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# Bank Regulation and Market Discipline around the World

Kaoru Hosono [*], Hiroko Iwaki [†], Kotaro Tsuru [‡]

## Abstract

This paper investigates the effectiveness of depositor discipline and its relationship with various bank regulations and supervisions using a panel of about 17,000 bank-year data during 1992-2002 around 60 countries. We first theoretically show that bank regulations affect deposit interest rate and its sensitivity to bank risk through the bank insolvency risk and the fraction of deposit protection, among others. Then we find empirical evidence that strict regulations on bank activities and powerful supervisory authorities tend to reduce deposit interest rate and its sensitivity to bank risk, suggesting that they tend to reduce market discipline by depositors.

JEL Classification Codes: G21, G28

Key words: Market Discipline, Bank Regulation, Supervision, Deposit Insurance

## 1. Introduction

A series of banking crises that occurred in the last two decades around the world have shown that banking crises have systematic and disruptive effects on the financial system and the real economy as well. To avoid or lessen the likelihood of a banking crisis and its negative impact on the economy, almost all of the countries in the world have regulated banks by restricting their activities and entry, imposing capital adequacy requirements, and supervising operations and management. Most countries have financial safety net in place as well including explicit or implicit deposit insurance and resolution procedures of insolvent banks.

Recent banking crises, however, have also shown that these government regulations and safety nets have not successfully controlled bank risk-taking behavior. To maintain the safety and soundness of banking system, the disciplinary role of private agents, *market discipline*, is attracting more and more attention by policy-makers and expected to supplement bank regulations (e.g., Basel, 2003). Market discipline in the banking sector can be described as a situation in which private sector agents including de-

* Gakushuin University
Corresponding author: Mejiro 1-5-1, Toshima-ku, Tokyo,171-8588, Japan.
Tel. +81-3-5992-4909 Fax. +81-3-5992-1007, email kaoru.hosono@gakushuin.ac.jp
† Development Bank of Japan
‡ Research Institute of Economy, Trade and Industry

positors, creditors, and stockholders face costs that are increasing in the risks undertaken by banks and take action on the basis of these costs. For example, uninsured depositors, who are exposed to bank risk taking, may penalize riskier banks by requiring higher interest rates or by withdrawing their deposits (Martinez Peria and Schmukler (2001), p. 1030). Even insured depositors may respond to bank risk if there is some uncertainty or costs involved with recovering deposits in the case of bank failure. A high risk sensitivity of depositors implies that banks will be punished by paying higher deposit interest rate or attracting smaller amounts of deposit if they take excessive risk-taking. Hence, depositors who are highly sensitive to bank risk are likely to restrain banks' excessive risk-taking behavior.

Despite growing emphasis on market discipline among policy makers, its effectiveness has not been well examined empirically. Though there is growing literature on the effectiveness of market discipline in the U.S. and some other countries (see the surveys by Flannery, 1998 and Demirgüç-Kunt and Kane, 2002), it is not yet well understood under what conditions market discipline works well. One important exception is Demirgüç-Kunt and Huizinga (2003). They examined the effects of deposit insurance designs on depositor discipline and found that explicit deposit insurance reduced depositor's sensitivity to bank risk and that the more it did as its coverage was broader.

This paper aims at providing new cross-country evidence on the relationship between various bank regulations and depositor discipline. To increase depositors' sensitivity to bank risk and enhance market discipline, the proposed new capital adequacy framework (Basel II) focuses exclusively on disclosure. A well-developed accounting, audit and rating system is arguably a necessary condition for effective market discipline because without them, depositors would not be able to estimate bank risk accurately and be responsive to its changes. Then, how should we understand the relationship between other banking regulatory actions and depositor discipline? We theoretically show that depositors' risk sensitivity depends upon the probability of bank insolvency and the extent of deposit protection in the case of bank insolvency. Bank regulations affect depositor discipline either through bank insolvency risk or depositor protection.

Some bank regulations may successfully control bank risk, contribute to bank stability, and hence reduce depositors' sensitivity to bank risk. We call this mechanism *regulatory discipline* in the sense that regulatory authorities directly discipline banks. Dewatripont and Tirole (1994), among others, point out that each depositor has little incentive or poor ability to monitor a bank due to the informational complexity and free-ride problem. Based on these limitations to depositors' ability to monitor and control bank risk, they assert that regulatory authorities are supposed to act as a representative monitor of banks for the sake of depositors by regulating banks. This "representative hypothesis" is consistent with regulatory discipline view. On the other hand, some regulations and safety nets shield depositors from bank insolvency risk and losses, and thus reduce depositors' sensitivity to bank risk, finally encouraging excessive risk taking on the side of banks. We call this mechanism *regulatory shield*. Regulatory shields may be generated not only from explicit deposit insurance but also from bank regulations. Regulatory authorities may have an incentive to protect and bail out incumbent banks since by giving benefits to incumbent banks, regulators can extracts rents from them ("regulatory capture" hypothesis by Stigler (1971) or "tollbooth" hypothesis by Shleifer and Vishny (1998) and Djankov et al. (2002)). In addition, regulators may not want to lose their reputation as a supervisor ("reputation concern", Boot and Thakor (1993)). Bank regulations

may lower market discipline either through “regulatory discipline” or “regulatory shield.”

This paper complements Demirgüç-Kunt and Huizinga (2003) by examining broader conditions for depositor discipline using a larger sample set (a panel of about 17,000 bank-year data during 1992-2002 across 60 countries). We investigate theoretically and empirically the effects of bank regulations and safety nets on depositors’ sensitivity to bank risk. We measure depositor’s sensitivity to bank risk by the magnitude of an increase in the risk premium of interest rates or a change in deposits outstanding responding to a marginal increase in bank risk as in most of the preceding studies including Demirgüç-Kunt and Huizinga (2003). This paper also complements Kane and Klingebiel (2004), who examined how policy actions undertaken at the outset of crises affected the damage of the crises on a country’s financial sector and on its real economy, finding that the most important steps were market-mimicking actions that promptly estimated and allocated losses during the early stages of a crisis. We focus on the potential role of market discipline in preventing crises, while they focus on ex-post policy actions to lessen the damages of crises.

This paper is also related to Barth, Caprio and Levine (2004), abbreviated by BCL hereafter, who assess bank regulations from the viewpoint of its effects on bank efficiency, performance or stability.[1] We focus on the effects of bank regulations on market discipline rather than its overall effects on bank performance.

In section 2, we present our theoretical models and working hypothesis concerning how bank regulations and other institutional factors affect the risk sensitivity of deposit interest rates. Sections 3 and 4 describe our empirical methodology and data set, respectively. Section 5 presents our empirical results on the risk sensitivity of deposit interest rate. Section 6 examines the risk sensitivity of deposit growth. Section 7 concludes.

## 2. A Model of Depositor Discipline

In this section, we present a simple model to show how the deposit interest rate is affected by bank risk and government policies.

We consider a one-period model in which a bank, risk-neutral depositors and the government exist. The bank has an asset that is normalized to one at the beginning of period. It has initial capital of $e$ and finances the remaining amount of $1-e$ by issuing deposits by promising the gross interest rate of $r_D$. At the end of the period, the value of asset turns out to be $v$, whose cumulative distribution, $F(v)$, and its density, $f(v)$, are known to everyone at the beginning of the period. Depositors incur a cost of $m$ if the bank is insolvent. This may be interpreted as a verification cost that depositors incur to verify $v$ as in Townsend (1979) and other costly state verification (CSV) models. It may also be interpreted as restitution cost that depositors incur in the case of bank insolvency due to the time and costs needed to recover deposits as is stressed by Cook and Spellman (1994). If $v<(1-e)r_D$, then the bank is insolvent without the government’s support. The government plays two roles. It affects $F(v)$ by regulating banking activities. The government also protects depositors either by explicit deposit insurance or by implicit bailout

1 See also Cull, Senbet and Sorge (2005) for empirical evidence on the link between deposit insurance and financial stability and development.

policy. Suppose that the government pays $S(v)$ in the case of insolvency after $v$ realizes. Whether the government has to pay a verification cost or not does not matter here. $S(v)$ is known to everyone at the beginning of the period. There is a safe asset whose gross interest rate is $r$.

We analyze the determination of deposit interest rate assuming that $F(v)$ is predetermined. That is, we analyze the situation after the bank determines its portfolio, (anticipating its effect on the deposit interest rate) to focus on the depositors' response to bank portfolio. We do not take up the free-ride problem associated with the depositors' monitoring, either. This is not because we think that these problems are unimportant but because our purpose here is to derive empirical implications that we can test. If the free-riding problem is so severe that no depositor monitors bank risk, the deposit interest rate would be insensitive to bank risk at all.

The expected return to one unit of deposits is

$$(1)\quad R \equiv r_D\{1-F[(1-e)r_D]\} + \frac{1}{(1-e)}\int_0^{(1-e)r_D} f(v)\{v+S(v)-m\}\,dv$$

, where the first term is the expected return in the non-default region and the second term is that in the default region. The arbitrage between the deposit and the safe asset implies that

$$(2)\quad R=r$$

The gross interest rate to deposits, $r_D$, is determined by equation (2). If there are multiple solutions, we assume that the lowest value is chosen. Considering that a lower deposit interest rate increases bank profits, we think that this assumption is reasonable.

To make the analysis simple, we specify $F(v)$ and $S(v)$. First we assume that the value of asset is distributed uniformly on $[0, 2\mu]$, so that

$$(3)\quad F(v)=\frac{v}{2\mu}\ .$$

A problem of the uniform distribution is that a higher $\mu$ implies a higher expected return and a higher variance as well. However, $\mu$ affects the deposit interest rate mainly through the probability of insolvency. Note that the probability of insolvency is $\frac{(1-e)r_D}{2\mu}$. A higher value of $\mu$ reduces the insolvency risk and thereby the deposit interest rate as we see below. Next we assume that the government repays depositors a fraction of $\alpha \le 1$ of bank debt in the case of insolvency. That is,

$$(4)\quad S(v)=\alpha(1-e)r_D - v$$

If the government sets $\alpha$ to be equal to one and $m$ equal to zero, it fully compensates depositors either by an efficient blanket guarantee of deposit insurance or recapitalization to avoid bank failure. In this case, $r_D$ is simply equal to $r$. If the government sets $\alpha$ less than one, we obtain $r_D$ by substituting equations (3) and (4) into equation (2) as follows,

(5) $R(r_D;\mu,\alpha,e,m)=\left(1-\frac{m}{2\mu}\right)r_D-\frac{(1-\alpha)(1-e)r_D^2}{2\mu}=r$

In this section we analyze a situation where there is no credit rationing by assuming that there is a real value of $r_D$ that satisfies equation (5). In section 6, we discuss the credit rationing case where depositors respond to bank risk by adjusting deposit quantity. We obtain the following equilibrium value of $r_D$:

(6) $r_D(\mu,\alpha,e,m)=\frac{\left(\mu-\frac{m}{2}\right)-\sqrt{\left(\mu-\frac{m}{2}\right)^2-2(1-\alpha)(1-e)\mu r}}{(1-\alpha)(1-e)}$

From equation (6), it is straightforward to show that $\frac{\partial r_D}{\partial e}<0$. Banks with a high initial capital faces a low probability of insolvency and hence a low risk premium.

Now we proceed to analyze the effects of various bank regulations and other institutional factors on the deposit interest rate and its sensitivity to bank capital. We consider that bank regulations and legal environment affect the parameters $(e,\mu,\alpha,m)$ and thereby the deposit interest rate and its sensitivity to bank capital. One institutional factor may affect two or more of these parameters. Deposit insurance, for example, would directly increase the proportion that the government pays to depositors, $\alpha$, but it may also induce a bank's excessive risk-taking behavior, leading to a high insolvency risk, that is, lower $\mu$. After analyzing the effect of each parameter on the deposit interest rate, we discuss the effect of each institutional factor on the deposit interest rate through the parameters.

Result 1: $\frac{\partial r_D}{\partial e}<0$ , $\frac{\partial^2 r_D}{\partial e^2}>0$

A policy that tends to increase the capital ratio would not only decrease the deposit interest rate but also its sensitivity to bank capital as is illustrated by Figure 1.

Result 2: $\frac{\partial r_D}{\partial \mu}<0$ and $\frac{\partial^2 r_D}{\partial \mu \partial e}>0$ .

A policy that lowers the insolvency risk of banks would reduce the deposit interest rate and its sensitivity to bank equity.

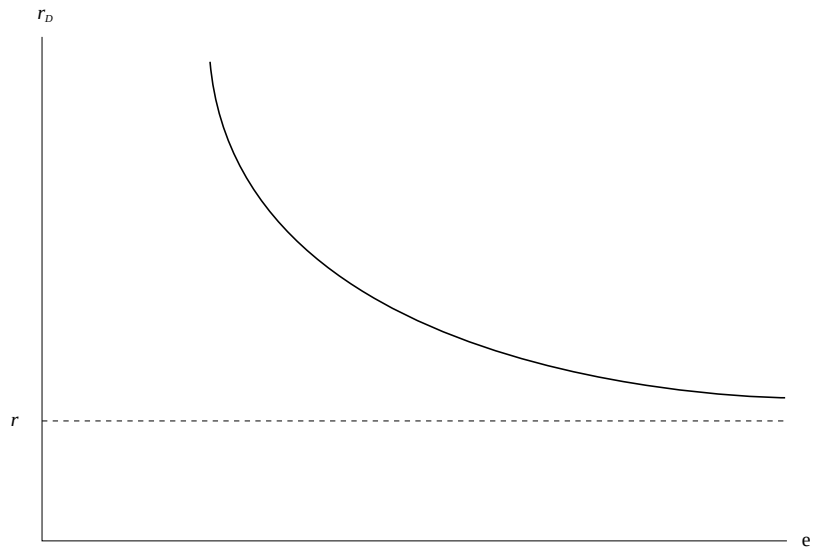
Result 3: $\frac{\partial r_D}{\partial \alpha}<0$ and $\frac{\partial^2 r_D}{\partial \alpha \partial e}>0$

The higher proportion the government compensates depositors' losses in the case of bank insolvency, the lower the deposit interest rate and its sensitivity to bank equity given the insolvency risk and other parameters held constant.

Result 4: $\frac{\partial r_D}{\partial m}>0$ and $\frac{\partial^2 r_D}{\partial m \partial e}<0$

In a country where the verification/restitution cost in the case of insolvency is low, the deposit interest

Figure 1. Bank equity and deposit interest rate




and its sensitivity to bank capital are low.

So far, we have assumed that banks have no market power, as the expected rate of return on deposits equals the alternative return to safe asset. It is easy to allow for a market power of banks. Suppose that the bank has to pay the deposit interest rate so that its expected rate of return is $r-s$, where a higher $s \geq 0$ indicates a stronger market power of the bank and hence a lower expected ruturn to its deposits. Then, the following results hold.

Result 5: $\frac{\partial r_D}{\partial s} < 0$ and $\frac{\partial^2 r_D}{\partial s \partial e} > 0$

If a bank has a strong market power in the deposit market, the deposit interest rate is low and its sensitivity to bank capital is also low.

Several points are noteworthy concerning our theoretical predictions. First, our results on the signs of the second-order derivatives such as $\frac{\partial^2 r_D}{\partial e^2} > 0$ and $\frac{\partial^2 r_D}{\partial \mu \partial e} > 0$ certainly depend upon the distribution of the return, $F(v)$, though we believe that they hold for some distributions other than the uniform distribution. It should be noted, however, that a similar prediction that credit constraints become tighter as net worth becomes smaller ($\frac{\partial^2 r_D}{\partial e^2} > 0$) has been pointed out and tested using non-financial firms' data by preceding studies (e.g., Bernanke, Gertler, and Gilchrist, 1996; Hosono and Watanabe, 2002).

Second, a marginal increase in $e$, $\mu$, $s$, and $\alpha$ and a marginal decrease in $m$ decrease the probability of insolvency, $\frac{(1-e)\, r_D(e, \mu, \alpha, m)}{2\mu}$, given the other parameters constant, either directly (in the case of $e$) or indirectly through a decrease in the deposit interest rate (in the case of all the parameters). In practice, however, these parameters may depend upon each other. Especially, the parameter of insol-

vency risk, $\mu$, represents the bank's choice of asset portfolio, which is likely to be affected by the initial capital ratio, $e$, the degree of deposit protection, $\alpha$, and the restitution/verification costs, $m$. Taking this possibility into consideration, we discuss how various bank regulations affect these parameters and thus deposit interest rate and its risk sensitivity below.

Finally, we do not consider that the government can fully control or precisely choose the parameters. We do consider that the government regulations and legal environment can affect the parameters. For example, depositors of a failed bank have to fill out forms to obtain their funds from the deposit insurance agency after the bank failure. Though the government cannot control (or even measure) these restitution costs, $m$, deposit insurance design and legal quality would affect the restitution costs through the bureaucratic delay and the credibility of deposit insurance.

### A. Regulations on bank activities and banking-commerce links

Regulations on bank activities and banking-commerce links affect the sensitivity of deposit interest rate to bank risk through two different channels. On one hand, regulations on bank activities affect bank profitability and insolvency risk. Whether they reduce or increase bank profitability and risk is theoretically ambiguous. They may alleviate the conflicts of interest between banking and security underwritings, reduce the opportunities to engage in risky business such as real estate investment, and prevent banks to be as powerful as to capture regulatory bodies. On the other hand, they may deprive banks of the opportunities to diversify asset portfolios or to exploit economies of scope and scale, thus leading to a high probability of bank failure. If regulations on bank activities effectively lower the probability of bank failure, i.e, increase $\mu$, deposit interest rate would be lower and less sensitive to bank risk, and vice versa (Result 2).

On the other hand, regulations on bank activities are often implemented arbitrarily by regulatory bodies and hence likely to lead to a forbearance policy. In that case, depositors are insensitive to bank risk since a forbearance policy or a bailout policy will decrease the costs that depositors incur in the case of bank insolvency, leading to a higher $\alpha$ and reducing deposit interest rate and its risk sensitivity (Result 3).

Therefore, if we find that regulations on bank activities tend to reduce deposit interest rate and its sensitivity to bank equity, we cannot judge whether they effectively control bank risk or they are associated with a forbearance policy, i.e. they affect the sensitivity from the route of $\mu$ or $\alpha$.

### B. Regulations on capital adequacy

Minimum capital requirements tend to increase the average bank capital level and lower the insolvency risk. Given other conditions unchanged, deposit interest rate would be lower and less sensitive to bank risk as capital regulations become stricter (Result 1).

Capital requirements also affect the probability of insolvency by changing bank risk-taking behavior. The effects of capital adequacy requirements on bank risk-taking behavior are theoretically ambiguous. Merton (1977), among others, insist that capital requirements reduce bank risk taking under deposit insurance because the option value of deposit insurance decreases as leverage decreases. However, capital requirements may change the scale of banks and also change the asset risk in ambiguous ways (see e.g., Koehn and Santomero, 1980)[2]. Moreover, as Hellman, Murdock and Stiglitz (2000) argue, if equity is

more expensive than safe assets, capital requirements have a perverse effect of harming banks' franchise values, and hence they may encourage gambling. If capital requirements reduce bank risk-taking behavior, they reduce the insolvency risk (i.e., increase $\mu$) and vice versa. Therefore, their effect on the level and risk-sensitivity of deposit interest rate are also ambiguous (Result 2).

Having multiple capital zones as in the U.S.'s prompt corrective action may reduce greatly the moral hazard problem of just one zone capital requirements. Because we do not have data on the number of capital zones, we have to ignore this distinction, though it would make an important difference concerning the effects of capital regulations on bank risk-taking and on depositors' risk sensitivity.

### C. Regulations on bank entry

Restrictions on bank entry tend to increase the monopolistic rents of the incumbent banks, leading to a higher $\mu$. In addition, regulations on bank entry may increase the market power of the bank, leading to a higher $s$. If banks respond to a large franchise value by prudent behavior, restrictions on bank entry will further lower the probability of bank failure. On the other hand, a small number of large banks may be easier to induce the government to implement a forbearance policy, leading to a higher $\alpha$. In any case, deposit interest rate would be lower and less sensitive to bank risk under strong regulations on bank entry (Results 2, 3 and 5).

### D. Deposit Insurance

Explicit deposit insurance reduces the losses that depositors incur in the case of bank insolvency, leading to a higher $\alpha$ and thus lowering deposit interest rate and its sensitivity to bank risk (Result 3). On the other hand, deposit insurance may induce a bank's excessive risk-taking behavior, leading to a lower $\mu$ and hence increasing deposit interest rate and its sensitivity to bank risk (Result 2).

Consequently, it is theoretically ambiguous whether explicit deposit insurance reduces or increases the level and sensitivity of deposit interest rate to bank risk. Demirgüç-Kunt and Huizinga (2003) found that explicit deposit insurance decreased the level and sensitivity of deposit interest rate to bank risk measures and that this tendency was stronger for more generous deposit insurance, using a panel of about 6500 bank-year data during 1990-97 around 52 countries. We extend sample countries and periods to reexamine their results.

### E. Supervision

Supervisory bodies have the authority to take specific actions to prevent and correct its risk taking behavior and the related undesirable outcome on the ground that outside private agents do not have information or power necessary to control bank risk. In particular, prompt corrective action, i.e. a rule establishing pre-determined levels of bank solvency deterioration that forces automatic intervention, limits excessive risk-taking and thus lower the probability of insolvency, leading to a higher $\mu$. At the same time, prompt corrective action also tends to reduce the problem of regulatory forbearance by inducing

2 See also Keeley and Furlong (1990), who criticize the Markowitz two-parameter portfolio model adopted by Koehn and Santomero (1980).

supervisors to be more proactive early on, leading to a lower $\alpha$. Thus, the effect of supervisory actions on deposit interest rate and its risk sensitivity are theoretically ambiguous (Results 2 and 3).

Some supervisory actions are not taken under a pre-determined rule. To extract rents from the banking industry, strong supervisors may use their discretional power to benefit the banking sector and are more likely to bail out an insolvent bank and protect the depositors consequently, leading to a higher $\alpha$. This effect, given other conditions unchanged, will make deposit interest rate lower and less sensitive to bank risk (Result 3).

## F. Accounting, disclosure, audit and ratings

In this subsection, we slightly change the above model to consider imperfect accounting and disclosure. So far we have assumed that depositors exactly know the bank's net worth, $e$. However, in many countries, accounting is far from complete. Depositors do not know precisely the bank's net worth at least for some time. Now we assume that depositors receive an imprecise signal of bank net worth and infer the true net worth based on the signal.

Suppose that depositors know that a bank is a good bank that has a net worth of $e_G$ with the probability of $\beta$ and that it is a bad bank that has a net worth of $e_B$ with the probability of $(1-\beta)$. Without a loss of generality, we assume that $e_G > e_B$. Depositors receive a correct signal with the probability of $\pi$ and a wrong signal with the probability of $(1-\pi)$ for each type. If, for example, depositors receive a good signal, the probability that the bank is really good is given by

$$(7)\ \Pr ob[Bank=G \mid Signal=G]=\frac{\beta\pi}{\beta\pi+(1-\beta)(1-\pi)}$$

The probability that the bank is bad though depositors receive a good signal is

$$(8)\ \Pr ob[Bank=B \mid Signal=G]=\frac{(1-\beta)(1-\pi)}{\beta\pi+(1-\beta)(1-\pi)}$$

The deposit interest rate for a bank with a good signal, denoted by $\hat{r}_G$, is determined by

$$(9)\ \Pr ob[Bank=G \mid Signal=G]\,R(\hat{r}_G;e_G)+\Pr ob[Bank=B \mid Signal=G]\,R(\hat{r}_G;e_G)=r$$

, where $R(\bullet)$ is given by equation (5).
Substituting equations (7) and (8) into equation (9), we get

$$(10)\ \hat{r}_G=\frac{\left(\mu-\frac{m}{2}\right)-\sqrt{\left(\mu-\frac{m}{2}\right)-2(1-\alpha)(1-\hat{e}_G)\mu r}}{(1-\alpha)(1-\hat{e}_G)}$$

, where $\hat{e}_G$ is the expected value of $e$ given the good signal:

$$(11)\ \hat{e}_G=\frac{\beta\pi e_G+(1-\beta)(1-\pi)e_B}{\beta\pi+(1-\beta)(1-\pi)}$$

Similarly, the deposit interest rate for a bank with a bad signal, denoted by $\hat{r}_B$ is determined by equation (6), where $e$ is replaced by

$$(12)\ \hat{e}_B = \frac{\beta(1-\pi)e_G + (1-\beta)\pi e_B}{\beta(1-\pi)+(1-\beta)\pi}$$

Here we have assumed that the asymmetric information problem caused by the imperfect signal is *not* so serious that it induces an adverse selection problem in the sense that good banks exit from the market.

Result 6. For $\pi > \frac{1}{2}, \frac{\partial\left\{\frac{-(\hat{r}_G - \hat{r}_B)}{e_g - e_b}\right\}}{\partial\pi} > 0$

For $\pi > \frac{1}{2}$, $\hat{e}_G > \hat{e}_B$ and hence $\hat{r}_G < \hat{r}_B$. In addition, we can show that the absolute value of $\hat{r}_G - \hat{r}_B$ is an increasing function of $\pi$. As the signal becomes accurate, the deposit interest rates determined based on the signal approach to those determined based on the true value of capitals. Therefore, the sensitivity of the deposit interest rate to the true value of bank equity, $\frac{-(\hat{r}_G - \hat{r}_B)}{e_g - e_b}$, increases as the accounting and disclosure develops and the signal becomes accurate (Figure 2). This is the route through which we expect disclosure to enhance market discipline. The difference in deposit interest rates between good and bad banks may be unlikely to be detected, however, if only imprecise signals are available to researchers as well.

### G. Government ownerships of banks

Whether banks owned by government are more or less likely to engage in prudential management is not theoretically clear. They may be more effectively controlled by regulatory bodies than privately-owned banks, leading to a higher $\mu$. On the other hand, they may be subject to a soft budget constraint and hence tend to take excessive risk-taking, leading to a lower $\mu$. Therefore, their impact on deposit interest rate and its risk-sensitivity are also ambiguous (Result 2).

When government-owned banks become insolvent, they are more likely to be bailed out, leading to a higher $\alpha$. In such a case, greater government ownership is associated with the lower value of deposit interest rate and its lower risk sensitivity (Result 3).

### H. Contract enforcement and protection of property rights

Strong enforcement of contracts and powerful protection of property rights are likely to reduce various transaction costs associated with law enforcement for the protection of properties. In our theoretical model, improvements in legal system tend to decrease the verification or restitution costs, , in the case of bank insolvency. Such legal environment may also enable regulatory authorities to effectively control banks, leading to a higher . As a result, deposit interest rate would be lower and less sensitive to bank risk in a country with a high legal quality (Results 2 and 4).

## 3. Empirical Methodology

We examine how institutional differences across countries affect depositors' sensitivity to bank risk. Pooling all the bank-year data across countries, we estimate the following equation using OLS, follow-

ing Demirgüç-Kunt and Huizinga (2003):

$$
\begin{aligned}
Interest\ Rate_{i,j,t} = {} & \beta' \, Bank\ Fundamentals_{i,j,t-1} \\
& + \alpha' \, Institutions_{j,t} \\
& + \gamma' \, Bank\ Fundamentals_{i,j,t-1} * Institutions_{j,t} \\
& + \delta Macroeconomic\ Variables_{j,t-1} + \varepsilon_{i,j,t}
\end{aligned} \tag{13}
$$

, where the subscripts $i$ , $j$ , $t$ denote bank, country, and year index respectively. is the average interest rate on deposits adjusted by inflation rate. is a vector of the measures of bank risk and other bank characteristics described below. We use one-period lagged values of *Bank Fundamentals* to take into account that depositors know bank characteristics with a certain delay. We measure the average interest rates by dividing total interests paid on deposits by deposits outstanding. If depositors respond to bank risk, the coefficients on the inverse measures of bank risk characteristics in equation (13) are negative.

Bank fundamentals include a bank risk measure and other control variables. Bank risk is (inversely) measured either by liquid assets (Liquidity), operating income (Profit), or equity (Equity), as a proportion of total assets. Though our theoretical analysis developed in Section 2 focuses on bank equity as a risk measure, we empirically examine a broader set of risk measures. These three accounting measures are commonly used in preceding cross-country studies (e.g, Martinez-Peria and Schmukler, 2001; Demirgüç-Kunt and Huizinga, 2003). Considering poor accounting practices of most developing countries, these preceding studies regard Liquidity as the best risk measure among the three. Demirgüç-Kunt and Huizinga (2003) points out that Equity and Profit are subject to manipulation and tend to be overstated at weak banks. Controlling variables are overhead costs (OVERHEAD) as a proportion of total assets, the logarithm of total assets to GDP (ASSETSIZE), and the ratio of customer and short-term funding to total interest bearing liability (MATURITY). ASSETSIZE may either lower or heighten the deposit interest rate. Depositors of a large bank may be protected implicitly by a “too-big-to-fail policy” and hence require a low risk premium. If a large bank takes excessive risk under the too-big-to-fail policy, however, depositors would require a higher risk premium. MATURITY is added to the interest rate equation to control for the difference in interest rates across deposits with different maturities.

$Institutions_{j,t}$ denotes bank regulation and other institutional indexes that may affect deposit interest rate and its risk sensitivity as is discussed in section 2. The interaction terms of and represent how institutional variables affect depositors’ sensitivity to bank risk. The following partial derivatives reveal this point,

$$
\frac{\partial Interest\ Rates_{i,j,t}}{\partial Bank\ Fundamentals_{i,j,t-1}} = \beta + \gamma Institutions_{j,t} \tag{14}
$$

$MacroeconomicVariables_{j,t}$ include inflation rate, growth rate of real per capita GDP, and government bill rate adjusted by inflation rate.

There are two potential pitfalls or biases when we estimate equation (13) with OLS as is suggested by Demirgüç-Kunt and Huizinga (2003). First, Liquidity may be endogenous, because a risky bank may hold more liquid assets to avoid higher interest rates. Suppose that a higher value of $\varepsilon$ in equation (13) first leads to a higher value of Interest Rate. This then leads to a higher value of Liquidity because of the

possible endogeneity of this latter variable. This makes the coefficient on Liquidity less negative. So the absolute value of the coefficient may be biased downwards. In addition, the deposit interest rate may be correlated with Liquidity simply due to reserve requirements even without market discipline. Following Demirgüç-Kunt and Huizinga, we deal with these problems by instrumenting for Liquidity using exogenous influences on bank operations such as macro shocks and the Reserve rate defined by total bank reserves (at the macro level) divided by total bank deposits (at the macro level). Specifically, we perform a two-stage regression where the first regression is as follows,

$$(15)\quad \begin{aligned} Liquidity_{i,j,t} = {} & \alpha + \beta_1 OVERHEAD_{i,j,t} + \beta_2 MATURITY_{i,j,t} + \beta_3 INFLATION_{j,t} + \beta_4 GRONWTH_{j,t} \\ & + \beta_5 GDP/cap_{j,t} + \beta_6 GOVERMENT\ RATE_{j,t} + \beta_7 RESERVE\ RATE_{j,t} + \varepsilon_{i,j,t} \end{aligned}$$

Then, we replace Liquidity by its predicted value as a regressor in equation (13).

The second problem is that we do not control for deposit growth in the deposit interest rate equation (13), though market discipline works through both interest rate and deposit quantity adjustment. We estimate the following equation for the growth rate of deposits outstanding, $\triangle Deposits$, and add its predicted value to the regressors in equation (13):

$$(16)\quad \begin{aligned} \triangle Deposit_{i,j,t} = {} & \alpha + \beta_1 OVERHEAD_{i,j,t} + \beta_2 INFLATION_{j,t} + \beta_3 GROWTH_{j,t} + \beta_4 GDP/cap_{j,t} \\ & + \beta_5 ASSETSIZE_{i,j,t} + \varepsilon_{i,j,t} \end{aligned}$$

In sum, as a robustness check, we estimate equation (13) with replaced by the predicted value of *Liquidity* and the predicted value of $\triangle Deposit$ added as a regressor.

One may be concerned about a possibility that a riskier bank may be willing to offer a higher deposit interest rate and to increase its deposit and thus assets in order to undertake a gamble for resuscitation. If this is the case, a positive correlation between deposit interest rates and bank risk measures does not necessarily imply market discipline. However, there is another possibility that a riskier bank may be willing to offer a lower interest rate and to decrease its deposit and thus assets in order to maintain its capital ratio above the minimum requirement level. In this case, a positive correlation between deposit interest rates and bank risk measures strongly suggests market discipline. Though we do not completely deal with this kind of identification problem and its associated bias, like most of the preceding studies, we will see later that there is no systemic correlation between deposit growth rates and bank risk measures, suggesting that there seems to be no significant problem in estimating equation (13).

Another potential problem is that if deposit interest rates are regulated either explicitly or implicitly, the coefficient on bank risk measures in equation (13) is likely to be underestimated, because depositors who cannot require a sufficiently high risk premium are likely to withdraw deposits from a risky bank. All of the countries in our sample had liberalized regulations on deposit interest rates before the sample periods began as far as those countries that are examined in Demirgüç-Kunt and Detragiache (1998, Table 1). However, there may be still some kind of implicit restrictions on deposit interest rates. To take this possibility into consideration, we estimate the growth rate of deposits in Section6.

Table 1. Definitions of Bank Data

| dependent variables | Definition |
|---|---|
| Deposit Growth | Rate of Change in Total Deposits (6080) / GDP Deflators |
| Deposit Interest Rate | Interest Expense (6250) / (Customer & Short Term Funding (2030) + Other Funding (2035))- Rate of change in GDP deflators |

| Bank risk variable | Definition |
|---|---|
| Liquidity | Liquid Assets (2075) / Total Assets (2025) |
| Profit | Operating Income (2190) / Total Assets (2025) |
| Equity | Equity (2055) / Total Assets (2025) |

| Others | Definition |
|---|---|
| Overhead | Overheads (2090) / Total Assets (2025) |
| Shrot term debt / total debt | Customer & Short Term Funding (2030) / (Total Liability (6290) - Non-Interest-Bearing Liability (2040)) |
| Asset size | Logarithm of (Total Assets(2075)/Nominal GDP) |

Note
1. Numbers in parentheses denote code numbers from BankScope
2. GDP deflators are from International Financial Statistics by IMF.
3. GDP deflators are replaced with CPI for Bahamas, Bulgaria, Kenya and Luxenburg due to data avaialbility.
4. Nominal GDP is from World Bank's World Development Indicators.

# 4. Data

## 4.1 Sample Selection and Bank-Level Variables

Our main data source of bank financial statements is BankScope compiled by Fitch IBCA. We select countries that contain 20 banks or more. We exclude the bank-year samples that displayed 50% or more growth rate of deposits because they are likely to have been involved with mergers or acquisitions. We also exclude obvious data errors, including the samples that displayed -50 or less growth rate of deposits, that displayed no loan outstanding, and that displayed 100% or more absolute values of real deposit interest rate. We do not restrict sample banks to commercial banks but include savings banks, cooperative banks, real estate mortgage banks, medium and long-term credit banks, non-banking credit institutions, specialized governmental credit institutions, and multi-lateral governmental banks. We are left with 6222 banks across 60 countries. The sample covers the period of 1992-2002. The longest period in a country is 11 years. The number of bank-year samples that we can use for our basic estimation is 26397, though the actual sample size that we use for estimation is smaller due to the limited availability of institutional variables. The definitions of bank-level variables are given by Table 1. Deposit interest rate is defined as the average interest rate of bank funding, i.e., the sum of "customer & short-term funding" and "other funding." Though our definition is the same as in Demirgüç-Kunt and Huizinga (2003) and includes bond interest rates, the ratio of "other funding" to "customer & short-term funding" is as small as 6% on average. Descriptive sample statistics of bank-level variables are given by Table 2 by country.

Table 2. Bank Characteristics by Country

| | Deposit growth | Interest rate | Equity | Liquidity | Profit | OVERHEAD | MATURITY | ASSETSIZE |
|---|---|---|---|---|---|---|---|---|
| AUSTRALIA | 0.03 | 0.05 | 0.07 | 0.07 | 0.03 | 0.02 | 0.86 | 0.03 |
| AUSTRIA | 0.05 | 0.02 | 0.06 | 0.15 | 0.04 | 0.02 | 0.88 | 0.00 |
| BAHAMAS | 0.04 | 0.05 | 0.16 | 0.44 | 0.07 | 0.04 | 0.97 | 0.14 |
| BANGLADESH | 0.11 | 0.03 | 0.04 | 0.21 | 0.03 | 0.02 | 1.00 | 0.02 |
| BELGIUM | 0.04 | 0.03 | 0.07 | 0.16 | 0.03 | 0.02 | 0.92 | 0.00 |
| BULGARIA | 0.02 | -0.13 | 0.17 | 0.46 | 0.10 | 0.08 | 0.98 | 1.02 |
| CANADA | 0.03 | 0.03 | 0.08 | 0.05 | 0.03 | 0.02 | 0.98 | 0.01 |
| CHILE | 0.04 | 0.02 | 0.18 | 0.26 | 0.07 | 0.04 | 0.90 | 0.04 |
| CHINA-PEOPLE'S REP. | 0.15 | 0.02 | 0.10 | 0.30 | 0.03 | 0.01 | 0.87 | 0.04 |
| COLOMBIA | 0.01 | -0.01 | 0.13 | 0.14 | 0.11 | 0.09 | 0.91 | 0.01 |
| COSTA RICA | 0.09 | 0.01 | 0.20 | 0.29 | 0.08 | 0.06 | 1.00 | 0.01 |
| CROATIA | 0.08 | -0.02 | 0.19 | 0.24 | 0.08 | 0.05 | 0.87 | 0.02 |
| CZECH REPUBLIC | 0.07 | 0.01 | 0.07 | 0.22 | 0.06 | 0.05 | 0.95 | 0.04 |
| DENMARK | 0.05 | 0.01 | 0.13 | 0.23 | 0.05 | 0.04 | 0.95 | 0.02 |
| DOMINICAN | 0.12 | 0.02 | 0.10 | 0.27 | 0.09 | 0.07 | 0.86 | 0.03 |
| EGYPT | 0.07 | 0.02 | 0.07 | 0.16 | 0.04 | 0.01 | 0.96 | 0.04 |
| FRANCE | 0.03 | 0.05 | 0.06 | 0.11 | 0.04 | 0.03 | 0.89 | 0.00 |
| GERMANY | 0.04 | 0.03 | 0.09 | 0.32 | 0.04 | 0.03 | 0.95 | 0.00 |
| GREECE | 0.06 | 0.02 | 0.09 | 0.34 | 0.05 | 0.03 | 0.99 | 0.00 |
| GUATEMALA | 0.07 | 0.01 | 0.07 | 0.17 | 0.07 | 0.06 | 0.80 | 0.01 |
| HONDURAS | 0.08 | -0.02 | 0.13 | 0.23 | 0.08 | 0.06 | 0.88 | 0.03 |
| HONG KONG | 0.01 | 0.06 | 0.19 | 0.34 | 0.04 | 0.02 | 0.90 | 0.04 |
| HUNGARY | 0.09 | -0.05 | 0.11 | 0.08 | 0.08 | 0.05 | 0.92 | 0.02 |
| INDIA | 0.11 | 0.02 | 0.06 | 0.35 | 0.04 | 0.03 | 0.97 | 0.01 |
| INDONESIA | 0.07 | -0.06 | 0.07 | 0.14 | 0.05 | 0.03 | 0.81 | 0.01 |
| IRELAND | 0.12 | 0.00 | 0.09 | 0.22 | 0.02 | 0.01 | 0.97 | 0.12 |
| ITALY | 0.04 | 0.01 | 0.12 | 0.34 | 0.04 | 0.03 | 0.80 | 0.00 |
| JAPAN | 0.02 | 0.02 | 0.05 | 0.20 | 0.02 | 0.02 | 0.97 | 0.01 |
| KENYA | 0.03 | 0.04 | 0.13 | 0.35 | 0.10 | 0.06 | 0.97 | 0.02 |
| KOREA REP. OF | 0.09 | 0.04 | 0.05 | 0.12 | 0.03 | 0.02 | 0.84 | 0.06 |
| LATVIA | 0.11 | -0.04 | 0.10 | 0.10 | 0.08 | 0.08 | 0.98 | 0.02 |
| LUXEMBOURG | 0.02 | 0.04 | 0.06 | 0.45 | 0.02 | 0.01 | 0.92 | 0.01 |
| MALAYSIA | 0.08 | 0.02 | 0.08 | 0.21 | 0.04 | 0.02 | 0.99 | 0.05 |
| MEXICO | 0.04 | 0.10 | 0.13 | 0.24 | 0.06 | 0.05 | 0.95 | 0.01 |
| NETHERLANDS | 0.05 | 0.04 | 0.08 | 0.31 | 0.03 | 0.02 | 0.87 | 0.03 |
| NIGERIA | 0.10 | -0.12 | 0.12 | 0.53 | 0.14 | 0.09 | 0.99 | 0.01 |
| NORWAY | 0.05 | 0.01 | 0.08 | 0.06 | 0.04 | 0.02 | 0.82 | 0.03 |
| PAKISTAN | 0.09 | 0.00 | 0.07 | 0.38 | 0.04 | 0.03 | 0.98 | 0.02 |
| PANAMA | 0.07 | 0.05 | 0.09 | 0.26 | 0.03 | 0.02 | 0.96 | 0.07 |
| PARAGUAY | 0.03 | 0.13 | 0.17 | 0.42 | 0.10 | 0.10 | 0.96 | 0.02 |
| PERU | 0.10 | 0.01 | 0.12 | 0.19 | 0.09 | 0.08 | 0.98 | 0.01 |
| PHILIPPINES | 0.07 | -0.01 | 0.16 | 0.28 | 0.06 | 0.04 | 0.97 | 0.03 |
| POLAND | 0.14 | 0.00 | 0.12 | 0.11 | 0.06 | 0.04 | 0.99 | 0.01 |
| PORTUGAL | 0.06 | 0.00 | 0.06 | 0.11 | 0.03 | 0.02 | 0.85 | 0.00 |
| ROMANIA | -0.09 | -0.31 | 0.21 | 0.19 | 0.14 | 0.07 | 0.99 | 0.02 |
| RUSSIAN | 0.02 | -0.32 | 0.17 | 0.39 | 0.09 | 0.06 | 0.97 | 0.04 |
| SINGAPORE | 0.11 | 0.04 | 0.13 | 0.19 | 0.03 | 0.01 | 0.99 | 0.11 |
| SLOVAKIA | 0.04 | 0.04 | 0.05 | 0.39 | 0.07 | 0.04 | 0.97 | 0.06 |
| SLOVENIA | 0.12 | -0.04 | 0.13 | 0.15 | 0.06 | 0.04 | 0.95 | 0.03 |
| SOUTH AFRICA | 0.08 | 0.02 | 0.11 | 0.17 | 0.08 | 0.05 | 0.91 | 0.05 |
| SPAIN | 0.05 | 0.00 | 0.10 | 0.16 | 0.04 | 0.03 | 0.94 | 0.00 |
| SWEDEN | 0.00 | 0.00 | 0.05 | 0.17 | 0.03 | 0.02 | 0.64 | 0.13 |
| SWITZERLAND | 0.03 | 0.02 | 0.14 | 0.22 | 0.05 | 0.03 | 0.84 | 1.42 |
| THAILAND | 0.06 | 0.04 | 0.08 | 0.15 | 0.02 | 0.02 | 0.88 | 0.06 |
| TUNISIA | 0.08 | 0.05 | 0.15 | 0.12 | 0.05 | 0.02 | 0.81 | 0.05 |
| TURKEY | -0.17 | -0.35 | 0.12 | 0.45 | 0.10 | 0.07 | 0.95 | 0.03 |
| UNITED KINGDOM | 0.05 | 0.03 | 0.11 | 0.28 | 0.04 | 0.02 | 0.96 | 0.01 |
| URUGUAY | 0.09 | 0.18 | 0.10 | 0.23 | 0.10 | 0.08 | 0.98 | 0.04 |
| USA | 0.05 | 0.02 | 0.09 | 0.08 | 0.05 | 0.03 | 0.89 | 0.00 |
| VENEZUELA | 0.07 | -0.12 | 0.15 | 0.34 | 0.14 | 0.10 | 0.99 | 0.01 |

## 4.2 Institutional Variables

Bank regulation indexes are basically the same as those in BCL (2001, 2004), which is based on the survey as of 1999 conducted by World Bank. These cover major fields of bank regulations: regulations on capital adequacy index (CAPREG)[3], regulations on bank activities and bank-commerce link index (ACTREG), entry into banking requirements index (ENTRYREQ), official supervisory power index (SPOWER), and private monitoring index (PMONITOR). We have excluded deposit insurance variables from PMONITOR, which is the only difference from BCL (2001, 2004). Unfortunately, these regulatory indexes are available only at 1999. We apply these values as of 1999 for all the sample period. We also use the component variables of CAPREG, ACTREG and SPOWER to examine the relationship between these regulations and market discipline in details.

Systemic banking crises often lead to drastic changes in the regulatory frameworks and the overall banking stability as well, which in turn may change depositors' risk sensitivity. Because our sample period covers the pre- and post- Asian crises, our assumption that institutional variables were constant during the whole sample period may cause a bias on depositors' risk sensitivity. To check this possibility, we conduct our estimation using only the period after 1999.

Deposit insurance generosity is measured by MORALHZARD, which is constructed using the principal component analysis of deposit insurance design features following Demirgüç-Kunt and Detragiache (2002). Information on deposit insurance schemes is available only as of 1997, though information on the foundation year of explicit deposit insurance is available. We also use the components of MORALHAZARD.

In addition to the above regulatory variables, we use the share of government-owned banks (GOVBANK), contract enforcement index (CONTRACT), and property right index (FPROP). GOVBANK is again the value at 1999. Among many institutional quality measures, we choose CONTRACT and FPROP because they are most suitable to capture the restitution or verification costs in our model, though the results do not seem to depend on the choice of specific variables.

The definitions of institutional variables and their descriptive sample statistics are shown by Tables 3 and 4, respectively. In Table 4A, we report the mean values of each variable over the sample period by country. This is the reason why some dummy variables like TYPE take values between zero and one. In Table 4B, we present pair-wise correlations among the institutional variables, showing that most of the institutional variables are not significantly correlated with the following exceptions. First, GOVBANK is negatively correlated with ENTRYREQ, PMONITOR, CONTRACT and FPROP and positively correlated with ACTREG. Second, ACTREG is negatively correlated with CONTRACT and FPROP, while PMONITOR is positively correlated with CONTRACT and FPROP. Finally, CONTRACT and FPROP are positively correlated with each other. The absolute values of correlation coefficients are mostly less than 0.5 except for those between PMONITOR and FPROP and between CONTRACT and FPROP.

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3 BCL (2004) and BCL (2001) are different in that the former assigns a value of one to "no" and zero to "yes," while the latter assigns one to "yes" and zero to "no" to the following questions: 1) Can assets other than cash or government securities be used to increase capital?, and 2) Can borrowing funds be used? We follow BCL (2004).

Table 3. Definitions and Sources of Institutional and Macroeconomic Variables

A. Bank Regulation Variables

| Variable | Definition | Value |
|---|---|---|
| 1. Capital regulatory variables | | |
| (a) Overall capital stringency (OCAPREG) | Whether the capital requierement reflects certain risk elements and duducts certain market value losses from capital before minimum capital adequacy is determined. | Ranges from 0 to 6<br>Higher values indicate greater stringency |
| (b) Initial capital stringency (ICAPREG) | Whether certain funds may be used to initially capitalize a bank and whether they are officiallly verified. | Ranges from 0 to 3<br>Higher values indicate greater stringency |
| (c) Capiral regulatory index (CAPREG) | The sum of (a) and (b). | Ranges from 0 to 9<br>Higher values indicate greater stringency |
| 2. Bank activity regulatory variables and mixing banking/commerce regulatory variables | | |
| (a) Securities activities (SECURITY) | The extent to which banks may engage in underwriting, brokering, and dealing in securities, and all aspects of the mutual fund industry. | Ranges from 1 to 4<br>Higher values, more restrictive |
| (b) Insurance activities (INSURANCE) | The extent to which banks may engage in insurance underwriting and selling. | Ranges from 1 to 4<br>Higher values, more restrictive |
| (c) Real estate activities (REAL ESTATE) | The extent to which banks may engage in real estate investment, development and management. | Ranges from 1 to 4<br>Higher values, more restrictive |
| (d) Banks owning nonfinancial firms (NONFINANIAL) | The extent to which banks may own and control nonfinancial firms | Ranges from 1 to 4<br>Higher values, more restrictive |
| (e) Bank activity regulation index (ACTREG) | The sum of (a) to (d). | Ranges from 1 to 16<br>Higher values, more restrictive |
| 3. Compentition regulatory variables | | |
| (a) Entry into banking requirements (ENTRYRE | Whether various types of legal submission are required to obtain a banking license. | Ranges from 0 to 8<br>Higher values indicate greater stringency |
| 4. Official supervisory action varaiables | | |
| (a) Official supervisory power (SPOWER) | Whether the supervisory authorities havethe authority to take specific actions to prevent and correct problems. | Ranges from 0 to 14<br>Higher value indicate greater power. |
| (1) Prompt corrective power (PCACT) | Whether the law establishes predetermined levels of bank solvency deterioration that force automatic actions, such as intervention. | Ranges from 0 to 6<br>Higher value indicate greater power.<br>corrective power. |
| (2) Restructuring power (RPOWER) | Whether the supevisory authorities have the power to restructure and reorganize a troubled bank. | Ranges from 0 to 6<br>Higher value indicate greater power. |
| (3) Declaring insolvency power (DINSOL) | Whether the supevisory authorities have the power to declare a deeply troubled bank insolvent. | Ranges from 0 to 2<br>Higher value indicate greater power. |
| 5. Private monitoring variables | | |
| (a) Certified audit required | Whether ther is a compuslry external audit by a licensed or certified auditor. | Ranges from 0 to 1 |
| (b) Percent of 10 biggest banks rated internationally | The percentage of the top ten banks that are rated by international credit rating agencies is 100% or less. | (percentage) |
| (c) Bank accounting | Whether the income statement includes accrued or unpaid interest or principal | Ranges from 0 to 3 HIgher value indicate more informative bank accounts. |

| | | |
|---|---|---|
| | on nonperforming loans and whether banks are required to produce consolidated financial statements. | |
| (d) Private monitoring index (PMONITOR) | Whether (a) occurs, (b) equals 100%, (c) occcurs, off-balance sheet items are disclosed to the public, banks must disclose risk management procedures to the public, and subordinated debt is allowable (required) as a part of regulatory capital | Ranges from 0 to 6 Higher values indicate more private supervision. |

Notes: Definition and quantification are identical to BCL (2004) with the exception of private monitoring index.
We exclude "no explicit deposit insurance scheme" from private monitoring index.
The above egulation variables are as of 1999. .
Data source is the World Bank questionare described by BCL (2001)

B. Deposit insurance features

| Variable | Definition |
|---|---|
| (a) Insurace type (TYPE) | Implicit=0, Explicit=1 |
| (b) No cocinsurance (COINSURE) | Implicit=0, Insurance with coinsurance=1, Insurance without coinsurance=2 |
| (c) Unlimited explicit coverage (LIMIT) | Implicit=0, Insurance with coverage limit=1, Insurance without coverage limit=2 |
| (d) Foreign currency deposits (FOREIGN) | Implicit=0, Insurance without coverage=1, Insurance with coverage=2 |
| (e) Interbank deposits (INTER) | Implicit=0, Insurance without coverage=1, Insurance with coverage=2 |
| (f) Type of funding (FUNDTYPE) | Implciit=0, Unfunded=1, Funded=2 |
| (g) Source of funding (FUNDSOURCE) | Implicit=0, Bank=1, Both=2, Government=3 |
| (h) Management (MANAGE) | Implicit=0, Private=1, Joint=2, Government=3 |
| (i) Membership (MEMBER) | Implicit=0, Compulsory=1, Voluntary=2 |
| (j) Moral hazard (MORALHAZARD) | First principle derived from pricinpal component analysis using (a) to (i). |

Definition are identical to Demirguc-Kunt and Detragiache (2002). Data source is Demirguc-Kunt and Detragiache (2002).

C. Bank concentration and legal quality variables

| Variable | Definition and Source |
|---|---|
| Government bank share (GOVBANK) | The percentage of banking system's assets in banks that are 50% or more government owned a of 1999. Source: BCL (2001) |
| Contract enforcability (CONTRACT) | The relative degree to which contractual agreements are honored and complications presented by language and mentality differences. Scored 0-4, with higher scores for superior quality; average over 1980-95. Source: Knack and Keefer (1995), using data from Business Environmental Risk Intelligence (BERI). |
| Property rights (FPROP) | Rating of property rights on a scale from 1 to 5. The more protection private property receive the higher the score. Source: LLSV (1998), using data from 1997 Index of Economic Freedom |

D. Macroeconomic variables

| Variable | Definition |
|---|---|
| Inflation Rate (INFLATION) | Rate of change in GDP deflators |
| Real Percapita GDP Growth Rate (GROWTH) | Rate of change in real percapita GDP (US dollar) |
| Real Percapita GDP(GDP/cap) | Per capita GDP at constant US dollar |
| Short-Term Government Bond Rate (GOVERNMENT RATE) | T-bill rate, discounr rate or bank rate- Rate of change in GDP deflators |

Source: International Monetary Fund, *International Financial Statistics* and the World Bank, *World Development Indicatiors*.

Table 4A. Institutional Characteristics by Country

| | ACTREG | ENTRYREQ | CAPREG | SPOWER | PMONITOR | MORALHAZARD | GOVBANK |
|---|---|---|---|---|---|---|---|
| AUSTRALIA | 8.00 | 8.00 | 6.00 | 12.00 | 8.00 | -3.99 | 0.00 |
| AUSTRIA | 5.00 | 8.00 | . | 14.00 | . | 0.57 | 4.10 |
| BAHAMAS | . | . | . | . | . | . | . |
| BANGLADESH | 12.00 | 6.00 | 3.00 | 11.00 | . | 1.58 | 69.86 |
| BELGIUM | 9.00 | 8.00 | 8.00 | 13.00 | 5.00 | 1.69 | . |
| BULGARIA | 10.00 | 8.00 | 4.00 | . | 6.00 | 1.62 | 17.60 |
| CANADA | 7.00 | 8.00 | . | 7.00 | 7.00 | 2.14 | 0.00 |
| CHILE | 11.00 | 3.00 | 5.00 | 11.00 | . | 1.55 | 11.70 |
| CHINA-PEOPLE'S REP. | 14.00 | 6.00 | . | 10.00 | 5.00 | -3.99 | . |
| COLOMBIA | . | . | . | . | . | 1.86 | . |
| COSTA RICA | . | . | . | . | . | -3.99 | . |
| CROATIA | 7.00 | 7.00 | 4.00 | 12.00 | . | 0.50 | 36.99 |
| CZECH REPUBLIC | 8.00 | 8.00 | 4.00 | 13.00 | . | 1.17 | 19.00 |
| DENMARK | 8.00 | 8.00 | 7.00 | 9.00 | 6.00 | 1.69 | 0.00 |
| DOMINICAN REPUBLIC | . | . | . | . | . | 1.96 | . |
| EGYPT | 13.00 | 6.00 | 5.00 | 13.00 | 6.00 | . | 66.60 |
| FRANCE | 6.00 | 6.00 | . | 8.00 | . | 0.58 | . |
| GERMANY | 5.00 | 4.00 | . | 11.00 | . | 0.59 | 42.00 |
| GREECE | 9.00 | 8.00 | 4.00 | 10.00 | 5.00 | 1.21 | 13.00 |
| GUATEMALA | 13.00 | 8.00 | 4.00 | 8.00 | 4.00 | . | 7.61 |
| HONDURAS | 9.00 | 8.00 | 5.00 | 13.00 | . | . | 1.10 |
| HONG KONG | . | . | . | . | . | -3.99 | . |
| HUNGARY | 9.00 | 7.00 | 7.00 | 16.00 | . | 1.69 | 2.50 |
| INDIA | 10.00 | 6.00 | 7.00 | 9.00 | . | 1.98 | 80.00 |
| INDONESIA | 14.00 | 7.00 | 5.00 | 14.00 | . | -3.99 | 44.00 |
| IRELAND | 8.00 | 7.00 | . | 11.00 | 6.00 | 1.16 | . |
| ITALY | 10.00 | 8.00 | . | 6.00 | . | 1.27 | 17.00 |
| JAPAN | 13.00 | 6.00 | 7.00 | 13.00 | 7.00 | 1.89 | 1.15 |
| KENYA | 10.00 | 8.00 | 6.00 | 15.00 | 3.00 | 2.53 | . |
| KOREA REP. OF | 9.00 | 7.00 | 6.00 | 10.00 | . | 1.01 | 29.70 |
| LATVIA | 8.00 | . | . | 6.00 | . | -0.05 | . |
| LUXEMBOURG | 6.00 | 8.00 | 7.00 | 14.00 | 6.00 | 0.17 | 5.03 |
| MALAYSIA | 10.00 | 7.00 | 3.00 | 11.00 | 7.00 | -3.99 | 0.00 |
| MEXICO | 12.00 | 8.00 | 7.00 | 10.00 | . | 3.15 | 25.00 |
| NETHERLANDS | 6.00 | 8.00 | 5.00 | 8.00 | 6.00 | 1.56 | 5.90 |
| NIGERIA | 9.00 | 8.00 | 8.00 | 13.00 | 5.00 | 2.14 | 13.00 |
| NORWAY | . | . | . | . | . | 1.40 | . |
| PAKISTAN | . | . | . | . | . | -3.99 | . |
| PANAMA | 8.00 | 8.00 | 4.00 | 13.00 | . | -3.99 | 11.56 |
| PARAGUAY | . | . | . | . | . | . | . |
| PERU | 8.00 | 8.00 | 6.00 | 14.00 | 6.00 | 1.69 | 2.50 |
| PHILIPPINES | 7.00 | 7.00 | 4.00 | 12.00 | 6.00 | 2.53 | 12.12 |
| POLAND | 10.00 | 7.00 | 6.00 | 12.00 | 6.00 | 1.31 | 43.70 |
| PORTUGAL | 9.00 | 7.00 | 5.00 | 13.00 | 7.00 | 1.56 | 20.80 |
| ROMANIA | 13.00 | 8.00 | . | 9.00 | 5.00 | 1.69 | 70.00 |
| RUSSIAN FEDERATION | 8.00 | 8.00 | . | 8.00 | . | -3.99 | 68.00 |
| SINGAPORE | 8.00 | . | . | 3.00 | . | -3.99 | 0.00 |
| SLOVAKIA | 9.00 | 8.00 | 6.00 | . | 4.00 | 1.54 | 25.80 |
| SLOVENIA | 9.00 | 8.00 | 8.00 | 16.00 | 5.00 | . | 39.60 |
| SOUTH AFRICA | 8.00 | 8.00 | 8.00 | 4.00 | . | -3.99 | 0.00 |
| SPAIN | 7.00 | 8.00 | 9.00 | 10.00 | 7.00 | 1.69 | 0.00 |
| SWEDEN | 9.00 | 8.00 | 2.00 | 6.00 | . | 1.83 | 0.00 |
| SWITZERLAND | 5.00 | 8.00 | . | 13.00 | 7.00 | 0.88 | 15.00 |
| THAILAND | 9.00 | 8.00 | 5.00 | 11.00 | 5.00 | -3.99 | 30.67 |
| TUNISIA | . | . | . | . | . | . | . |
| TURKEY | 12.00 | 7.00 | . | 11.00 | 5.00 | 2.60 | 35.00 |
| UNITED KINGDOM | 5.00 | 8.00 | 6.00 | 12.00 | . | 0.17 | 0.00 |
| URUGUAY | . | . | . | . | . | . | . |
| USA | 12.00 | 7.00 | 6.00 | 14.00 | 7.00 | 2.53 | 0.00 |
| VENEZUELA | 10.00 | 8.00 | 3.00 | 14.00 | 5.00 | 1.58 | 4.87 |

Table 4A. Institutional Characteristics by Country (Continued)

| | CONTRACT | FPROP | RPOWER | DINSOL | PCACT | ICAPREG | OCAPREG |
|---|---|---|---|---|---|---|---|
| AUSTRALIA | 3.04 | 5.00 | 3.00 | 1.00 | 0.00 | 1.00 | 5.00 |
| AUSTRIA | 3.30 | 5.00 | 3.00 | 1.00 | 6.00 | 3.00 | . |
| BAHAMAS | . | 5.00 | . | . | . | . | . |
| BANGLADESH | . | 2.00 | 3.00 | 0.00 | 0.00 | 2.00 | 1.00 |
| BELGIUM | 3.27 | 5.00 | 3.00 | . | . | 2.00 | 6.00 |
| BULGARIA | . | . | 3.00 | 2.00 | . | 3.00 | 1.00 |
| CANADA | 3.27 | 5.00 | 1.00 | 1.00 | 0.00 | 2.00 | . |
| CHILE | 2.42 | 5.00 | 3.00 | 2.00 | 3.00 | 2.00 | 3.00 |
| CHINA-PEOPLE'S REP. | . | . | 3.00 | . | 0.00 | 3.00 | . |
| COLOMBIA | 1.93 | 3.00 | . | . | . | . | . |
| COSTA RICA | . | 3.00 | . | . | . | . | . |
| CROATIA | . | . | 2.00 | 2.00 | 4.00 | 2.00 | 2.00 |
| CZECH REPUBLIC | . | . | 3.00 | 2.00 | 5.00 | 3.00 | 1.00 |
| DENMARK | 3.27 | 5.00 | 1.00 | 2.00 | 2.00 | 1.00 | 6.00 |
| DOMINICAN REPUBLIC | . | 2.00 | . | . | . | . | . |
| EGYPT | 2.08 | 3.00 | 2.00 | 1.00 | 6.00 | 2.00 | 3.00 |
| FRANCE | 2.46 | 4.00 | 1.00 | 0.00 | 0.00 | 1.00 | . |
| GERMANY | 3.39 | 5.00 | 2.00 | 2.00 | 0.00 | 1.00 | . |
| GREECE | 2.33 | 4.00 | 3.00 | 2.00 | 0.00 | 2.00 | 2.00 |
| GUATEMALA | . | 3.00 | 3.00 | 1.00 | 3.00 | 2.00 | 2.00 |
| HONDURAS | . | 3.00 | 3.00 | 2.00 | 5.00 | 3.00 | 2.00 |
| HONG KONG | . | 5.00 | . | . | . | . | . |
| HUNGARY | . | . | 3.00 | 2.00 | 6.00 | 3.00 | 4.00 |
| INDIA | 1.94 | 3.00 | 2.00 | 0.00 | 0.00 | 2.00 | 5.00 |
| INDONESIA | 1.73 | 3.00 | 2.00 | 2.00 | 6.00 | 3.00 | 2.00 |
| IRELAND | 3.16 | 5.00 | 3.00 | 1.00 | 0.00 | 1.00 | . |
| ITALY | 2.06 | 4.00 | 2.00 | 1.00 | 0.00 | 2.00 | . |
| JAPAN | 3.12 | 5.00 | 3.00 | 2.00 | 6.00 | 3.00 | 4.00 |
| KENYA | 2.14 | 3.00 | 3.00 | 2.00 | 6.00 | 3.00 | 3.00 |
| KOREA REP. OF | 2.20 | 5.00 | 3.00 | 2.00 | 4.00 | 1.00 | 5.00 |
| LATVIA | . | . | . | . | 0.00 | . | . |
| LUXEMBOURG | . | 5.00 | 3.00 | 1.00 | 0.00 | 2.00 | 5.00 |
| MALAYSIA | 2.28 | 4.00 | 3.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| MEXICO | 1.83 | 3.00 | 3.00 | 2.00 | 3.00 | 2.00 | 5.00 |
| NETHERLANDS | 3.27 | 5.00 | 3.00 | 1.00 | 0.00 | 2.00 | 3.00 |
| NIGERIA | 1.66 | 3.00 | 3.00 | 2.00 | 5.00 | 3.00 | 5.00 |
| NORWAY | 3.44 | 5.00 | . | . | . | . | . |
| PAKISTAN | 1.66 | 4.00 | . | . | . | . | . |
| PANAMA | . | 3.00 | 3.00 | 2.00 | 0.00 | 2.00 | 2.00 |
| PARAGUAY | . | 3.00 | . | . | . | . | . |
| PERU | 1.73 | 3.00 | 3.00 | 2.00 | 4.00 | 1.00 | 5.00 |
| PHILIPPINES | 1.81 | 4.00 | 3.00 | 2.00 | 6.00 | 1.00 | 3.00 |
| POLAND | . | . | 3.00 | 2.00 | 0.00 | 2.00 | 4.00 |
| PORTUGAL | 1.91 | 4.00 | 3.00 | 2.00 | 0.00 | 1.00 | 4.00 |
| ROMANIA | . | . | 3.00 | 2.00 | 0.00 | 3.00 | . |
| RUSSIAN FEDERATION | . | . | 3.00 | 1.00 | 2.00 | . | 4.00 |
| SINGAPORE | 3.17 | 5.00 | . | . | 0.00 | . | 5.00 |
| SLOVAKIA | . | . | 0.00 | 2.00 | . | 3.00 | 3.00 |
| SLOVENIA | . | . | 3.00 | 2.00 | 6.00 | 3.00 | 5.00 |
| SOUTH AFRICA | 2.70 | 3.00 | 0.00 | 1.00 | 0.00 | 3.00 | 5.00 |
| SPAIN | 2.56 | 4.00 | 3.00 | 1.00 | 3.00 | 3.00 | 6.00 |
| SWEDEN | 3.31 | 4.00 | 2.00 | 0.00 | 0.00 | 1.00 | 1.00 |
| SWITZERLAND | 3.59 | 5.00 | 3.00 | 1.00 | 0.00 | 1.00 | . |
| THAILAND | 2.23 | 5.00 | 3.00 | 2.00 | 0.00 | 2.00 | 3.00 |
| TUNISIA | . | 3.00 | . | . | . | . | . |
| TURKEY | 1.99 | 4.00 | 3.00 | 2.00 | 0.00 | 1.00 | . |
| UNITED KINGDOM | 3.42 | 5.00 | 3.00 | 1.00 | 0.00 | 1.00 | 5.00 |
| URUGUAY | . | 4.00 | . | . | . | . | . |
| USA | 3.54 | 5.00 | 3.00 | 2.00 | 5.00 | 2.00 | 4.00 |
| VENEZUELA | 1.69 | 3.00 | 3.00 | 2.00 | 5.00 | 1.00 | 2.00 |

Table 4A. Institutional Characteristics by Country (Continued)

| | TYPE | COINSURE | LIMIT | FOREIGN | INTERBANK | FUNDTYPE | FUNDSOURCE | MANAGE | MEMBER |
|---|---|---|---|---|---|---|---|---|---|
| AUSTRALIA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AUSTRIA | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 |
| BAHAMAS | . | . | . | . | . | . | . | . | . |
| BANGLADESH | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| BELGIUM | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| BULGARIA | 0.99 | 1.98 | 0.99 | 1.98 | 0.99 | 1.98 | 1.98 | 1.98 | 0.99 |
| CANADA | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| CHILE | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 3.00 | 3.00 | 1.00 |
| CHINA-PEOPLE'S REP. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| COLOMBIA | 1.00 | 1.00 | 1.86 | 1.00 | 2.00 | 2.00 | 1.00 | 3.00 | 1.00 |
| COSTA RICA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CROATIA | 0.79 | 1.58 | 0.79 | 1.58 | 0.79 | 1.58 | 1.58 | 1.58 | 0.79 |
| CZECH REPUBLIC | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| DENMARK | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| DOMINICAN REPUBLIC | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| EGYPT | . | . | . | . | . | . | . | . | . |
| FRANCE | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| GERMANY | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 |
| GREECE | 0.99 | 1.97 | 0.99 | 1.97 | 0.99 | 1.97 | 0.99 | 1.97 | 0.99 |
| GUATEMALA | . | . | . | . | . | . | . | . | . |
| HONDURAS | . | . | . | . | . | . | . | . | . |
| HONG KONG | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HUNGARY | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| INDIA | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| INDONESIA | 0.45 | 0.00 | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| IRELAND | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 3.00 | 1.00 |
| ITALY | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 2.00 | 1.00 |
| JAPAN | 1.00 | 2.00 | 1.96 | 1.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| KENYA | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| KOREA REP. OF | 0.83 | 1.65 | 1.47 | 0.83 | 0.83 | 1.65 | 1.65 | 2.48 | 0.83 |
| LATVIA | 0.66 | 1.32 | 0.66 | 1.32 | 0.66 | 1.32 | 1.32 | 1.98 | 0.66 |
| LUXEMBOURG | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| MALAYSIA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| MEXICO | 1.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| NETHERLANDS | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 3.00 | 1.00 |
| NIGERIA | 1.00 | 2.00 | 1.00 | 1.00 | 2.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| NORWAY | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 1.00 | 1.00 |
| PAKISTAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PANAMA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PARAGUAY | . | . | . | . | . | . | . | . | . |
| PERU | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| PHILIPPINES | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| POLAND | 0.95 | 0.95 | 0.95 | 1.91 | 0.95 | 1.91 | 1.91 | 2.86 | 0.95 |
| PORTUGAL | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| ROMANIA | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| RUSSIAN FEDERATION | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SINGAPORE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SLOVAKIA | 0.97 | 1.95 | 0.97 | 1.95 | 0.97 | 1.95 | 1.95 | 1.95 | 0.97 |
| SLOVENIA | . | . | . | . | . | . | . | . | . |
| SOUTH AFRICA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SPAIN | 1.00 | 2.00 | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 |
| SWEDEN | 0.98 | 1.95 | 0.98 | 1.95 | 0.98 | 1.95 | 1.95 | 2.93 | 0.98 |
| SWITZERLAND | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 2.00 |
| THAILAND | 0.71 | 0.00 | 1.41 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| TUNISIA | . | . | . | . | . | . | . | . | . |
| TURKEY | 1.00 | 2.00 | 2.00 | 2.00 | 1.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| UNITED KINGDOM | 1.00 | 1.00 | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| URUGUAY | . | . | . | . | . | . | . | . | . |
| USA | 1.00 | 2.00 | 1.00 | 2.00 | 2.00 | 2.00 | 2.00 | 3.00 | 1.00 |
| VENEZUELA | 1.00 | 2.00 | 1.00 | 1.00 | 1.00 | 2.00 | 2.00 | 3.00 | 1.00 |

Table 4B. Correlations Among Institutional Variables

| | ACTREG | CAPREG | ENYRYREQ | MORALHAZARD | SPOWER | PMONITOR | GOVBANK | CONTRACT | FPROP |
|---|---|---|---|---|---|---|---|---|---|
| ACTREG | 1.00 | | | | | | | | |
| CAPREG | -0.15 | 1.00 | | | | | | | |
| ENYRYREQ | -0.21 | 0.11 | 1.00 | | | | | | |
| MORALHAZARD | 0.00 | 0.13 | -0.05 | 1.00 | | | | | |
| SPOWER | 0.06 | 0.11 | -0.03 | 0.23 | 1.00 | | | | |
| PMONITOR | -0.31 | 0.06 | -0.24 | -0.19 | -0.07 | 1.00 | | | |
| GOVBANK | 0.36** | -0.06 | -0.31** | 0.01 | 0.02 | -0.40** | 1.00 | | |
| CONTRACT | -0.48** | 0.13 | 0.03 | 0.03 | -0.21 | 0.44** | -0.43** | 1.00 | |
| FPROP | -0.47** | 0.22 | -0.09 | -0.04 | -0.08 | 0.52** | -0.41** | 0.77** | 1.00 |

**,* indicate statistical significance levels of 5 and 10 percent,respectively.

# 5. Estimation Results of Deposit Interest Rate

## 5.1 Baseline Results

Table 5 shows the estimation results of deposit interest rate (Equation 13). We organize the discussion below for each institutional variable by focusing on the interaction terms of bank risk measures and institutional variables. Before discussing the effects of bank regulations on market discipline, however, we briefly look at the control variables based mainly on the results for Liquidity as a risk measure. We do not report the coefficients on the control variables except for the case of ACTREG in Table 5 to save space.

The coefficients on Liquidity are negative and significant for all the specifications except for the cases of ENTRYREQ and PMONITOR. This result suggests that market discipline works to some degree in many countries.[4] Most of the coefficients on Profit and Equity are also negative, but the significance levels are somewhat lower especially in the case of Equity, probably reflecting its poor accuracy.

Among the bank characteristics variables, most of the coefficients on OVERHEAD are not significant, though they are significantly negative when CONTRACT is used as an institutional variable. A negative coefficient on OVERHEAD may suggest that banks with lower overhead costs provide depositors with less convenient service and have to pay higher interest rates (Demirgüç-Kunt and Huizinga, 2003), though such a relationship is not robust. MATURITY, i.e., the ratio of short-term debt to total debt, has a significantly negative coefficient in all the specifications, suggesting that the interest rate of short-term debt is lower than that of long-term debt. ASSETSIZE has a significantly positive coefficient, suggesting that a relatively large bank has to pay a high deposit interest rate.

Looking at macroeconomic variables, INFLATION has a significantly negative coefficient in all the specifications, suggesting that nominal deposit interest rate does not change one to one to the inflation rate, because the dependent variable is the real deposit interest rate. RATE has significantly positive co-

4 We estimate the interest rate equation without institutional variables and its interaction terms for individual countries using within estimator. These results are consistent with the cross-country ones reported in the main tables. See Hosono, Iwaki and Tsuru (2004) for the country-by-country estimation results

Table 5. Deposit Interest Rate, Market Discipline, and Institutions

A. ACTREG

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Constant | 0.072 *** | 0.075 *** | 0.068 *** | 0.056 *** |
| | (.000) | (.000) | (.000) | (.000) |
| Bank risk | -0.043 *** | -0.296 *** | -0.012 | -0.225 *** |
| | (.000) | (.000) | (.558) | (.000) |
| OVERHEAD | -0.008 | 0.078 * | -0.018 | -0.323 *** |
| | (.575) | (.081) | (.487) | (.000) |
| MATURITY | -0.020 *** | -0.022 *** | -0.023 *** | 0.007 * |
| | (.000) | (.000) | (.000) | (.074) |
| ASSETSIZE | 0.001 *** | 0.001 *** | 0.001 *** | -0.001 *** |
| | (.000) | (.000) | (.000) | (.000) |
| GOVERNMENT RATE | 0.362 *** | 0.358 *** | 0.357 *** | 0.275 *** |
| | (.000) | (.000) | (.000) | (.000) |
| INFLATION | -0.562 *** | -0.571 *** | -0.573 *** | -0.517 *** |
| | (.000) | (.000) | (.000) | (.000) |
| GROWTH | 0.061 ** | 0.064 ** | 0.062 ** | -0.952 *** |
| | (.028) | (.015) | (.016) | (.000) |
| DEPOSIT GROWTH (Predicted value) | | | | 0.851 *** |
| | | | | (.000) |
| ACTREG | -0.002 *** | -0.003 *** | -0.002 *** | -0.003 *** |
| | (.000) | (.000) | (.000) | (.001) |
| Bank risk x ACTREG | 0.003 *** | 0.023 *** | 0.003 | 0.012 ** |
| | (.001) | (.000) | (.339) | (.020) |
| No. of obs. | 16617 | 17124 | 17123 | 6598 |
| Adj. R-square | 0.67 | 0.67 | 0.67 | 0.73 |
| F value | 331.2 *** | 371.9 *** | 329.2 *** | 290.6 |

B. CAPREG

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.038 *** | -0.264 | -0.066 * | 0.083 *** |
| | (.007) | (.185) | (.093) | (.009) |
| CAPREG | -0.001 ** | -0.001 | -0.001 | 0.006 *** |
| | (.047) | (.409) | (.262) | (.000) |
| Bank risk x CAPREG | 0.006 ** | 0.040 | 0.015 ** | -0.030 *** |
| | (.012) | (.255) | (.014) | (.000) |
| No. of obs. | 9988 | 10035 | 10035 | 3580 |
| Adj. R-square | 0.74 | 0.73 | 0.73 | 0.85 |
| F value | 1102.1 *** | 875.1 *** | 950.5 *** | 281.5 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the ratio of interest expense to interest-paying debt, deflated by GDP deflator.
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

C. ENTRYREQ

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.004 | 0.192 | 0.104 | -0.472 *** |
| | (.719) | (.215) | (.243) | (.000) |
| ENTRYREQ | -0.001 ** | -0.0001 | -0.0001 | -0.013 *** |
| | (.012) | (.860) | (.908) | (.000) |
| Bank risk x ENTRYREQ | -0.001 | -0.032 ** | -0.014 | 0.052 *** |
| | (.529) | (.017) | (.181) | (.000) |
| No. of obs. | 16490 | 16997 | 16997 | 6542 |
| Adj. R-square | 0.67 | 0.66 | 0.66 | 0.73 |
| F value | 324.3 *** | 328.9 *** | 340.3 | 272.2 *** |

D. MORALHAZARD

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.022 *** | -0.127 *** | 0.005 | -0.096 *** |
| | (.000) | (.000) | (.696) | (.000) |
| MORALHAZARD | -0.004 *** | -0.004 *** | -0.004 *** | -0.002 ** |
| | (.000) | (.000) | (.000) | (.041) |
| Bank risk x MORALHAZARD | 0.009 *** | 0.043 *** | 0.014 *** | 0.001 |
| | (.000) | (.000) | (.002) | (.817) |
| No. of obs. | 17240 | 17743 | 17741 | 6813 |
| Adj. R-square | 0.61 | 0.61 | 0.61 | 0.62 |
| F value | 295.6 *** | 314.3 *** | 304.8 *** | 528.1 *** |

E. SPOWER

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.086 *** | -0.485 *** | -0.041 * | -0.380 *** |
| | (.000) | (.000) | (.095) | (.000) |
| SPOWER | -0.004 *** | -0.004 *** | -0.003 *** | -0.005 *** |
| | (.000) | (.000) | (.000) | (.000) |
| Bank risk x SPOWER | 0.006 *** | 0.033 *** | 0.006 ** | 0.024 *** |
| | (.000) | (.000) | (.021) | (.000) |
| No. of obs. | 16561 | 17068 | 17067 | 6598 |
| Adj. R-square | 0.66 | 0.66 | 0.66 | 0.73 |
| F value | 359.7 *** | 381.4 *** | 379.9 *** | 253.2 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the ratio of interest expense to interest-paying debt, deflated by GDP deflator.
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

F. PMONITOR

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | 0.008 | -0.511 *** | -0.141 | 0.079 |
| | (.717) | (.002) | (.175) | (.357) |
| PMONITOR | -0.007 *** | -0.010 *** | -0.009 *** | 0.0002 |
| | (.000) | (.000) | (.000) | (.931) |
| Bank risk x PMONITOR | -0.004 | 0.071 *** | 0.026 * | -0.016 |
| | (.205) | (.005) | (.096) | (.254) |
| No. of obs. | 9223 | 9261 | 9261 | 3710 |
| Adj. R-square | 0.87 | 0.87 | 0.87 | 0.89 |
| F value | 1017.5 *** | 853.8 *** | 889.7 *** | 465.9 *** |

G. GOVBANK

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.009 *** | -0.021 | 0.037 *** | -0.084 *** |
| | (.000) | (.142) | (.004) | (.000) |
| GOVBANK | 0.0004 *** | 0.0005 *** | 0.0004 *** | 0.000 |
| | (.000) | (.000) | (.000) | (.211) |
| Bank risk x GOVBANK | -0.0002 | -0.005 *** | -0.001 | 0.002 ** |
| | (.179) | (.000) | (.102) | (.041) |
| No. of obs. | 14294 | 14788 | 14787 | 5757 |
| Adj. R-square | 0.73 | 0.73 | 0.73 | 0.82 |
| F value | 341.6 *** | 324.9 *** | 347.0 *** | 271.4 *** |

H. CONTRACT

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.103 *** | -0.527 *** | -0.095 ** | -0.307 *** |
| | (.000) | (.000) | (.018) | (.000) |
| CONTRACT | -0.016 *** | -0.015 *** | -0.012 *** | -0.018 *** |
| | (.000) | (.000) | (.000) | (.000) |
| Bank risk x CONTRACT | 0.029 *** | 0.149 *** | 0.043 *** | 0.078 *** |
| | (.000) | (.000) | (.001) | (.000) |
| No. of obs. | 16113 | 16620 | 16619 | 6486 |
| Adj. R-square | 0.62 | 0.62 | 0.61 | 0.74 |
| F value | 751.8 *** | 778.8 *** | 732.3 *** | 298.3 *** |

I. FPROP

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.120 *** | -0.604 *** | -0.076 | -0.287 *** |
| | (.000) | (.000) | (.242) | (.000) |
| FPROP | -0.016 *** | -0.016 *** | -0.012 *** | -0.013 *** |
| | (.000) | (.000) | (.000) | (.000) |
| Bank risk x FPROP | 0.024 *** | 0.120 *** | 0.023 * | 0.044 *** |
| | (.000) | (.000) | (.069) | (.000) |
| No. of obs. | 16787 | 17294 | 17292 | 6723 |
| Adj. R-square | 0.59 | 0.59 | 0.59 | 0.73 |
| F value | 724.2 *** | 735.6 *** | 702.6 *** | 292.5 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the ratio of interest expense to interest-paying debt, deflated by GDP deflator.
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

efficients with less than one. Deposit interest rate partially reflects the government rate. The signs of the coefficients on GROWTH are mixed.

Now we turn to the effects of bank regulations and other institutional factors on the risk sensitivity of deposit interest rate by focusing on our variables of interest: the interaction terms of institutional variables and bank risk measures. The estimation results not reported in tables are available from the author upon request.

## A. Regulations on bank activities and banking-commerce links

Panel A of Table 5 indicates that the interaction terms of ACTREG and bank risk measures are significantly positive, except for the case when EQUITY is used as a risk measure, suggesting that strict regulations on bank activities tend to reduce the risk sensitivity of deposit interest rate. In addition, the coefficients of ACTREG are significantly negative regardless of the risk measures. Strict restrictions on bank activities tend to reduce the deposit interest rate. Our theoretical analysis suggests that restricting bank regulations reduces either bank insolvency risk (regulatory discipline) or depositors' losses in the case of bank insolvency (regulatory shield).

We decompose ACTREG into 4 components and find strong evidence that restricting securities activities and real estate activities, in particular, reduce deposit interest rate and its risk sensitivity (not reported).

## B. Regulations on capital adequacy

The evidence on the relationship between capital adequacy regulations and the risk sensitivity of deposit interest is mixed (Panel B of Table 5). Though the interaction terms of CAPREG with Liquidity and Equity are both significantly positive, suggesting a dampening effect on the risk sensitivity of deposit interest rate, the interaction term of CAPREG with Profit is not significant and its interaction term with the predicted value of Liquidity is significantly negative. The latte result suggests an enhancing ef-

fect on the risk sensitivity of deposit interest rate.

The mixed evidence on CAPREG may reflect the two conflicting theoretical hypotheses concerning the effects of capital regulations on bank risk-taking. BCL (2004) investigated the effects of bank regulations on bank efficiency and fragility. They obtained mixed results on the relationship between capital regulations and the likelihood of a systemic bank crisis, suggesting that strict capital regulations do not necessarily reduce the probability of bank insolvency. Their results are consistent with our findings.

We decompose CAPREG into the overall capital stringency index (OCAPREG) and the initial capital stringency index (ICAPREG) and examine their effects on the risk sensitivity of deposit interest rate. We find that the results for ICAPREG are consistent, suggesting that stringent initial capital regulations tend to lower deposit interest rate and its risk sensitivity, while the results for OCAPREG are mixed (not reported).

### C. Regulations on bank entry

We do not find a robust relationship between strict entry requirements and the risk sensitivity of deposit interest rate (Panel C of Table 5). Strict entry requirements do not seem to systematically affect the risk sensitivity of deposit interest rate through bank insolvency risk or depositors' losses in the case of insolvency.

### D. Deposit insurance designs

Though generous deposit insurance is often asserted to reduce the risk sensitivity of deposit interest rate, the results for MORALHAZARD are somewhat mixed (Panel D of Table 5). While the simple OLS regression results suggest that generous deposit insurance tends to weaken the risk sensitivity of deposit interest rate, the two-step regression result indicates that such a dampening effect is insignificant once we consider the endogeneity of Liquidity and include the predicted value of deposit growth.

We replace MORALHAZARD by a simple explicit/implicit deposit insurance dummy (TYPE) and obtain an even weaker result: The interaction term of TYPE and Liquidity is significantly positive but its interaction terms with the other bank risk measures are not significant. Our results based on a large sample set across 60 countries are not consistent with Demirgüç-Kunt and Huizinga (2003), who obtained robust results, using bank data across 30 countries, that explicit deposit insurance tended to reduce the risk sensitivity of deposit interest rate even when they controlled for the endogeneity problems of Liquidity and deposit growth. We try to make our sample countries and periods identical to Demirgüç-Kunt and Huizinga (2003) as much as possible [5] and find that the interaction terms of MORALHAZARD with the predicted value of Liquidity as well as Liquidity and Equity are significantly positive, though the interaction term of MORALHAZARD and Profit is positive but not significant. The difference in sample country-years seems to be a main reason for the two different results between ours and Demirgüç-Kunt and Huizinga (2003).

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5 Demirgüç-Kunt and Huizinga (2003) do not report the countries for which they estimate the interest rate equation. However, they report the average interest expense for 41 countries in Table 2. Therefore, we checked whether each of the 41 countries of their list have enough data to estimate the interest rate equation, finding that 29 countries actually had enough data. Because they use 29 or 30 countries to estimate the deposit interest rate equation in Table 3, we consider that their sample countries are almost identical to the 29 countries in our dataset. Though their sample period covers the 1990-97 periods, we do not have data for 1990-91. Therefore, we restrict our sample to the 1992-97 periods.

Our observations may cover the countries where or years when deposit insurance is less credible than the observations covered by Demirgüç-Kunt and Huizinga (2003). Deposit insurance that is not very credible increases repudiation risk and hence does not tend to reduce market discipline.

We investigate the relationship between each deposit insurance design features that are components of the MORALHAZARD index and the risk sensitivity of deposit interest rate (Table 6). Though OLS results show that the interaction terms of Liquidity with 7 out of 9 components are significantly positive, the two-step regression results suggest that only 2 components, i.e., funded insurance (FUNDTYPE) and voluntary membership (MEMBER) tend to reduce the risk sensitivity of deposit interest rate. Our OLS regression results are roughly consistent with Demirgüç-Kunt and Huizinga (2003), who conducted only OLS for deposit insurance design features. [6]

Table 6 . Deposit Interest Rate, Market Discipline, and Deposit Insurance Design Features

| Design Features | TYPE | COINSURE | LIMIT | FOREIGN | INTERBANK |
|---|---|---|---|---|---|
| Liquidity | -0.033 *** | -0.019 *** | -0.051 *** | -0.010 | -0.041 *** |
| | (.005) | (.010) | (.000) | (.204) | (.000) |
| Design Features | -0.016 *** | -0.008 *** | -0.017 *** | 0.004 *** | -0.008 *** |
| | (.000) | (.000) | (.000) | (.000) | (.000) |
| Liquidity x Design Features | 0.023 * | 0.003 | 0.041 *** | 0.002 | 0.026 *** |
| | (.053) | (.442) | (.003) | (.642) | (.002) |
| No. of obs. | 17419 | 17240 | 17419 | 17240 | 17240 |
| Adj. R-square | 0.66 | 0.61 | 0.67 | 0.61 | 0.61 |
| F value | 383.5 *** | 292.6 *** | 418.5 *** | 311.5 *** | 303.2 *** |

| Design Features | FUNDTYPE | FUNDSOURCE | MANAGE | MEMBER |
|---|---|---|---|---|
| Liquidity | -0.062 *** | -0.043 *** | -0.036 *** | -0.024 *** |
| | (.000) | (.000) | (.000) | (.001) |
| Design Features | -0.014 *** | -0.013 *** | -0.006 *** | -0.013 *** |
| | (.000) | (.000) | (.000) | (.000) |
| Liquidity x Design Features | 0.033 *** | 0.019 *** | 0.014 *** | 0.015 ** |
| | (.000) | (.000) | (.000) | (.009) |
| No. of obs. | 17240 | 17240 | 17240 | 17240 |
| Adj. R-square | 0.62 | 0.62 | 0.61 | 0.61 |
| F value | 293.4 *** | 290.5 *** | 284.2 *** | 288.8 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the ratio of interest expense to interest-paying debt, deflated by GDP
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

6 Our OLS results show that explicit deposit insurance (TYPE), blanket guarantee (LIMIT), funded insurance (FUNDTYPE), protection of interbank deposit (INTERBANK), government-funded insurance (FUNDSOURCE), publicly managed insurance (MANAGE), and voluntary membership (MEMBER) tended to reduce the risk sensitivity of deposit interest rate, while coinsurance (COINSURE) and protection of foreign currency deposit (FOERIGN) has no significant impact. On the other hand, Demirgüç-Kunt and Huizinga (2003) also found that TYPE, LIMIT, FUNDTYPE, INTERBANK, FUNDSOURCE, and MANAGE tended to reduce the risk sensitivity of deposit interest rate, while COINSURE and FOERIGN tended to enhance it.

## E. Supervision

We find a strong association between official supervisory power and the risk sensitivity of deposit interest rate, irrespectively of the bank risk measures or the regression methods (Panel E of Table 5). A strong supervisory power tends to reduce the risk sensitivity of deposit interest rate. We also find that powerful supervision tends to reduce deposit interest rate. Powerful supervisory authorities seem to reduce the risk sensitivity of deposit interest rate either through regulatory discipline or regulatory shield.

The supervisory power index, SPOWER, is composed of prompt corrective power index (PCACT), restructuring power index (RPOWER), and declaring insolvency power index (DINSOL). We find that the results for RPOWER and DINSOL strongly suggest that they tend to reduce the risk sensitivity of deposit interest rate, while the results for PCACT are mixed (not reported).

## F. Accounting, disclosure, audit and ratings

We do not find a robust effect of superior disclosure and accounting on the risk sensitivity of deposit interest rate (Panel F of Table 5). This is possibly because accurate data of bank risk is difficult to obtain especially in a country with poor accounting and disclosure practices. It should be noted that our results do not necessarily imply that improvement in accounting or disclosure is not important to enhance depositor discipline, because our results may depend on the limited availability of accurate data.

## G. Government ownership of banks

The relationship between the size of government-owned banks and the risk sensitivity of deposit interest rate is not robust (Panel G of Table 5). Concerning the relationship between government ownership of banks and bank insolvency risk, Caprio and Marinez (2000) and BCL (2004) obtained inconsistent results. Caprio and Marinez (2000), using panel data, found that government ownership is significantly and positively associated with increases in bank fragility, while BCL (2004), using cross-country data, did not find a positive relationship between government ownership and the likelihood of a crisis. Given these preceding studies, it is unlikely that government-owned banks are relatively safe as compared to privately owned banks. Therefore, our results suggest two possibilities. One possibility is that government ownership of banks does not affect bank insolvency risk. The other is that government-ownership of banks increases insolvency risk and reduces depositors' losses in the case of insolvency through implicit deposit protection.

## H. Contract Enforcement and Protection of Property Rights

We find strong evidence that strong enforcement of contract (CONTRACT), and protection of property rights (FPROP) tend to reduce the risk sensitivity of deposit interest rate (Panels H and I of Table 5). The interaction terms of these legal quality variables and bank risk measures are significantly positive. We also find that a high legal quality tends to reduce the deposit interest rate level. These results are consistent with our hypotheses that in a country with well developed legal environment, regulatory authorities can control bank risk effectively and that depositors incur low restitution or verification costs in the case of bank insolvency.

## 5.2 Robustness

We check the robustness of the baseline results for the deposit interest rate to deal with some potential biases caused by the limitation of data availability.

First, we restrict our sample banks to commercial banks. We used for the baseline estimation all the sample banks whose data were available. However, if the coverage of some small banks including savings banks and cooperative banks varies country by country and depositors' risk sensitivity to bank risk depend on bank types, our baseline results may be biased. To deal with this potential sample selection bias, we restrict our sample banks to commercial banks, whose data are presumably easily available for most of the countries. Table 7 reports the OLS estimation results for Liquidity as a bank risk measure, confirming most of the baseline results. In particular, ACTREG, CAPREG, MORALHAZARD, SPOW-

Table 7. Deposit Interest Rate, Market Discipline, and Institutions (Commercial bank)

| | ACTREG | CAPREG | ENTYYREQ | MORALHAZARD | SPOWER |
|---|---|---|---|---|---|
| Liquidity | -0.049 *** | -0.049 *** | 0.027 ** | -0.015 *** | -0.050 *** |
| | (.000) | (.008) | (.038) | (.000) | (.001) |
| Design Features | -0.002 *** | | | | |
| | (.000) | -0.001 | | | |
| | | (.285) | 0.0004 | | |
| | | | (.433) | -0.005 *** | |
| | | | | (.000) | -0.003 *** |
| | | | | | (.000) |
| Liquidity x Design Features | 0.006 *** | | | | |
| | (.000) | 0.009 *** | | | |
| | | (.005) | -0.005 ** | | |
| | | | (.024) | 0.015 *** | |
| | | | | (.000) | 0.004 *** |
| | | | | | (.001) |
| No. of obs. | 9559 | 5846 | 9438 | 9880 | 9507 |
| Adj. R-square | 0.74 | 0.75 | 0.74 | 0.68 | 0.73 |
| F value | 408.0 *** | 972.3 *** | 369.2 *** | 387.6 *** | 507.6 *** |

| | PMONITOR | GOVBANK | CONTRACT | FPROP |
|---|---|---|---|---|
| Liquidity | -0.046 * | 0.002 | -0.089 *** | -0.089 *** |
| | (.074) | (.535) | (.000) | (.006) |
| Design Features | -0.009 *** | | | |
| | (.000) | 0.0005 *** | | |
| | | (.000) | -0.018 *** | |
| | | | (.000) | -0.016 *** |
| | | | | (.000) |
| Liquidity x Design Features | 0.006 | | | |
| | (.140) | -0.001 *** | | |
| | | (.000) | 0.027 *** | |
| | | | (.000) | 0.019 *** |
| | | | | (.005) |
| No. of obs. | 5233 | 8345 | 8974 | 9467 |
| Adj. R-square | 0.91 | 0.76 | 0.71 | 0.67 |
| F value | 1383.2 *** | 403.0 *** | 755.6 *** | 654.9 *** |

ER, CONTRACT, and FPROP significantly reduce the sensitivity of the deposit interest rate to Liquidity. On the other hand, the interaction terms of Liquidity with ENTREYREQ and GOVBANK are significantly negative, while these were not significant for the whole sample banks.

Next, we restrict our sample periods to 1999-2002. As we discussed in Section 4.2, applying the regulatory variables as of 1999 to the whole sample period may cause a bias. Considering that most of the crisis-hit Asian countries changed their regulatory frameworks after the crisis, applying the regulatory variables as of 1999 to the pre-crisis period may be particularly problematic. Table 8 shows the OLS estimation results for Liquidity as a bank risk measure. The interaction terms of Liquidity with ACTREG,, SPOWER, CONTRACT, and FPROP are significantly positive, as for the baseline results. The interaction terms of Liquidity with CAPREG, and MORALHAZARD are positive but not significant. On the other hand, the interaction term of Liquidity with PMONITOR is significantly negative, suggesting that

Table 8. Deposit Interest Rate, Market Discipline, and Institutions (1999−2002)

| | ACTREG | CAPREG | ENTYYREQ | MORALHAZARD | SPOWER |
|---|---|---|---|---|---|
| Liquidity | -0.021 ** | -0.039 | 0.05 *** | -0.001 | -0.029 ** |
| | (.024) | (.165) | (.007) | (.853) | (.021) |
| Design Features | -0.002 *** | | | | |
| | (.000) | -0.002 * | | | |
| | | (.072) | 0.002 ** | | |
| | | | (.030) | -0.0005 | |
| | | | | (.619) | -0.002 *** |
| | | | | | (.000) |
| Liquidity x Design Features | 0.002 * | | | | |
| | (.099) | 0.006 | | | |
| | | (.151) | -0.007 *** | | |
| | | | (.005) | 0.001 | |
| | | | | (.807) | 0.002 ** |
| | | | | | (.037) |
| No. of obs. | 6686 | 4342 | 6645 | 6840 | 6651 |
| Adj. R-square | 0.54 | 0.50 | 0.54 | 0.55 | 0.54 |
| F value | 396.7 *** | 200.6 *** | 380.4 *** | 523.0 *** | 378.6 *** |

| | PMONITOR | GOVBANK | CONTRACT | FPROP |
|---|---|---|---|---|
| Liquidity | 0.092 *** | -0.010 *** | -0.075 *** | -0.102 *** |
| | (.003) | (.001) | (.000) | (.006) |
| Design Features | -0.002 | | | |
| | (.202) | 0.0003 *** | | |
| | | (.001) | -0.013 *** | |
| | | | (.000) | -0.018 *** |
| | | | | (.000) |
| Liquidity x Design Features | -0.017 *** | | | |
| | (.000) | 0.0002 | | |
| | | (.321) | 0.023 *** | |
| | | | (.000) | 0.021 *** |
| | | | | (.006) |
| No. of obs. | 4021 | 5997 | 6445 | 6709 |
| Adj. R-square | 0.85 | 0.58 | 0.53 | 0.48 |
| F value | 449.1 *** | 417.8 *** | 477.7 *** | 360.2 *** |

improving accounting standards and disclosure tended to enhance the sensitivity of the deposit interest rate to bank risk after 1999.

# 6. Deposit growth

## 6.1 Theory and Estimation Methodology

Deposit interest rate may not fully adjust to reflect the expected loss of depositors for several reasons. Park and Peristiani (1998), for example, insist that the risk premium of a risky bank does not fully reflect its risk either because a risky bank with some market power is willing to charge a relatively low interest rate to decrease the amount of deposits or because the regulatory authorities prohibit a risky bank from charging an absolutely high interest rate. If deposit interest rate is not fully flexible and depositors increase the supply of deposits with higher interest rates, riskier banks can attract fewer amounts of deposits.

In a very weak banking system, credit rationing to banks may even occur. Suppose that bank capital suddenly drops to such a low level that the bank cannot provide depositors with a sufficiently high expected return by any deposit interest rate because raising deposit interest rate would increase an insolvency risk and decrease expected return to deposits. If the quantity of deposits remains constant, the deposit market would collapse. In such a situation, the amount of deposits may adjust to a sufficiently low level that deposit market recovers the equilibrium. In this adjustment process, a riskier bank would lose more deposits.

We estimate the following equation applying OLS to pooled data, which is similar to the deposit interest rate equation (13).

$$
\begin{aligned}
\triangle Deposit_{i,j,t} = {} & \beta' \, Bank\ Fundamentals_{i,j,t-1} \\
& + \alpha' \, Institutions_{j,t} \\
& + \gamma' \, Bank\ Fundamentals_{i,j,t-1} * Institutions_{j,t} \\
& + \delta Macroeconomic\ Variables_{j,t-1} + \varepsilon_{i,j,t}
\end{aligned} \tag{17}
$$

We exclude the ratio of customer and short-term funding to total interest bearing liability (MATURITY) from the bank fundamental variables and government bill rate (Rate) from the macroeconomic variables.

To check the robustness, we control for the endogeneity problem of Liquidity and omitted variable problem of Inerest Rate. Specifically, we estimate equation (17) with replaced by the predicted value of from equation (15) and the predicted value of from following regression added:

$$
\begin{aligned}
Interest\ Rate_{i,j,t} = {} & \alpha + \beta_1 OVERHEAD_{i,j,t-1} + \beta_2 MATURITY_{i,j,t-1} + \beta_3 INFLATION_{j,t} \\
& + \beta_4 GROWTH_{j,t} + \beta_5 GDP/cap_{j,t} + \varepsilon_{i,j,t}
\end{aligned} \tag{18}
$$

## 6.2 Estimation Results

Table 9 shows the estimation results of deposit growth.[7] Several points are notable. First, the explanatory powers of the regressors, measured by adjusted R-squares are much lower than that of deposit interest rate regression. Second, the coefficient of Liquidity is not necessarily significantly positive. As Demirgüç-Kunt and Huizinga (2003) stresses, these inconclusive results may come from the opposing

Table 9 . Deposit Growth Rate, Market Discipline, and Institutions

A. ACTREG

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Constant | 0.040 *** | 0.011 | 0.040 *** | -0.004 |
| | (.000) | (.130) | (.000) | (.885) |
| Bank risk | -0.034 | 0.621 *** | -0.064 * | -0.057 |
| | (.126) | (.001) | (.075) | (.731) |
| OVERHEAD | 0.132 | -0.001 | 0.129 | 0.392 *** |
| | (.478) | (.996) | (.484) | (.002) |
| ASSETSIZE | 0.002 *** | 0.002 *** | 0.002 *** | 0.002 *** |
| | (.000) | (.000) | (.000) | (.000) |
| INFLATION | -0.138 *** | -0.135 *** | -0.145 *** | 0.581 *** |
| | (.000) | (.000) | (.000) | (.000) |
| GROWTH | 0.891 *** | 0.903 *** | 0.871 *** | 1.110 *** |
| | (.000) | (.000) | (.000) | (.000) |
| INTEREST RATE (Predicted value) | | | | 0.821 *** |
| | | | | (.000) |
| Bank risk x ACTREG | 0.003 | -0.053 *** | 0.012 ** | 0.003 |
| | (.196) | (.010) | (.017) | (.872) |
| No. of obs. | 18986 | 19506 | 19505 | 6662 |
| Adj. R-square | 0.03 | 0.03 | 0.03 | 0.03 |
| F value | 40.0 *** | 45.3 *** | 43.7 *** | 19.6 *** |

B. CAPREG

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.063 | -0.828 *** | -0.104 | -0.640 *** |
| | (.248) | (.004) | (.321) | (.000) |
| CAPREG | -0.004 *** | -0.009 *** | -0.005 *** | -0.022 *** |
| | (.068) | (.000) | (.010) | (.003) |
| Bank risk x CAPREG | 0.006 | 0.130 *** | 0.026 | 0.107 *** |
| | (.446) | (.002) | (.106) | (.000) |
| No. of obs. | 12009 | 12068 | 12068 | 3580 |
| Adj. R-square | 0.02 | 0.02 | 0.02 | 0.05 |
| F value | 21.0 *** | 26.0 *** | 22.4 *** | 16.2 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the deposit growth rate , deflated by GDP deflator.
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

C. ENTRYREQ

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | 0.035 | 0.106 | -0.036 | 0.185 |
| | (.423) | (.883) | (.669) | (.572) |
| ENTRYREQ | 0.003 * | 0.002 | 0.0004 | 0.008 |
| | (.057) | (.594) | (.792) | (.406) |
| Bank risk x ENTRYREQ | -0.007 | -0.014 | 0.008 | -0.031 |
| | (.279) | (.856) | (.548) | (.495) |
| No. of obs. | 18859 | 19379 | 19379 | 6606 |
| Adj. R-square | 0.03 | 0.03 | 0.03 | 0.03 |
| F value | 37.1 *** | 40.0 *** | 39.3 *** | 19.3 *** |

D. MORALHAZARD

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.020 ** | 0.261 ** | -0.010 | -0.050 |
| | (.015) | (.034) | (.521) | (.225) |
| MORALHAZARD | -0.004 *** | 0.003 | -0.004 *** | -0.009 ** |
| | (.002) | (.131) | (.002) | (.012) |
| Bank risk x MORALHAZARD | 0.009 * | -0.108 ** | 0.023 ** | 0.045 *** |
| | (.064) | (.011) | (.040) | (.003) |
| No. of obs. | 19406 | 19921 | 19919 | 6894 |
| Adj. R-square | 0.03 | 0.03 | 0.03 | 0.04 |
| F value | 42.6 *** | 46.1 *** | 45.5 *** | 26.6 *** |

E. SPOWER

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | 0.076 *** | 0.979 *** | 0.045 | 0.552 *** |
| | (.010) | (.001) | (.547) | (.009) |
| SPOWER | 0.002 *** | 0.004 ** | 0.001 | 0.012 *** |
| | (.009) | (.022) | (.242) | (.000) |
| Bank risk x SPOWER | -0.008 *** | -0.073 ** | -0.004 | -0.05 *** |
| | (.003) | (.034) | (.563) | (.005) |
| No. of obs. | 18872 | 19392 | 19391 | 6662 |
| Adj. R-square | 0.03 | 0.03 | 0.03 | 0.04 |
| F value | 42.4 *** | 49.5 *** | 44.9 *** | 22.5 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the deposit growth rate , deflated by GDP deflator.
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

F. PMONITOR

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | 0.073 | 0.851 | 0.422 ** | 0.348 |
| | (.415) | (.241) | (.034) | (.346) |
| PMONITOR | -0.010 *** | -0.005 | -0.006 | 0.002 |
| | (.005) | (.479) | (.124) | (.882) |
| Bank risk x PMONITOR | -0.017 | -0.123 | -0.061 * | -0.062 |
| | (.213) | (.308) | (.056) | (.278) |
| No. of obs. | 11105 | 11155 | 11155 | 3723 |
| Adj. R-square | 0.02 | 0.02 | 0.02 | 0.04 |
| F value | 22.0 *** | 20.3 *** | 21.1 *** | 15.0 *** |

G. GOVBANK

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | -0.033 *** | -0.004 | 0.039 | -0.105 ** |
| | (.000) | (.992) | (.254) | (.050) |
| CAPREG | 0.001 *** | 0.001 * | 0.001 | 0.0003 |
| | 0.000 | 0.100 | 0.000 | 0.602 |
| Bank risk x CAPREG | -0.00001 | -0.002 | -0.001 | 0.0003 |
| | 0.990 | 0.791 | 0.191 | 0.896 |
| No. of obs. | 16613 | 17120 | 17119 | 5808 |
| F value | 38.7 *** | 39.4 *** | 39.5 *** | 20.5 *** |

H. CONTRACT

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | 0.161 *** | 1.099 *** | 0.218 *** | 0.333 * |
| | (.000) | (.000) | (.010) | (.060) |
| CAPREG | -0.0002 | 0.005 | -0.004 | 0.036 *** |
| | (.958) | (.470) | (.291) | (.006) |
| Bank risk x CAPREG | -0.056 *** | -0.323 *** | -0.079 *** | -0.139 ** |
| | (.000) | (.005) | (.007) | (.038) |
| No. of obs. | 17436 | 17956 | 17955 | 6567 |
| Adj. R-square | 0.02 | 0.03 | 0.02 | 0.03 |
| F value | 34.5 *** | 39.5 *** | 34.8 *** | 18.3 *** |

I. FPROP

| | Liquidity | Profit | Equity | Predicted value of Liquidity |
|---|---|---|---|---|
| Bank risk | 0.259 *** | 1.198 *** | 0.348 *** | 0.485 *** |
| | (.000) | (.000) | (.000) | (.010) |
| CAPREG | -0.004 | -0.004 | -0.010 *** | 0.026 ** |
| | (.169) | (.361) | (.001) | (.016) |
| Bank risk x CAPREG | -0.059 *** | -0.247 *** | -0.083 *** | -0.128 *** |
| | (.000) | (.005) | (.000) | (.004) |
| No. of obs. | 19166 | 19686 | 19684 | 6809 |
| Adj. R-square | 0.03 | 0.03 | 0.03 | 0.04 |
| F value | 47.2 *** | 49.8 *** | 45.5 *** | 21.3 *** |

***,**,* indicate statistical significance levels of 1,5 and 10 percent,respectively.
Dependent variable is the deposit growth rate , deflated by GDP deflator.
P-values are in parentheses under the estimated coefficients, using heteroskedasticity-consistent standard errors from an OLS regression.

managerial incentives: Managers of a risky bank may be willing to attract additional deposits to make a gamble on one hand, while they may be willing to shrink deposits and assets to avoid failure or be forced to decrease assets to meet capital adequacy requirements.

Looking at the coefficients of the interaction terms between bank risk measures and regulation variables, we find no robust evidence except for SPOWER. The interaction terms of SPOWER and the bank risk measures are significantly negative, except for the case of Equity, suggesting that SPOWER tends to reduce the risk sensitivity of deposit growth. This is consistent with the estimation results of the deposit interest rate. Most of the interaction terms of bank risk measures and the other bank regulation variables are either insignificant or mixed depending on risk measures.

We also find strong evidence that strong contract enforcement (CONTRACT) and protection of property right (FPROP) are likely to reduce the risk sensitivity of deposit growth rate, which is again consistent with the results for deposit interest rate.

## 7. Conclusion

We find strong evidence that strict regulations on bank activities and powerful supervisory authorities tend to decrease the deposit interest rate and its sensitivity to bank risk, suggesting that these regulations and supervisions reduce market discipline on banks by depositors. We also find that explicit deposit insurance that is funded or whose membership is voluntary tend to lower market discipline. The evidence on the effects of a strict capital regulation, a severe entry requirement and a large presence of government-owned banks on market discipline are mixed, depending on the measure of bank risk and the estimation method. In addition to these bank regulation indexes, we investigated general legal qualities and found that a higher legal quality tends to reduce deposit interest rate and market discipline, suggesting that countries in a well developed legal system tends to effectively control bank risk or to reduce depositors' restitution or verification costs.

Our results on the risk sensitivity of deposit growth are relatively poor in the sense that the explanatory powers of the regressors are much lower than that of the deposit interest rate regression. We find evidence that strong supervisory power and higher legal quality tend to reduce the risk sensitivity of deposit growth, which is consistent with the results for the deposit interest rate.

Our results suggest that strict regulations on bank activities and powerful supervisory authorities lead to lower required interest rates at a cost of lower market discipline. Whether strict regulations on bank activities help to prevent bank failures and contribute to prudent bank behaviors ("regulatory discipline") or tend to be associated with generous bailouts of insolvent banks ("regulatory shield") is an important issue to be explored in the future.

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