18, where a higher value indicates a higher degree of financial liberalization. *Source: Abiad, Detragiache and Tressel (2008)*

Equity/TA	The ratio of bank's equity capital/total assets. <i>Source: Bankscope</i>
Liquid Assets/TA	The ratio of bank's liquid asset/total assets. <i>Source: Bankscope</i>
Cost/Income	The natural logarithm of the ratio of cost to income. <i>Source: Bankscope</i>
Market beta	Stock market beta. <i>Source: Bankscope</i>

*Country-Specific Control Variables*

GDP/Cap	The natural log of real GDP per capita (PPP). <i>Source: World Economic Outlook, IMF</i>
GDP Growth	Real GDP growth (annual %). <i>Source: World Economic Outlook, IMF</i>
Inflation	Inflation, consumer prices (annual %). <i>Source: World Economic Outlook, IMF</i>
Real Interest Rate	Real interest rate (%). <i>Sources: World Economic Outlook and International Financial Statistics</i>

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† The shareholder rights and creditor rights data in these studies are updated from La Porta, Lopez-de-Silanes, Shleifer and Vishny (1998).

Table 2. Descriptive Statistics

Variables	N	Mean	Std.Dev.	Min	Max
z-score	4287	0.99	0.91	-6.61	3.57
NPL/CAP	3937	2.32	1.64	-6.91	6.89
EC	4287	1.29	0.56	0	3.04
EC squared	4287	2.09	1.22	0	5.99
Subordinated Debt	4287	0.49	0.50	0	1
Interbank Liabilities	4287	0.42	0.49	0	1
TA/GDP	4287	5.01	2.94	-0.43	13.11
Fitch Support Rating	1250	3.20	1.62	1	5
Equity/TA	4287	10.29	9.67	-1.86	99.74
Cost/Income	4287	4.12	0.30	0.95	6.77
Liquid Assets/TA	4287	11.10	12.57	0.03	91.14
Market Beta	4287	0.80	0.66	-3.06	7.81
Controlling Shareholders	4287	0.19	0.39	0	1
Foreign Ownership	4287	0.04	0.20	0	1
GDP/Capita	4287	10.24	0.79	7.37	10.89
GDP Growth	4287	2.89	2.00	-10.90	9.82
Inflation	4287	2.86	2.05	-0.89	25.87
Real Interest Rate	4287	3.63	4.71	-10.03	47.33
Shareholder Rights	4287	4.10	1.29	0	5
Creditor Rights	4287	1.68	1.07	0	4
CRS	4287	2.62	0.61	1	3
Total FL	4287	16.85	2.06	10	18

The summary statistics are based on the observations used in the regressions, which the independent variables are lagged one year, and z-score, NPL/CAP, EC, TA/GDP, Cost/Income, GDP/Capital are in natural logarithm.