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Banking Risks around the World

The Implicit Safety Net Subsidy Approach

Luc Laeven

The degree of risk taking by a bank is related to the size of the gross subsidy that has been extended to the bank by the safety net. This subsidy can be calculated by applying a technique that models deposit insurance as a put option on the bank's assets.

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Summary findings

Laeven calculates gross safety net subsidies for a large sample of banks in 12 countries to assess the relationship between the risk-taking behavior of banks and certain bank characteristics. He finds that gross safety net subsidies are higher for banks that have concentrated ownership, that are affiliated with a business group, that are small, or that have high credit growth, and for banks in countries with low GDP per capita, high inflation, or poor quality and enforcement of the legal system. These findings suggest that the moral hazard behavior of a bank depends on its institutional environment and its corporate governance structure.

Laeven also presents a matrix that shows estimates of safety net subsidies for a range of given combinations of equity volatilities and equity-to-deposit ratios. These figures could be used as input to an early warning system for both individual and systemic banking problems.

This paper—a product of the Financial Sector Strategy and Policy Department—is part of a larger effort in the department to study the performance and risks of banks. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Rose Vo, room MC9-624, telephone 202-473-3722, fax 202-522-2031, email address hvo2@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The author may be contacted at llaeven@worldbank.org. November 2000. (34 pages)

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Introduction

Banking crises have not only shown that banks often take excessive risks, but that risk taking differs across banks. Some banks engage in more risks than their capital can bear in case the downside potential of the risks fully materializes, in which case these banks need to be intervened or even closed down. Others are more prudent and would be able to weather a banking crisis. It is not well known whether different types of banks take different risks. In this study, we will analyze a large sample of banks in different countries to see whether there is a relationship between bank characteristics such as its ownership structure and its risk-taking behavior. We measure the degree of risk-taking by the size of the gross subsidy that has been extended to the bank by the safety net. This so-called implicit gross safety net subsidy is calculated by applying a well-known technique that models deposit insurance as a put option on the bank's assets.

We find empirical support of our method to assess the risks of a bank. Gross safety net subsidies are higher for banks in crisis countries and have some power in predicting bank distress. We also find for countries with explicit deposit insurance schemes that deposit insurance has been underpriced on average for the sample period of 1991-98. In other words, banks have been subsidized by governments. We find that gross subsidies are higher for banks with concentrated ownership, especially for banks that are predominantly owned by a single company, another financial institution, and to a lesser extent by a single family or individual. Banks with dispersed ownership, on the other hand, are found to engage into a relatively low degree of risk-taking, as measured by the level of gross safety net subsidy. We also find that gross safety net subsidies are higher for banks that are affiliated to a business group, that are small and/or have high credit growth, and for banks in countries with low GDP per capita, high inflation rates, poor quality and enforcement of the legal systems, low bank concentration, and/or low foreign bank penetration. Section 1 reviews the relevant literature of deposit insurance. Section 2 presents the methodology we apply to calculate gross safety net subsidies. Section 3 describes the data. Section 4 presents descriptive statistics of our calculated gross safety net subsidies. Section 5 presents our empirical findings. Section 6 concludes.

1. Literature

Many countries have implemented deposit insurance schemes to provide liquidity to banks in case of bank runs and to prevent bank runs from happening. In most countries that have explicit deposit insurance schemes, deposits are only insured up to a certain limit, so-called partial deposit insurance. In some countries, such as Turkey, deposits are insured in full, so-called complete deposit insurance. The advantage of complete deposit insurance is that bank runs are fully eliminated. On the other hand, complete deposit insurance destroys all potentially beneficial information production and monitoring by depositors. Bhattacharya, Boot and Thakor (1998) show that partial governmental deposit insurance encourages market discipline through bank monitoring by informed depositors, and that regulatory measures such as limited regulatory forbearance and tough bank closure rules may control bank risk taking. They argue that underlying the partial insurance conclusion is the presumption that informed depositors – with their own endowments at risk – will monitor banks better than governmental regulators do.

Demirgüç-Kunt and Huizinga (1999) find empirical evidence that the adoption of an explicit deposit scheme involves a trade-off between increased depositor safety and reduced market discipline on banks by their creditors, while Demirgüç-Kunt and Detragiache (1999) provide empirical evidence using a large sample of countries that explicit deposit insurance increases banking system vulnerability in countries with weak institutional environments.

Since Merton (1977), deposit insurance has typically been modeled in the literature as a put option on the bank's assets. Marcus and Shaked (1984) were the first to implement Merton's (1977) model and test the issue of over/underpricing of insurance premium empirically. Ronn and Verma (1986) claim that Marcus and Shaked (1984) incorrectly look at the pre-insurance value of bank assets. They design a model that looks at the post-insurance value of bank assets and that incorporates capital forbearance by the bank regulators.

Duan (1994) develops a maximum likelihood framework to estimate the value of the deposit insurance. The approach in Duan (1994) has been improved by Duan and Yu (1999) who employ the recently developed GARCH option pricing technique in determining the deposit insurance value instead of the Black and Scholes (1973) option pricing framework. Empirical studies have demonstrated that financial asset returns exhibit many robust features such as fat-tailed return distributions that are incompatible with the Black and Scholes (1973) model. The GARCH option pricing model has been found to outperform its Black and Scholes (1973) counterpart.

The above methods have been applied in a number of empirical studies. Few of those studies, however, look at developing countries. Duan and Yu (1994) calculate insurance premiums for ten listed depository institutions in Taiwan for 1985-1992. They use Duan's (1994) maximum likelihood estimation method to assess fair deposit insurance premiums. Their findings indicate that these institutions were heavily subsidized by the deposit insuring agency except in 1989. Duan and Yu (1994) also use Ronn and Verma's (1986) method and find significantly different estimates than with Duan's (1994) method. Fries, Mason and Perraudin (1993) employ Ronn and Verma's (1986) method on 16 banks in Japan for the period 1975-1992. They find that Japanese institutions were heavily subsidized by the deposit insuring agency. Kaplan (1998) applies Duan's (1994) method to calculate risk-adjusted deposit premiums for 15 Thai banks during 1992-97. Kaplan (1998) interprets deposit insurance as a contributing factor to banking crises. Deposit insurance, as a government guarantee to the banking system, acts as a subsidy to banks. As banks try to increases this subsidy by growing rapidly and undertaking riskier lending, they create conditions that make banking crises more likely. Kaplan finds that Thai commercial banks had been receiving large subsidies even prior to the crisis. Moreover, those banks with the highest insurance subsidies were the banks that were nationalized, closed, intervened, or sold to foreigners in 1998.

We will follow Kaplan (1998) by claiming that the level of the gross safety net subsidy extended to the bank is a measure of the risk-taking of that particular bank. We will estimate the gross safety net subsidies by calculating the risk-adjusted deposit insurance premiums that banks should have been paying under a risk-adjusted deposit insurance scheme giving their amount of risk-taking. Since no country actually has implemented a market-based risk-adjusted deposit insurance scheme[2], the risk-adjusted deposit insurance premium will be a fictitious premium.

[2] Although countries with an explicit deposit insurance scheme have mostly designed flat rate deposit insurance schemes, a number of countries do have small variations in deposit insurance premia that are intended to reflect differences in risk. Such differential systems are, however, not market-based.

In fact, Chan, Greenbaum and Thakor (1992) show that it is impossible to implement a risk-sensitive deposit insurance pricing scheme that is incentive compatible unless banks are permitted access to rents, either through explicit regulatory subsidies or through restricted entry into banking.

In countries with an explicit deposit insurance scheme, the difference between the gross safety net subsidy and the deposit insurance premiums that the banks actually pay to the deposit insurance fund is essentially the net subsidy extended to the bank by the safety net of the country. Deposit insurance would be underpriced if the net subsidy is positive. Since we are not specifically interested in the issue of over- or underpricing of deposit insurance, but merely in estimating overall banking risks we will focus on the level of gross subsidies.

2. Methodology

In this section we will describe Merton's (1977) model of deposit insurance that can be used to calculate implicit safety net subsidies, and the implementations of the model by Ronn and Verma (1986) and Duan (1994). We then describe our preferred method. Consider a firm with assets $\$V$ that issues a single homogeneous debt and promises to pay $\$B$ at maturity date T. Merton (1977) shows the impact of a third-party guarantee of the payment to the bondholders where there is no uncertainty about the obligation of the guarantee being met. At maturity date, the value of the firm's equity is the same with or without third-party guarantee, namely $\max(0, V - B)$; the value of the debt is always B; and the value of the guarantor's claim is $\min(0, V - B)$. In effect, the guarantee creates an additional cash inflow to the firm of $-\min(0, V - B)$ dollars, which can be rewritten as $\max(0, B - V)$. Hence, the payoff structure of the loan guarantee is identical with that of a put option, where the promised payment B corresponds to the exercise price, and the value of the firm's assets V corresponds to the common stock's price.

Merton (1977) applies this model to a bank for which the debt issue corresponds to deposits. Because most deposits are of the demand type, the model assumption of term-debt issue is not strictly applicable. However, if one interprets the length of time until maturity as the length until the next audit of the bank's assets, then from the point of view of the guarantor, deposits can be treated as if they were term and interest bearing. Two more assumptions are made. First, it is assumed that deposits equal total bank debt and that both principal and interest are insured. The insured deposits will be riskless and their current value can be written as $D = B\exp(-rT)$. Second, it is assumed that the bank's asset values follow geometric Brownian motion.

$$d\ln V_t = \mu dt + \sigma dW_t \tag{1}$$

where V is the value of assets, μ is the instantaneous expected return on assets, σ is instantaneous expected standard deviation of assets returns, and W indicates a standard Wiener process. The Black-Scholes option-pricing model can be used to value the deposit insurance per unit of deposits

$$g = \Phi(\sigma\sqrt{T-t} - h_t) - \frac{(1-\delta)V_t}{D}\Phi(-h_t), \tag{2}$$

where $h_t = \dfrac{\ln\left(\dfrac{(1-\delta)V_t}{D}\right) + \dfrac{\sigma^2}{2}(T-t)}{\sigma\sqrt{T-t}}$, g is the value of the deposit insurance guarantee per dollar of insured deposits, Φ is the cumulative normal distribution function, T is the time until maturity of the debt, t is time, D is the face value of the debt, and δ is the (annualized) dividend yield (annual dividend payment per dollar of equity).

In order to implement the model, the two unobservable variables, the bank's asset value V and the volatility parameter σ, have to be estimated. Ronn and Verma (1986) suggest using two restrictions for the identification of these two unknowns. The first restriction is obtained by viewing the equity value of the bank, which is directly observable, as a call option on the bank's assets with a strike price equal to the value of the bank's debt

$$E_t = V_t\Phi(d_t) - D\Phi(d_t - \sigma\sqrt{T-t}) \tag{3}$$

where $d_t = \dfrac{\ln\left(\dfrac{V_t}{D}\right) + \dfrac{\sigma^2}{2}(T-t)}{\sigma\sqrt{T-t}}$. Ronn and Verma (1986) model equity as being dividend protected and therefore dividends do not appear in the previous equation. The Black-Scholes formula thus defines a one-to-one mapping between the unknown asset value and the observed equity value.

The relationship between the equity and asset volatility, which can be obtained by applying Ito's Lemma to equation (3), is used by Ronn and Verma (1986) as the second restriction

$$\sigma = \frac{\sigma_E E_t}{V_t \Phi(d_t)}, \qquad (4)$$

where σ_E is the standard deviation of equity returns. The derivation of equation (4) can be found in the Appendix.

Since the market value of equity is observable and the equity volatility can be estimated, two nonlinear restrictions are now in place for identifying two unknowns. Using data on total debt (deposits), bank equity, and equity volatility, equations (3) and (4) can be solved simultaneously for V and σ. Given these values, equation (2) is used to solve for the value of deposit insurance per dollar of deposits, which we interpret as the gross safety net subsidy. In order for this approach to be valid, the time until maturity, T, of the put and call options must be the same. Ronn and Verma (1986) use Merton's (1977) assumption that the time until maturity of the debt is equal to the time until the next audit. They interpret the strike price of the put option to be equal to total debt of the bank instead of total deposits only. This assumes that all the debts of the bank are insured and that they are issued at the risk-free interest rate.

From equations (2)-(4) it follows that the implicit safety net subsidies can be expressed as a function of only three known variables: the equity volatility, the ratio of equity to deposits, and the dividend yield. Table 1 in the Appendix presents this relationship for a range of equity volatility and equity-to-deposits values.

Duan (1994) shows that Ronn and Verma's (1986) method is problematic from a statistical point of view, since they estimate instantaneous equity volatility by the sample standard deviation of daily equity returns. This estimator is, however, not efficient and imposes equity volatility to be constant. Such an assumption is inconsistent with the assumption of Merton's (1977) theoretical model that equity volatility is stochastic.

Duan (1994) has developed a maximum likelihood framework to estimate the value of the deposit insurance which is consistent with the assumption of Merton's (1977) theoretical model that equity volatility is stochastic. By the process in (1), the one-period transition density of the unobserved values of the bank's assets can be characterized by $\ln(V_{t+1}/V_t) \sim N(\mu,\sigma^2)$. Therefore, the log-likelihood function for a sample of unobserved V_t can be expressed as:

$$L_V(V_t,t,\mu,\sigma) = -\frac{n-1}{2}\ln(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{t=2}^{n}\left[\ln\left(\frac{V_t}{V_{t-1}}\right) - \mu\right]^2, \quad t = 1, \ldots, n. \quad (5)$$

Since the call-option formula (3) is an element-by-element transformation from an unobserved sample of asset values to an observed time series of equity values, we can write the log-likelihood function for the observed sample of equity values as:

$$L(E_t,t,\mu,\sigma) = -\frac{n-1}{2}\ln(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{t=2}^{n}\left[\ln\left(\frac{\hat{V}_t(\sigma)}{\hat{V}_{t-1}(\sigma)}\right) - \mu\right]^2 - \sum_{t=2}^{n}\ln(\Phi(\hat{d}_t)), \quad (6)$$

with $t = 1, \ldots, n$, and where $\hat{V}_t(\sigma)$ is the unique solution to (3) for any σ, and $\hat{d}_t$ corresponds to d_t with $\hat{V}_t(\sigma)$ in place of V_t. In the above expression, we have used the fact that $\partial E_t / \partial V_t = \Phi(d_t)$.

With the log-likelihood function in (6), an iterative optimization routine can be used to compute the maximum likelihood estimates. Given starting values for μ and σ and data on equity values E_t and debt D_t, equation (3) can be solved to yield a series of bank asset values V_t. Equation (6) is then used to solve for $\hat{\mu}$ and $\hat{\sigma}$. This process is iterated to find the maximum likelihood estimates of $\hat{\mu}$ and $\hat{\sigma}$, and their standard errors. Using the put option formula for deposit insurance (2), one can solve for the value of the guarantee per dollar of deposits and its standard error. Although from a theoretical point of view, the maximum likelihood method as developed in Duan (1994) and in Duan and

Yu (1999) has some advantages, this method is extremely difficult to implement in practice, because it requires a lot of computation time, especially for a large set of observations[3], and because it requires high-frequency data on deposits, which is generally not available. Extrapolation of the end-year observations of the level of deposits to get high-frequency data on deposits would definitely lead to a poor estimate of $\hat{\sigma}$.

Although Duan (1994) correctly points out that the sample standard deviation of stock returns is not an efficient estimator for instantaneous equity volatility, rejecting Ronn and Verma (1986)'s method for this reason seems too strong. It is well-known that the variance of a time series can be accurately estimated over a relatively short time interval by using high-frequency data. An estimate for equity variance, which theoretically should be the equity variance at a single point in time, is therefore unlikely to be much affected by estimating it using a discrete interval of time, as long as the leverage of the bank has not changed drastically over the estimation interval. The advantage of the Ronn and Verma (1986) method is that it does not require high-frequency data on deposits, but only year-end observations. For the above reasons we decide to use the theoretically less prudent, but widely applied method developed by Ronn and Verma (1986) to compute the gross safety net subsidies.

The gross subsidy is calculated as if all deposits are fully insured. Many countries, however, do not have an explicit deposit insurance scheme in place in which every bank pays a certain premium to a deposit insurance fund. Nevertheless many governments are expected to guarantee depositor's funds, i.e. there is so-called implicit deposit insurance. In a banking system with an implicit deposit insurance scheme, the value of the deposit insurance put option can be seen as a subsidy provided by the government to the bank which fully accrues to the welfare of the depositors. Most explicit deposit insurance schemes provide partial insurance by insuring deposits up to a certain level for which the bank pays a (usually fixed) fee to the deposit insurance fund. If the premium paid by the bank is lower than the gross subsidy, deposit insurance will be underpriced.

We make the assumption that the next audit of the bank will take place in one year, and that the maturity of the debt equals one year as well (T=1). We thus model deposit

[3] We have implemented both Ronn and Verma's (1986) and Duan's (1994) method to a subset of our sample of banks. While our program based upon Ronn and Verma's (1986) method provides an estimate of the gross safety net subsidy in a number of seconds, convergence of our program based upon Duan's (1994) method could take several hours for a single observation.

insurance as a limited term (one-year) contract. Since it is likely that the government will give the bank some forbearance after it finds out that the bank is undercapitalized modeling deposit insurance as a one year contract seems to be restrictive. Pennacchi (1987) allows for unlimited term contracts and shows that the assumption of a limited term contract can underestimate the cost of insurance.

It is clear that the cost of insurance should have been higher if the audit indicates that a bank is undercapitalized and the government decides to give the bank some time instead of forcing it to immediately increase its capital ratio. Since the level of regulatory control is unknown *ex ante* we prefer to model deposit insurance as a limited term contract, acknowledging that our annual gross safety net subsidies might be underestimated. As long as a possible underestimation is similar across banks our method remains valid for comparative purposes. Moreover it is likely that regulatory control is weaker in countries with weak banks, so that we would underestimate the gross safety net subsidies of the most risky banks. Any comparative results we find using a limited term contract would thus probably have been even stronger had we modeled deposit insurance in a multi-period environment.

We estimate annual equity volatility by using a sample of daily equity returns. We exclude an observation if during that day it is announced that the bank will be restructured, merged or closed down, since such announcements tend to lead to large jumps in share prices, that have a distortionary effect on the accuracy of the estimated volatility of equity returns. As a second correction we standardize our estimate of annual equity volatility across countries by converting each sample period to 252 days, since the number of trading days is different across countries. After these two corrections, our estimate of equity volatility σ_E can be written as follows

$$\sigma_E = \sqrt{\frac{252}{T}}\sigma_{E,T}, \tag{7}$$

where T is the actual number of trading days minus those trading days on which large jumps occurred, and $\sigma_{E,T}$ is the bank's equity volatility based upon T trading days.

3. Data

We have selected our sample of countries and banks as follows. We want to include a number of Asian countries to see whether the gross safety net subsidies are different between countries that have been heavily affected by the East Asian financial crisis of 1997 and countries that have not. As a second control group we include a number of highly developed Western countries, which are expected to provide us a benchmark for a low degree of risk taking. To assess the impacts of the crisis we need data for the crisis years 1997-98 as well as for some years before the crisis. Within each country we restrict our sample to the number of exchange listed banks, since we need data on bank market capitalization and dividend yields.

We have collected data on daily stock market capitalization and annualized dividend yields from Datastream. Total deposits at year end, net loans at year end and ownership data are taken from BankScope. For missing observations we have consulted Bloomberg. Ownership data is collected as follows. We distinguish between four concentrated ownership forms. State-owned (the state, treasury, military or other government-institution owns shares in the bank), family-owned (a family or individual owns shares in the bank), company-owned (a manufacturing company owns shares in the bank), and owned by another financial institution (another financial institution owns shares in the bank). Banks that have no concentrated owners (dispersed ownership) are classified as being widely held. We define a number of ownership dummies that are related to the above classification of ownership and that are based upon different thresholds of shareholdings. Our threshold for a majority shareholding is 50% of shares, and our threshold for a major shareholding is 20% of shares.

We have also collected country-specific data. GDP per capita figures and inflation rates are taken from International Financial Statistics (IFS) of the International Monetary Fund (IMF). As a proxy for the quality and enforcement of the legal system of a country we have collected figures from the Law and Order index of the International Country Risk Guide (ICRG), published by Political Risk Service. The Law and Order index ranges from 0 to 6, with a higher figures indicating a higher quality or less risk. Law and Order are assessed separately, with each sub-component comprising zero to three points. The Law sub-component is an assessment of the strength and impartiality of the legal system, while the Order sub-component is an assessment of popular observance of the law. Data on bank concentration and foreign bank penetration are taken from the World Bank Financial Structure Database. Finally, we have taken data from Demirgüç-Kunt and Huizinga (1999) on the features of the deposit insurance scheme of a country, in particular whether insurance is implicit or explicit and how large the explicit insurance premiums are.

Our data set includes listed banks from 12 countries, namely the four East Asian crisis countries (Indonesia, South Korea, Malaysia, and Thailand), four other countries in South East Asia (Hong Kong, Japan, Singapore, and Taiwan), and the four major Western countries to provide for a benchmark (France, Germany, UK and US). Across these 12 countries we have collected data on 137 listed banks during the period 1991-98. The banks in our sample include most of the major listed banks in the country[4]. The features of the deposit insurance schemes of the 12 countries are presented in Table 2 of the Appendix.

To limit the large number of listed banks in Japan, we only look at the long-term credit banks (3 in total), the city banks (9 in total), and the trust banks (7 in total), thereby excluding the mostly smaller regional banks (127 in total). To limit the large number of listed banks in the US, we only include the 22 largest US banks, namely the multinational banks (6 in total) and the super regional banks (16 in total) as defined by Goldman Sachs.

For the 137 banks we have collected a total of 917 observations across eight years. Data is missing for 179 observations for a number of reasons. Some banks have not reported accounting data for each year, some banks only listed at a certain point in the sample period, and some banks were de-listed during the sample period, because of government intervention or merger activity.[5] Missing observations for the year 1998 are

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[4] The distribution of the number of banks across countries is as follows (with the number of banks between brackets): France (4), Germany (8), Hong Kong (12), Indonesia (8), Japan (19), Korea (22), Malaysia (10), Singapore (5), Taiwan (8), Thailand (12), United Kingdom (7), US (22).

[5] In Indonesia, Bank Tiara Asia, a private foreign exchange bank, was taken over in 1998 by the Indonesian Bank Restructuring Agency and is therefore missing for 1998. Although Indonesian Bank Danamon merged with state-owned bank PDCFI in 1998, both banks continued reporting separately for another year, so that we could include Bank Danamon's 1998 data. For Japan, two long-term credit banks have been de-listed - Long Term Credit Bank on October 26th, 1998 and Nippon Credit Bank on December 14th, 1998 – and have been nationalized. Since both banks did report 1998 deposit data, we were able to include the 1998 data of those two banks as well. For Malaysia, we did not include Kwong Yik Bank, because this bank was acquired by RHB Capital and officially de-listed on August 26th, 1997. For Korea, we exclude Commercial Bank of Korea and Korea Long Term Credit Bank, because they were not listed, and Donghwa Bank, because it only started to operate in 1996. The sample of Korean banks changes in 1998

largely due to bank restructuring that took place after the East Asian financial crisis of 1997.

4. Safety Net Subsidies

We have calculated annual gross safety net subsidies as one-year put options on the value of bank assets for the 137 banks for each of the years between 1991-98 using Ronn and Verma's (1986) method. For all the countries in our sample we find that the gross safety net subsidy is increasing over the time period from an average of 2 basis points (bp) per annum in 1991 to 216 bp per annum in 1998, and, more specifically, that the average subsidy is higher during the crisis period 1997-98 than during the pre-crisis years (see Appendix, Table 3.a).

Over the sample period, the gross safety net subsidy (averaged across all banks in the country and over all years) is highest for the four East Asian crisis countries Indonesia (154 bp), Thailand (136 bp), Korea (37 bp) and Malaysia (26 bp), and for Hong Kong (38 bp). The high subsidy of Hong Kong might be explained by contagion effects. The subsidy (averaged across all banks in the country and over all years) is lowest for the four highly developed Western countries Germany (0.18 bp), US (0.4 bp), UK (1.3 bp), and France (2.4 bp), and for Taiwan (1.3 bp). Taiwan's financial system is predominantly state-owned and banks are highly protected, which might be an explanation for our result that suggests that Taiwanese banks take low risks. The calculated subsidies of the remaining Asian countries Singapore (6 bp) and Japan (12 bp) are somewhere in the middle (see Appendix, Table 3.b, for further details).

The subsidies indicate that risk-taking is different among ownership forms. The gross subsidies across the different ownership forms are (in decreasing order of risk and

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due to merger activity. Commercial Bank of Korea and Hanil Bank merged in 1998 creating a new bank called Hanvit Bank, while Hana Bank announced on September 8th, 1998 to merge with Boram Bank (to become effective in 1999). Korea First Bank has been sold to New Bridge Capital of the US as of December 30th, 1998, although trading was not suspended until June 25th, 1999, and Kookmin Bank announced a merger with Korea Long Term Credit Bank on August 25th, 1998. Accounting data for Seoul Bank continued to be reported until 1998, although the bank was nationalized in 1998, and subsequently sold to HSBC Bank on February 22nd, 1999. In Thailand, due to lack of data, we exclude Laem Thong Bank, Nakornthon Bank, and Union Bank of Bangkok. For 1998, we also do not have data on Bangkok Bank of Commerce, which was closed and de-listed in 1998, and on First Bangkok City Bank, which was acquired by the government in February of 1998 and merged with state-owned Krung Thai Bank in 1999.

with safety net subsidy averaged over all banks in the country and over all years between brackets): family (128 bp), company (91 bp), other financial institution (57 bp), state (36 bp), and widely (15 bp). These figures indicate that concentrated ownership links between banks and other parties, such as in the Japanese *keiretsu* or the Korean *chaebol*, increase risk-taking by banks, and that dispersed ownership of banks is to be preferred. The impact of state-ownership on risk-taking of a bank is found to be of an intermediate level (see Appendix, Table 3.c). Note that not all countries have banks with all four different ownership forms. In Western countries, for example, most banks are widely held. On the other extreme, in Indonesia most banks have concentrated ownership. In our sample, 32% of Indonesian banks have an owner that holds at least 20% of shares.

5. Empirical Analysis

In the previous section we have quickly interpreted the summary statistics of the calculated gross safety net subsidies. Although those summary statistics show some clear patterns, we will conduct in this section a more accurate analysis of the differences of subsidies across countries, periods, and ownership forms using econometric techniques to control for bank-specific effects. We transform the variables with the logarithm operator. Calculated gross safety net subsidies, for example, are transformed as follows: *lsubsidy* = *ln*(1+*subsidy*), where *subsidy* is the gross safety net subsidy in basis points of total debt calculated using the Ronn and Verma (1986) method. With *lsubsidy* as the dependent variable we estimate a series of OLS regression models. Our results will be presented with White's (1980) heteroskedasticity-consistent standard errors.

5.1 Ownership, Size and Credit Growth

First, we regress the level of the gross safety net subsidies on a dispersed ownership dummy, country dummies and year dummies. The dispersed ownership dummy takes value one if no shareholder owns more than 5% of shares in the bank, and zero otherwise. The country dummies will control for differences in institutional environments across countries. We take the US and year 1991 as benchmark variables to prevent multicollinearity. Table 4.a in the Appendix presents the results. We find that for the period 1991-98 gross safety net subsidies to banks in France, Hong Kong, Indonesia, Japan, Korea, Malaysia, Taiwan, Thailand and UK were higher on average than to banks in the US. Notably, it are the banks in the crisis countries Indonesia (9.3 bp higher than US), Thailand (5.6 bp higher), Korea (4.4 bp higher), Malaysia (1.9 bp higher) and Hong Kong (1.9 bp higher) that received the highest gross subsidies, compared to the US (on average across all banks in the country and over all years). We also find that for the period 1991-98 gross safety net subsidies were high in 1992 (0.5 bp higher than 1991), and especially in 1997 (4.1 bp higher) and 1998 (15.7 bp higher), compared to 1991 (on average across all banks). This result is expected because 1997 and 1998 are the East Asian crisis years. Controlling for country and time effects, we find that widely held banks are less risky (received 0.2 bp less gross subsidy than banks with concentrated ownership). We find similar results if we use a dispersed ownership dummy that takes value one if no shareholder owns more than 20% of shares in the bank (instead of 5%), and zero otherwise.

To control for bank-specific size effects we add the amount of net loans outstanding as of year-end as a variable to the above model. The results are presented in Table 4.b of the Appendix, and are similar to the previous model. In addition we find that gross safety net subsidies are higher for small banks (in terms of loan size). Since it follows from the above that gross safety net subsidies were highest for the crisis-ridden East Asian countries, we also estimate the model with country dummies for Indonesia, Korea, Malaysia and Thailand only. We find that gross safety net subsidies are significantly higher for these four countries than for the other eight countries in the sample (see Appendix, Table 4.c).

For robustness we repeat the previous analysis while excluding the crisis years 1997-98 from the analysis. The results are quite similar, and can be found in Table 4.d-e of the Appendix. Again, we find that widely held and large banks received a significantly lower amount of gross safety net subsidies, i.e. are less risky, and that the banks in Indonesia, Thailand, Korea and Malaysia received significantly more gross subsidies than other countries. In addition, we find that gross subsidies were lower in 1996 than in 1991.

We also estimate a model that controls for another bank-specific effect, namely loan growth. The results can be found in Table 4.f of the Appendix. In addition to the above results, we find that banks with high loan growth received large gross subsidies.

This finding is as expected since credit growth has been excessive in a number of countries, in particular in the East Asian countries, where it has often been the result of excessive risk-taking.

Secondly, we regress the level of gross subsidy on the different concentrated ownership categories to see if there is a difference between them. We include the ownership dummy variables with absolute majority shareholdings, i.e. larger than 50% and the ownership variables with major shareholdings, i.e. between 20 and 50%. For the whole sample period, 1991-98, we find that the gross safety net subsidies to banks with majority shareholdings by companies and other financial institutions are higher. These banks might have more access to the safety net not only because they are more risky, but also because they might have better connections. In addition, we find that small banks receive more subsidy from the safety net. (see Table 5.a-b of the Appendix). For robustness check, we also exclude the crisis years. For the years 1991-96 we again find that majority shareholdings by companies and other financial institutions increases risk, and that small banks are less risky. In addition, we find that majority shareholdings by families increases risk, although to a smaller extent than for companies or other financial institutions (see Table 5.c-d of the Appendix). In all of the above models we do not find a significant difference in gross subsidies between dispersed ownership and state ownership of banks. For robustness, we have carried out the same regressions without the dummy variables that indicate absolute majority shareholdings, hence only with the majority shareholdings dummy variables. The results obtained are similar. Majority ownership by companies and other financial institutions, and to a lesser degree by families, increases the risks of banks compared to widely held/dispersed ownership.

To check whether gross safety net subsidies extended to banks in 1996 indicated which countries were at risk of a banking crisis in 1997 we carry out two regressions for 1996 observations only – one regression excluding loan size and one regression including loan size. Both regressions include country and ownership dummies. We find for both regressions that gross subsidies were expected to be higher in 1997 than in 1996 for the following three countries: Indonesia, Korea and Thailand (see Table 5.e-f of the Appendix). Except for Malaysia, these are indeed the East Asian countries that experienced banking crisis one year later, i.e. in 1997. Hence, we find that implicit gross safety net subsidies had some forecasting power with respect to the East Asian banking crisis. The calculated gross subsidies for the year 1996 indicate relatively excessive risks in the Indonesian, Thai and Korean banking systems, while we fail to find such an indication for the Malaysian banking system. Again, we find that concentrated ownership by companies, other financial institutions and families/individuals increases risk.

We also compare gross safety net subsidies of banks that are affiliated to a business group and of banks that are not. Since a bank that is affiliated to a business group might be prepared to support a group member that faces financial distress to a larger degree and for a longer period, we expect that the gross safety net subsidies to group affiliated banks is higher than to banks that are not linked to a business group. We classify a bank to be group affiliated if the bank is either a subsidiary of a diversified business group, or if a non-financial company holds more than 50% of the bank's shares. We regress the level of gross safety net subsidies on loan size and on a dummy variable that takes value one if the bank is group-affiliated and zero otherwise. We also include country and year dummies. We estimate this regression model both for the whole sample period and for the pre-crisis period 1991-96. For both periods we find that group-affiliated banks received significantly larger gross safety net subsidies, which suggests that those banks might have supported some member companies of their group (see Table 6.a-b of the Appendix for the results).

5.2 Macroeconomic Fundamentals, Legal System, Deposit Insurance, and Market Structure

Thus far we have used country dummies to control for differences across countries. In this section we expand our model with country-specific variables. Firstly, we control for differences in two macroeconomic fundamentals: the level of GDP per capita and the level of inflation. It is expected that banking systems are less risky in countries with high GDP per capita and low rates of inflation. We indeed find this to be the case for our sample when we regress the level of extended gross safety net subsidies on a constant, year dummies, a dispersed ownership dummy, the size of extended credit, GDP per capita and inflation. We also find again that widely held banks are less risky (see Table 7.a of the Appendix).

Secondly, we control for differences in the quality and enforcement of laws across countries. It is expected that banking systems are riskier in countries with poor legal systems. We indeed find this to be the case for our sample when we regress the level of gross safety net subsidies on a constant, year dummies, a dispersed ownership dummy, the size of extended credit, and a law and order index. We also find again that widely held and large banks are less risky (see Table 7.b of the Appendix).

Thirdly, we compare the impact of explicit versus implicit deposit insurance schemes. Seven countries of our sample of 12 countries have an explicit deposit insurance scheme in place. The other five countries have implicit insurance schemes. To assess the difference between explicit and implicit insurance we regress the level of gross safety net subsidies on a constant, year dummies, a dispersed ownership dummy, the size of extended credit, and a dummy variable that takes value one if the country has an explicit deposit insurance scheme, and find that banks are less risky if they operate in a country that has an explicit deposit insurance scheme. We also find again that widely held and large banks are less risky (see Table 7.c of the Appendix).

For the countries with explicit schemes, deposit insurance premiums range from 0.015% to 0.3 % of insured deposits. The actually charged deposit insurance premiums and calculated gross subsidies can be found in Table 8 of the Appendix. For two out of seven countries with explicit deposit insurance schemes (namely Japan and Korea) we find that the actually charged deposit insurance premiums are lower than the average gross subsidies over the period 1991-98. The net subsidies, however, do not differ statistically from zero at any reasonable level of significance. We can therefore not conclude for countries in our sample with explicit deposit insurance schemes that the actually charged deposit insurance premiums were inadequate, although many banks in our sample could have been charged higher premiums to reflect their risks.

We also look at the combined effect of the type of deposit insurance scheme and the quality of the legal system. Also when we add both variables we find that banks are less risky if they operate in a country with an explicit deposit insurance scheme and/or a sound legal system (see Table 7.d of the Appendix).

In our sample, countries with explicit insurance are mostly highly developed. Since the existence of explicit insurance and the existence of a good institutional environment are highly correlated in our sample, our finding might as well indicate that the existence of a good institutional environment reduces the risk of a banking system. We therefore cannot conclude that the existence of an explicit deposit insurance scheme reduces the risk of a banking system. This would not contradict Demirgüç-Kunt and Detragiache (1999) who provide empirical evidence that explicit deposit insurance increases banking system vulnerability in countries with weak institutional environments.

Finally we look at the effect of the market structure of a country's banking sector on the level of the safety net subsidy. In particular we look at the concentration of the banking market and the foreign bank penetration. We measure concentration by the share of the three largest banks' assets in total banking sector assets, and foreign bank penetration by the share of foreign bank assets in total banking sector assets. When we add these two variables to the model that controls for differences in the quality and enforcement of laws across countries we find that the gross safety net subsidy is higher for banks in countries with low bank concentration and/or low foreign bank penetration (see Table 7.e-f of the Appendix).

5.3 Forecasting Bank Distress

In section 5.1 we found that implicit gross safety net subsidies rightly indicated banking problems in three out of the four East Asian countries that experienced a banking crisis in 1997. In this section we will explore the *ex ante* power of implicit gross safety net subsidies to forecast bank distress. The year 1998 was characterized by government intervention in banks across the East Asian region (see Table 9 of the Appendix). We will analyze the link between bank intervention and the level of gross safety net subsidies before 1998 for our sample of banks to assess the forecasting power of the our method to forecast bank problems.

Firstly, we analyze whether gross safety net subsidies are indeed higher for banks that are intervened. We regress the level of gross subsidies in 1998 on the level of gross subsidies in 1997 and add a dummy variable that indicates whether the bank was intervened. As a second regression we add a country dummy for Indonesia which experienced a dramatic increase in gross subsidies between 1997 and 1998 due to the severity of the crisis. As expected, in both cases we find that gross safety net premiums are higher for intervened banks (see Table 10 of the Appendix).

We expect that banks that receive high gross safety net subsidies have a higher chance to fail, because they take higher risks. To assess the power to forecast bank failure we regress estimate a Probit model with a dummy variable taking value one of the bank is intervened in 1998 as dependent variable and the level of gross safety net subsidy in either 1996 or 1997 as dependent variable. Governments of some East Asian countries intervened more heavily into their banking sectors than others in 1998. Malaysia, for example, allowed banks to continue to operate even though many banks were undercapitalized. On the other hand, all Thai banks have been intervened in 1998. To control for differences in the level of intervention we add country dummies to the Probit model. We do not include a country dummy for Thailand, since all Thai banks have been intervened, and for countries were no banks have been intervened during 1998. We find that banks with high levels of gross safety net subsidies in either 1996 or 1997 had a higher chance to fail and/or be intervened in 1998 than banks with low levels of subsidies. In addition to Thailand, we also find that Indonesia and Korea intervened more heavily in banks than other countries (see Table 11 of the Appendix). These results are supportive of our claim that our method of calculating implicit gross safety net subsidies has some power in assessing the risks of banks and in forecasting bank distress.

6. Conclusions

We have applied Ronn and Verma's (1986) technique to calculate gross safety net subsidies for a large number of banks in different countries, in particular in South-East Asia. We have argued that a relatively high gross safety net subsidy is an indication that the bank takes excessive risks. We can, therefore, use gross safety net subsidies to assess the relationship between risk taking behavior of banks and their governance structure. For many banks, we find that deposit insurance has been subsidized by governments during the 90s, especially for East Asian banks. The subsidy is largest for banks with concentrated private ownership, especially for banks that are predominantly owned by either a single company or another financial institution, and to a lesser extent by a single family or individual. Banks with dispersed ownership, on the other hand, are found to engage into a relatively low degree of risk-taking, while state-owned banks are average performers. Banks with concentrated private ownership might have more access to the safety net not only because they are more risky, but also because they might have better connections. We also find that gross safety net subsidies are higher for banks that are affiliated to a business group, that are small and/or have high credit growth, and for banks in countries with low levels of GDP per capita, high inflation rates, poor quality and enforcement of laws, low bank concentration, and/or low foreign bank penetration. Our findings support the view that existing governmental deposit insurance schemes do not work properly, because they create moral hazard for banks, and suggests that these incentive problems differ in magnitude between different types of banks, in particular between banks that differ in governance structure. Finally, we find that measuring bank risk taking by calculating gross safety net subsidies has some power in predicting bank failures.

Our findings suggest that a bank's risk-taking depends to a large extent on its institutional environment and its corporate governance structure. Banks that operate in an environment with weak institutions and are characterized by concentrated private ownership tend to take high risks. An important finding is that government-owned banks take fewer risks than banks with concentrated private ownership. Although many authors favor private ownership of banks for reasons of economic efficiency (see, for example, La Porta et al., 2000), this result suggests that government-ownership of banks may be less detrimental to the stability of the financial system in countries with an underdeveloped financial system. The ultimate goal, however, should be a financial system with dispersed private ownership of banks where both shareholders and depositors are protected by proper enforcement of prudent regulation.

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Appendix

Derivation of the Relationship between Equity and Asset Volatility

The price of the bank's equity E_t as a call depends on the value of the bank's assets V_t

$$E_t = E(V_t, t) \tag{A1}$$

Applying Ito's Lemma to (A1) gives

$$dE_t = \frac{\partial E_t}{\partial V_t} dV_t + \frac{\partial E_t}{\partial t} dt + \frac{1}{2}\frac{\partial^2 E_t}{\partial V_t^2}\sigma_t^2 dt \tag{A2}$$

Since the last two terms are deterministic, we have

$$Var\left(\frac{dE_t}{E_t}\right) = \left(\frac{V_t \frac{\partial E_t}{\partial V_t}}{E_t}\right)^2 Var\left(\frac{dV_t}{V_t}\right) \tag{A3}$$

Equation (A3) describes the relationship between the variance of the instantaneous return on equity $Var\left(\frac{dE_t}{E_t}\right)$ and the variance of the instantaneous return on assets $Var\left(\frac{dV_t}{V_t}\right)$.

Let $\sigma_E^2 = Var\left(\frac{dE_t}{E_t}\right)$ and $\sigma^2 = Var\left(\frac{dV_t}{V_t}\right)$. Then the relationship between equity and asset volatility can be described as

$$\sigma_E = \frac{V_t \frac{\partial E_t}{\partial V_t}}{E_t}\sigma \tag{A4}$$

Applying a Black and Scholes (1973) framework Merton (1977) shows that $\frac{\partial E_t}{\partial V_t} = \Phi(d_t)$ with $d_t = \frac{\ln\left(\frac{V_t}{D}\right) + \frac{\sigma^2}{2}(T-t)}{\sigma\sqrt{T-t}}$. We thus find that

$$\sigma = \frac{\sigma_E E_t}{V_t \Phi(d_t)} \tag{A5}$$

which is equation (4) in the text.

Table 1 - Annual Implicit Safety Net Subsidies as a Percentage of Deposits

E/D \ σ_E	*10*	*20*	*30*	*40*	*50*	*60*	*70*	*80*	*90*	*100*
5	0.00	0.00	0.00	0.00	0.02	0.07	0.17	0.37	0.66	1.24
10	0.00	0.00	0.00	0.01	0.04	0.13	0.30	0.65	1.22	2.06
20	0.00	0.00	0.00	0.01	0.05	0.19	0.47	1.01	1.89	3.13
30	0.00	0.00	0.00	0.01	0.06	0.22	0.56	1.20	2.22	3.68
40	0.00	0.00	0.00	0.01	0.06	0.23	0.61	1.31	2.43	4.05
50	0.00	0.00	0.00	0.01	0.05	0.22	0.61	1.34	2.50	4.18

Notes: σ_E is annual volatility of equity returns (standard deviation of equity returns) in %. *E/D* is the ratio of market value of the bank's equity to the value of the bank's deposits in %. The dividend yield is assumed to be zero.

Table 2 - Deposit Insurance System Features

Country	*Type*	*Date Established*	*Insurance Premium*
France	Explicit	1980	Callable, but limited
Germany	Explicit	1966	0.03 % of deposits
Hong Kong	Implicit	-	-
Indonesia	Implicit	-	-
Japan	Explicit	1971	0.084 % of insured deposits
Korea	Explicit	1996	0.02 % of insured deposits
Malaysia	Implicit	-	-
Singapore	Implicit	-	-
Taiwan	Explicit	1985	0.015 % of insured deposits
Thailand	Implicit	-	-
UK	Explicit	1982	0.3 % of insured deposits (maximum)
US	Explicit	1934	0.24 % of insured deposits

Notes: For the sample of countries we list whether the country has an explicit or an implicit deposit insurance scheme. If the country has an explicit deposit insurance scheme then we report the date when it was established and the level of the annual insurance premium. Korea had implicit deposit insurance before 1996. The data is taken from Demirgüç-Kunt and Huizinga (1999), Table I.

Table 3 – Gross Safety Net Subsidies

(3a) *Across years*		(3b) *Across countries*		(3c) *Across ownership*	
Year	*Subsidy*	*Country*	*Subsidy*	*Owner20*	*Subsidy*
1991	2.1179	France	2.3670	Company	91.043
	(4.80)		(5.00)		(305)
	[71]		[29]		[99]
1992	3.9334	Germany	0.1808	Family	127.96
	(6.08)		(0.51)		(612)
	[87]		[54]		[67]
1993	1.0434	Hong Kong	37.857	Other FI	57.192
	(3.18)		(98.7)		(159)
	[114]		[79]		[67]
1994	1.0731	Indonesia	154.37	State	35.666
	(2.47)		(413)		(161)
	[124]		[55]		[63]
1995	1.4389	Japan	12.434	Widely	15.104
	(5.20)		(69.9)		(74.1)
	[131]		[149]		[625]
1996	0.7982	Korea	36.582		
	(2.39)		(89.1)		
	[131]		[125]		
1997	37.076	Malaysia	25.848		
	(74.4)		(81.9)		
	[136]		[60]		
1998	215.56	Singapore	5.9793		
	(533)		(28.8)		
	[123]		[37]		
		Taiwan	1.3375		
			(2.22)		
			[57]		
		Thailand	135.95		
			(531)		
			[93]		
		UK	1.3381		
			(3.56)		
			[48]		
		US	0.4040		
			(1.44)		
			[131]		
Average	35.544	*Average*	35.544	*Average*	35.544
	(210)		(210)		(210)
	[917]		[917]		[917]

Notes: Column (3a) reports gross subsidies across years with the subsidies averaged over all banks and across all countries. Column (3b) reports gross subsidies for each country with the subsidies averaged over all banks and across all years. Column (3c) reports gross subsidies across ownership forms with the subsidies averaged over all banks and across all years. The variable *Owner20* is identical to "Company" if a company owns more than 20% of the shares, "Family" if a family owns more than 20% of the shares, "OtherFI" if another financial institution owns more than 20% of the shares, "State" if a government institution owns more than 20% of the shares, and "Widely" if no concentrated group owns more than 20% of the shares. Gross subsidies are reported in basis points (bp) of total bank debt. Standard deviations of average subsidies are between round brackets. The number of banks in each category is between square brackets.

Table 4 - Explaining gross subsidies by dispersed ownership, country and year effects

	(4a)	(4b)	(4c)	(4d)	(4e)	(4f)
France	0.459***	0.591***	—	0.039	0.135	0.005
	(0.141)	(0.147)		(0.082)	(0.090)	(0.062)
Germany	0.092	0.204	—	-0.183***	-0.095	-0.134**
	(0.147)	(0.156)		(0.054)	(0.061)	(0.054)
Hong Kong	1.054***	0.734***	—	0.077	-0.092	0.072
	(0.171)	(0.177)		(0.069)	(0.081)	(0.066)
Indonesia	2.336***	1.826***	1.565***	1.240***	0.985***	1.206***
	(0.216)	(0.229)	(0.204)	(0.190)	(0.197)	(0.200)
Japan	0.990***	1.235***	—	0.302***	0.475***	0.448***
	(0.111)	(0.121)		(0.057)	(0.071)	(0.067)
Korea	1.680***	1.383***	1.053***	0.659***	0.497***	0.659***
	(0.121)	(0.130)	(0.104)	(0.066)	(0.075)	(0.072)
Malaysia	1.061***	0.616***	0.306**	0.249*	0.026	0.127
	(0.168)	(0.186)	(0.151)	(0.137)	(0.137)	(0.134)
Singapore	0.207	-0.052	—	-0.240***	-0.373***	-0.245***
	(0.158)	(0.165)		(0.063)	(0.074)	(0.067)
Taiwan	0.365*	0.187	—	0.435***	0.354***	0.281***
	(0.207)	(0.209)		(0.117)	(0.074)	(0.104)
Thailand	1.884***	1.646***	1.228***	0.679***	0.569***	0.606***
	(0.181)	(0.182)	(0.154)	(0.106)	(0.104)	(0.108)
UK	0.310**	0.470***	—	0.059	0.162***	0.075
	(0.138)	(0.139)		(0.057)	(0.065)	(0.062)
1992	0.410***	0.413***	0.387***	0.442***	0.434***	0.585***
	(0.138)	(0.141)	(0.144)	(0.124)	(0.127)	(0.125)
1993	-0.063	-0.046	-0.176	-0.154	-0.138	-0.002
	(0.133)	(0.133)	(0.122)	(0.103)	(0.103)	(0.101)
1994	-0.039	0.000	-0.143	-0.122	-0.093	0.016
	(0.129)	(0.129)	(0.114)	(0.100)	(0.100)	(0.102)
1995	-0.064	-0.011	-0.152	-0.139	-0.103	0.041
	(0.123)	(0.123)	(0.112)	(0.098)	(0.098)	(0.092)
1996	-0.196	-0.116	-0.279***	-0.274***	-0.222**	-0.085
	(0.121)	(0.122)	(0.106)	(0.094)	(0.095)	(0.089)
1997	1.626***	1.676***	1.522***	—	—	—
	(0.157)	(0.157)	(0.162)			
1998	2.815***	2.876***	2.734***	—	—	—
	(0.189)	(0.189)	(0.193)			
Widely5	-0.182**	-0.160**	-0.257 ***	-0.150***	-0.130***	-0.127**
	(0.083)	(0.081)	(0.076)	(0.052)	(0.052)	(0.052)
Lloan	—	-0.165***	-0.068***	—	-0.096***	—
		(0.030)	(0.024)		(0.023)	
LDloan	—	—	—	—	—	0.386**
						(0.161)
R^2	0.625	0.635	0.585	0.385	0.394	0.398
Obs	917	911	911	658	653	556

Notes: Dependent variable is ln(1+*Subsidy*), where *Subsidy* is the gross safety net subsidy in basis points (bp) of total debt calculated using the method of Ronn and Verma (1986). *Widely5* is a dummy variable that takes value 1, if no shareholder owns more than 5% of shares in the bank, and 0 otherwise. *Lloan* is ln(*Loan*), where *Loan* is the amount of net loans outstanding at year-end. *LDloan* is ln(1+*Dloan*), where *Dloan* is the growth of net loans during the year. A constant term was added, but is not reported. The US provides the benchmark for the country effects, and year 1991 for the year effects. In addition to country and year effects, model (4a) only controls for dispersed ownership. Model (4b) includes net loans to control for size effect. Model (4c) only includes country dummies for the East Asian crisis countries. Models (4d) and (4e) are identical to models (4a) and (4b) respectively, but are estimated using pre-crisis years only. Model (4f) controls for credit growth. Heteroskedasticity-consistent standard errors are in parentheses. *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significant at 10% level.

Table 5 - Explaining gross subsidies by majority ownership, country and year effects

	(5a)	(5b)	(5c)	(5d)	(5e)	(5f)
LLoan	—	-0.150***	—	-0.081***	—	-0.040
		(0.031)		(0.023)		(0.332)
State20	0.258	0.246	0.252	0.244	0.156	0.148
	(0.244)	(0.247)	(0.156)	(0.158)	(0.128)	(0.127)
State50	-0.111	-0.001	-0.029	0.165	0.349	0.362
	(0.314)	(0.316)	(0.156)	(0.153)	(0.228)	(0.228)
OtherFI5	—	—	—	—	-0.024	-0.112
					(0.081)	(0.077)
OtherFI10	—	—	—	—	0.034	0.037
					(0.131)	(0.133)
OtherFI20	0.275	0.249	0.198	0.181	0.543	0.520
	(0.177)	(0.179)	(0.181)	(0.181)	(0.435)	(0.442)
OtherFI50	0.743***	0.636***	0.256**	0.222**	0.494***	0.461*
	(0.251)	(0.251)	(0.113)	(0.110)	(0.247)	(0.252)
Family5	—	—	—	—	0.589*	0.558*
					(0.300)	(0.290)
Family10	—	—	—	—	0.854***	0.846***
					(0.264)	(0.261)
Family20	-0.219	-0.259	0.119	0.096	0.026	0.004
	(0.238)	(0.236)	(0.159)	(0.157)	(0.315)	(0.311)
Family50	0.479	0.311	0.629*	0.534[1]	-0.239	-0.295
	(0.495)	(0.496)	(0.062)	(0.338)	(0.264)	(0.264)
Company5	—	—	—	—	0.362**	0.348*
					(0.180)	(0.180)
Company10	—	—	—	—	0.456	0.409
					(0.310)	(0.315)
Company20	0.070	0.063	-0.102	-0.115	0.335	0.311
	(0.169)	(0.168)	(0.159)	(0.158)	(0.273)	(0.278)
Company50	0.981***	0.843***	0.664***	0.589***	0.841***	0.796**
	(0.248)	(0.248)	(0.120)	(0.200)	(0.316)	(0.335)
Indonesia	—	—	—	—	1.248***	1.159***
					(0.382)	(0.387)
Korea	—	—	—	—	0.545***	0.481***
					(0.135)	(0.140)
Thailand	—	—	—	—	0.587***	0.554***
					(0.263)	(0.263)
R^2	0.638	0.645	0.409	0.414	0.672	0.676
Obs	917	911	658	653	131	131

Notes: Dependent variable is ln(1+*Subsidy*), where *Subsidy* is the gross subsidy in basis points of total debt calculated using the method of Ronn and Verma (1986). *Lloan* is the logarithm of net loans outstanding at year-end. *State5* is a dummy variable that takes value 1 if the state owns 5-10% of the shares in the bank. Similarly, *State10* indicates 10-20% state ownership, *State20* indicates 20-50% state ownership, and *State50* indicates 50-100% state ownership. *Family5* is a dummy variable that takes value 1 if a family owns 5-10% of the shares in the bank. Similarly, *Family10* indicates 10-20% family ownership, *Family20* indicates 20-50% family ownership, and *Family50* indicates 50-100% family ownership. *OtherFI5* is a dummy variable that takes value 1 if another financial institution owns 5-10% of the shares in the bank. Similarly, *OtherFI10* indicates 10-20% ownership by another financial institution, *OtherFI20* indicates 20-50% ownership by another financial institution, and *OtherFI50* indicates 50-100% ownership by another financial institution. *Company5* is a dummy variable that takes value 1 if a company owns 5-10% of the shares in the bank. Similarly, *Company10* indicates 10-20% company ownership, *Company20* indicates 20-50% company ownership, and *Company50* indicates 50-100% company ownership. For models (5a)-(5d) a constant term, country dummies and year dummies were added, but are not reported. The US provides the benchmark for the country effects, and year 1991 for the year effects. In addition to country and year effects, model (5a) only controls for majority ownership effects. Model (5b) includes net loans to control for size effect. Models (5c) and (5d) are identical to models (5a) and (5b) respectively, but are estimated using years 1991-96 only. Models (5e) and (5f) include 1996 observations only. For models (5e) and (5f) a constant term was added, but is not reported, and only significant country effects are reported. In addition to country effects, model (5e) only controls for majority ownership effects. Model (5f) includes net loans to control for size effect. The ownership dummies *State5* and *State10* are dropped, because they contain no values *one*. Heteroskedasticity-consistent standard errors are in parentheses. *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level; [1] indicates significance at 11% level.

Table 6 - Explaining gross subsidies by group affiliation, country and year effects

	(6a)	(6b)
LLoan	-0.156***	-0.088
	(0.031)	(0.023)
Group	0.642***	0.543***
	(0.233)	(0.190)
R^2	0.638	0.403
Obs	911	653

Notes: Dependent variable is ln(1+*Subsidy*), where *Subsidy* is the gross subsidy in basis points of total debt calculated using the method of Ronn and Verma (1986). *Lloan* is the logarithm of net loans outstanding at year-end. *Group* is a dummy variable that takes value 1 if the bank is affiliated to a group, and 0 otherwise. We classify a bank to be group-affiliated if the bank is either a subsidiary of a diversified business group, or if a non-financial company holds more than 50% of the bank's shares. For both model (6a) and (6b) a constant term, country dummies and year dummies were added, but are not reported. The US provides the benchmark for the country effects, and year 1991 for the year effects. In addition to country and year effects, both models include net loans to control for size effects. Model (6a) is estimated for the full sample period. Model (6b) is estimated using pre-crisis years 1991-96 only. Heteroskedasticity-consistent standard errors are in parentheses. *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level.

Table 7 - Explaining subsidies by macroeconomic, institutional and competition variables

	(7a)	(7b)	(7c)	(7d)	(7e)	(7f)	(7g)
Widely5	-0.126*	-0.253***	-0.269***	-0.154*	-0.248***	-0.177**	-0.249***
	(0.077)	(0.078)	(0.089)	(0.087)	(0.073)	(0.076)	(0.081)
LLoan	-0.023	-0.113***	-0.189***	-0.082	-0.108***	-0.114***	-0.101***
	(0.027)	(0.024)	(0.025)	(0.026)	(0.022)	(0.029)	(0.030)
LGDPcap	-0.370***	—	—	—	—	—	—
	(0.050)						
LInfl	0.401***	—	—	—	—	—	—
	(0.086)						
LLaworder	—	-2.179***	—	-2.192***	-1.622***	-1.249***	-0.979**
		(0.364)		(0.363)	(0.409)	(0.444)	(0.450)
Explicit	—	—	-0.249**	-0.264**	-0.320***	-0.396***	-0.555***
			(0.116)	(0.116)	(0.109)	(0.113)	(0.132)
LConc	—	—	—	—	-0.492***	—	-0.294***
					(0.081)		(0.101)
LForeign	—	—	—	—	—	-0.190***	-0.139***
						(0.032)	(0.039)
R^2	0.568	0.530	0.504	0.533	0.439	0.392	0.399
Obs	911	911	911	911	775	661	661

Notes: Dependent variable is ln(1+*Subsidy*), where *Subsidy* is the gross safety net subsidy in basis points of total debt calculated using the method of Ronn and Verma (1986). *Lloan* is the logarithm of the amount of net loans outstanding at year-end. *LGDPcap* is the logarithm of the level of GDP per capita. *Linfl* is ln(1+*Infl*), where *Infl* is the inflation rate based upon the CPI of the country. *Llaworder* is the logarithm of the Law and Order index of the Political Risk Services group which ranges from 0 to 6 (6 indicating an excellent system of law and order). *Explicit* is a dummy variable that takes value 1 if the country has explicit deposit insurance, and 0 otherwise. *LConc* is the logarithm of the ratio of the three largest banks' assets to total banking assets. *LForeign* is the logarithm of the share of foreign bank assets in total banking sector assets. A constant term and year dummies were added, but are not reported. Year 1991 provides the benchmark for the year effects. In addition to year effects, model (7a) controls for dispersed ownership, loan size, GDP per capita, and inflation effects. Model (7b) controls for dispersed ownership, loan size and quality of legal system effects. Model (7c) controls for dispersed ownership and loan size effects, and for the existence of explicit deposit insurance. Model (7d) combines models (7b) and (7c) by controlling for dispersed ownership, loan size, and quality of legal system effects, and for the existence of explicit deposit insurance. Models (7a)-(7d) use data for the years 1991-98. Models (7e)-(7g) use data for the years 1991-97, since no competition data is available for the year 1998. Heteroskedasticity-consistent standard errors are in parentheses. *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level.

Table 8 – Gross Subsidies and Actually Charged Deposit Insurance Premiums

Country	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*Average*	*Actually Charged*
France	1.745	1.050	0.009	0.074	0.125	0.006	1.354	13.5	2.37	Callable
	(2.24)	(1.61)	(7e-3)	(0.10)	(0.07)	(6e-3)	(1.81)	(5.16)	(4.98)	
Germany	0.009	5e-6	4e-5	0.193	0.002	0.001	0.62	0.79	0.18	3.0
	(0.01)	(9e-6)	(8e-5)	(0.43)	(5e-3)	(3e-3)	(0.85)	(1.08)	(0.51)	
Japan	0.122	4.783	1.154	0.088	0.926	0.025	24.9	65.8	12.43	8.4
	(0.20)	(3.38)	(1.69)	(0.23)	(0.96)	(0.06)	(31.9)	(188)	(70.0)	
Korea	0.374	4.18	0.438	2.37	1.70	1.46	44.8	228	36.6	2.0
	(0.27)	(2.48)	(0.31)	(1.96)	(1.39)	(2.39)	(27.7)	(149)	(89.1)	
Taiwan	6.574	0.392	1.865	1.582	0.148	0.100	0.518	0.504	1.337	1.5
	(3.06)	(0.42)	(1.29)	(1.32)	(0.20)	(0.10)	(0.55)	(0.37)	(2.22)	
UK	0.592	2.06	0.026	0.125	0.014	0.004	0.383	6.84	1.34	30.0
	(0.42)	(2.32)	(0.04)	(0.19)	(0.03)	(0.01)	(0.27)	(7.15)	(3.56)	
US	0.030	0.001	0.084	0.003	0.020	0.004	0.084	2.22	0.404	2.4
	(0.00)	(0.00)	(0.17)	(0.01)	(0.07)	(0.01)	(0.16)	(2.93)	(1.44)	

Notes: For countries with explicit deposit insurance schemes the table reports the means of gross safety net subsidies (with standard deviations between brackets) and the actually charged insurance premiums (all in basis points of total bank debt). The actually charged insurance premiums are from Demirgüç-Kunt and Huizinga (1999), Table I. Note that Korea had implicit deposit insurance before the year 1996.

Table 9 – Bank Intervention in 1998

Country	*Name of Intervened Banks*
Indonesia	Bank Bali, Bank Danamon, Bank International Indonesia (BII), Bank Lippo, Bank Niaga, Bank Tiara Asia
Japan	Long Term Credit Bank, Nippon Credit Bank
Korea	Cho Hung Bank, Chung Chong Bank, Dae Dong Bank, Dong Nam Bank, Hana Bank, Hanil Bank, Housing and Commercial Bank, Kookmin Bank, Koram Bank, Korea First Bank, Kyungki Bank, Seoul Bank, Shinhan Bank
Malaysia	AMMB Holdings, RHB Capital
Thailand	Bangkok Bank, Bangkok Bank of Commerce, Bangkok Metropolitan Bank, Bank of Asia, Bank of Ayudhya, First Bangkok City Bank, Krung Thai Bank, Siam City Bank, Siam Commercial Bank, Union Bank of Bangkok, Thai Danu Bank, Thai Farmers Bank, Thai Military Bank

Notes: Bank intervention includes closure, re-capitalization, nationalization, sale to foreigners and domestic takeovers of banks. Only banks within our sample are included in the above list. Source: World Bank.

Table 10 – Gross Subsidies and Intervened Banks

	(10a)	(10b)
Subsidy(-1)	1.439*	1.327*
	(0.094)	(0.821)
Intervention	571.7***	478.6***
	(165.6)	(167.5)
Indonesia	—	626.4***
		(238.2)
Constant	35.0**	24.3*
	(17.6)	(14.1)
R^2	0.288	0.357
Obs	122	122

Notes: Dependent variable is the gross safety net subsidy in basis points of total debt calculated using the method of Ronn and Verma (1986) for the year 1998. *Subsidy(-1)* is the gross safety net subsidy in basis points of total debt for the year 1997. *Intervention* is a dummy variable that takes value one if the bank is intervened in 1998, and zero otherwise. Intervened can be closed, re-capitalized, nationalized, sold to foreigners, or merged with another local financial institution. In model (10b) we add a country dummy for Indonesia. We estimate both models using OLS. Heteroskedasticity-consistent standard errors are in parentheses. *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level.

Table 11 – Predicting Banking Distress

	(11a)	(11b)
Subsidy	0.177**	0.0048***
	(0.094)	(0.0015)
Indonesia	0.793	1.644***
	(0.659)	(0.518)
Japan	-1.622	-0.089
	(0.427)	(0.436)
Korea	1.001***	1.438***
	(0.352)	(0.330)
Malaysia	0.310	0.470
	(0.498)	(0.512)
Constant	-1.094***	-1.311***
	(0.183)	(0.212)
Pseudo-R^2	0.189	0.255
Obs	131	136

Notes: Dependent variable is a dummy variable that takes value one if the bank is intervened in 1998, and zero otherwise. Intervened can be closed, re-capitalized, nationalized, sold to foreigners, or merged with another local financial institution. *Subsidy* is the gross safety net subsidy in basis points of total debt calculated using the method of Ronn and Verma (1986). We have added country dummies for Indonesia, Japan, Korea and Malaysia. We estimate a Probit model. Model (11a) uses gross subsidy data for the year 1996 and intervention data for the year 1998. Model (11b) uses gross subsidy data for the year 1997 and intervention data for the year 1998. *** indicates significance at 1% level; ** indicates significance at 5% level; * indicates significance at 10% level.

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