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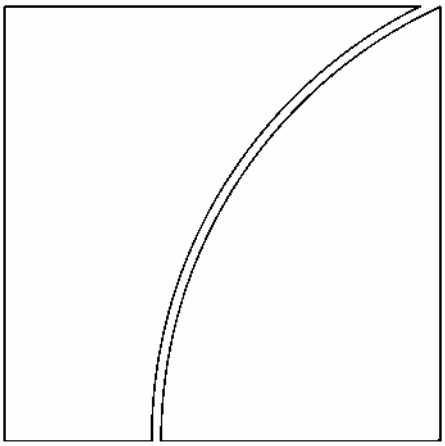

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Deposit Insurance and Bank Intermediation in the Long Run

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Abstract

This paper provides empirical evidence on the impact of deposit insurance on the growth of bank intermediation in the long run. We use a unique dataset capturing a variety of deposit insurance features across countries, such as coverage, premium structure, etc. and synthesize available information by means of principal component indices. This paper specifically addresses sample selection and endogeneity concerns by estimating a generalized Tobit model both via maximum likelihood and the Heckman 2-step method. The empirical construct is guided by recent theories of banking regulation that employ an agency framework. The basic moral hazard problem is the incentive for depository institutions to engage in excessively high-risk activities, relative to socially optimal outcomes, in order to increase the option value of their deposit insurance guarantee. The overall empirical evidence is consistent with the likelihood that generous government-funded deposit insurance might have a negative impact on the long-run growth and stability of bank intermediation, except in countries where the rule of law is well established and bank supervisors are granted sufficient discretion and independence from legal reprisals. Insurance premium requirements on member banks, even when risk-adjusted, are instead found to have little effect in restraining banks' risk-taking behavior.

Keywords: Deposit Insurance, Moral Hazard, Bank Regulation and Supervision, Financial Development.

JEL codes: G2, O1, F3.

Contents

Introduction[1]

Many governments in both developed and developing countries grant explicit[2] deposit insurance in the hope of reducing the risk of systemic failure[3]. The introduction of deposit insurance is intended to stabilize the financial system by forestalling hasty fire-sale losses on assets that could bring down other banks and disrupt financial markets and the payments system. Moreover, by bolstering depositors' faith in the stability of the system, deposit insurance is generally believed to contribute in the long run to a deeper financial system, which could lead to higher economic growth rates.[4]

This paper revisits the link between the design of a deposit insurance system and its long-run effect on financial depth and stability. Under "generous" deposit insurance schemes, if a depository institution, such as a savings and loan firm, goes bankrupt, the government absorbs all (or nearly all) of the depositors' losses. This might weaken market discipline (i.e. monitoring of bank activities by depositors and other bank stakeholders) and create a moral hazard problem, since there is now an incentive for depository institutions to engage in excessively high-risk activities, relative to socially optimal outcomes. Especially in lax regulatory environments, these incentives are likely to lead to greater systemic instability.

Underestimating agency problems might induce governments to design over-generous deposit insurance systems in the hope of boosting depositor confidence and increasing bank intermediation. We provide new evidence suggesting that, in countries with poor bank supervision, over-generous deposit insurance systems are actually associated with higher volatility and slower growth of bank intermediation in the long run.

The impact of deposit insurance programs on financial stability has been analyzed in a recent study by Demirgüç-Kunt and Detragiache (2002). Based on evidence for 61 countries between 1980 and 1997, they find that variations in coverage, funding or management of deposit insurance schemes are significant determinants of the likelihood of banking crisis, especially across countries where interest rates have been deregulated and the overall institutional framework is weak.

This paper takes a slightly different angle. We focus on the impact of alternative deposit insurance design features on the growth and volatility of bank intermediation over a longer horizon, and not only when a financial or banking system collapses into a crisis. Accordingly, our empirics are not based on crisis data alone.

A recent article by Reint Gropp and Jukka Vesala (2001) argues that in Europe implicit insurance has meant an even higher potential for moral hazard than explicit systems. This is because, though it introduces some uncertainty of being bailed out, the coverage of implicit insurance may extend to a larger set of bank stakeholders compared to the case of explicit laws protecting depositors alone.

However, especially in emerging countries lacking the institutional development necessary to make limits binding, explicit deposit insurance might offer no benefit over implicit. In fact, this paper will show how the effects of explicit deposit insurance are strongly dependent on the quality of banking regulation and supervision.

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[2] By explicit deposit insurance, we mean a formal detailed system enacted by law as opposed to an implicit unwritten agreement between governments and banks.

[3] By systemic failure we mean the simultaneous collapse of sizable portions of the banking system, possibly extending to the non-bank financial sector as well as to financial markets.

[4] See Levine (1997) on the links between financial depth and economic growth.

Instead of comparing countries with explicit vs. implicit deposit insurance, we evaluate different design features of explicit deposit insurance systems existing around the world. We argue that ex ante bailout expectations relax market discipline and influence bank risk taking behaviour.

The empirical construct is guided by recent theories of banking regulation that employ an agency framework. A stylized model of optimal portfolio selection is presented to illustrate how the introduction of insured deposits affects the optimal risk-taking behavior of banks.

This paper contributes to the empirical literature on deposit insurance in a couple of ways. First, we directly address the sample selection and endogeneity problems inherent in analyzing the effects of deposit insurance programs. The sample of countries that adopt explicit deposit insurance is clearly not random, and thus we employ a generalized Tobit estimation technique to account for this selection process. In other words, we estimate simultaneously the determinants of the decision to adopt an explicit deposit insurance system and the effects of adopting a particular deposit insurance scheme on the banking sector. This approach will also allow us to overcome the difficulty in categorizing variations in coverage or funding within the heterogeneous spectrum of countries lacking an official insurance arrangement. Hovakimian, Kane, and Leaven (2003) employ similar techniques.

Second, we attempt to summarize the features of explicit deposit insurance as completely as possible, rather than test the effects of individual program features or a subset of features. When considering the safety of their deposits, it is unlikely that depositors consider only one feature of a deposit insurance scheme, but rather all the features together (coverage limits, types of deposits covered, and the credibility of the insurer). Similarly, when choosing whether to participate in a deposit insurance program, banks likely consider not only their premium payments, but also whether and how future payments will be adjusted to reflect portfolio risk and when those payments will be collected. We analyze deposit insurance programs based primarily on two sets of features: (a) insurance features reflecting the generosity of coverage to depositors, and (b) the requirements imposed upon member banks (which we call entry hurdles). We then test whether principal component indices based on these two sets of features lead to higher levels of banking activity, and whether any such growth in bank intermediation comes at a price in terms of higher financial instability in the long run.

The paper is organized as follows. Section II provides a conceptual framework of how deposit insurance affects the level and volatility of banking development. A stylized model of optimal portfolio selection is presented to illustrate how the introduction of insured deposits affects the optimal risk-taking behavior of banks. Section III spells out the main testable hypotheses we draw from our theory. Section IV presents our results, Section V illustrates some robustness checks, and Section VI concludes.

II. A Stylized Model of Deposit Insurance and Banks' Risk-Shifting.

Since the seminal paper by Merton (1977), deposit insurance has attracted considerable academic and public policy attention. An extensive literature exists on the optimal pricing of deposit insurance premia (see for example Allen and Saunders (1993) and Laeven (2002)) as well as on moral hazard incentives and the importance of the market discipline enforced by uninsured depositors (see for example Dreyfus, Saunders and Allen (1994) and the papers presented at the BIS-Chicago Fed conference in November 2003).

With the availability of a new cross-country dataset of individual deposit insurance design features, recent studies have compared the performance of various deposit insurance systems around the world, providing best-practice policy recommendations (Garcia (1999), Financial Stability Forum (2001), Demirgüç-Kunt and Detragiache (2002) and Demirgüç-Kunt and Kane (2002)).

In most studies published so far, however, the moral hazard problem arising from mispriced deposit insurance or weakened depositors' market discipline is usually related to either the probability of crisis or the failure resolution costs borne by the insurance agency.

This paper takes a slightly different angle compared to the existing literature, exploring instead the relationship between deposit insurance and bank intermediation in the long run. In order to set the stage for our empirical analysis, we will lay out in this Section a stylized model that extends the standard moral hazard framework, tracing the link between the extent of coverage (or generosity) of a deposit insurance system and both the volatility and growth of bank intermediation.

Consider a three-date time line. At the initial date, t=0, the bank collects deposits (we will denote this amount with F) and finances residually through equity (bank capital). Thus, for simplicity, we restrict the financing claims to debt and equity.

At the intermediate date, t=1, bank insiders or managers make investment decisions so as to achieve a particular level of investment risk. For simplicity and for a focus on optimality of risk choices, bank investment opportunities take two forms: (1) safe investments with zero risk and non-negative net present value (NPV); and (2) one from a menu of possible risky investments (loans), which are indexed by a risk parameter q. Investments of I in riskless projects yield I at at the terminal date, t=2.[5] On the other hand, the gross cash flow outcomes from the risky projects are high (H) or low (L), with H>I>L>0, where q is the probability of the high outcome H, and (1-q) the probability of the low outcome, L.

At the core of the bank asset or lending risk incentive problem is imperfect observability by outsiders (depositors and regulators) of the asset or lending quality choices made by corporate insiders (bank managers). If asset risk choices were to be observed completely, forcing contracts (or regulatory devices) can be structured to achieve the first-best, efficient solution. Thus, in the context of our analysis, the investment and the associated risk choices made by the bank (as embodied in the loans extended or assets selected) are viewed as "private action." That is, there is less-than-perfect external monitoring of the risk choices by outsiders (including regulators).

We assume that depositors[6] only observe whether the bank chooses the safe vs. the risky investment, i.e. (1) or (2) above, but do not know q, i.e. the details of how risky is the investment actually undertaken by the bank.

Although q is observed by insiders only, both insiders and outsiders are assumed to know that q is distributed uniformly over the interval [0,1]. This approach captures the idea that the bank as an insider faces a discretionary risk choice, since it has additional information about the characteristics of the investments (say risky loans as captured in q).

At the final date, t=2, the investments are liquidated and the proceeds collected for gross cash flows of X (or the loan proceeds are collected at maturity). If the riskless investment was chosen at t=1, X will be equal to I. Otherwise, X will be equal to H or L if the risky investment was chosen.

We assume that depositors are insured by a government agency. However, as will be discussed in detail in the empirical analysis, the insurance coverage need not be an unlimited blanket guarantee, but may be more or less generous. Here we will denote with G the generosity of the deposit insurance system in place.

Thus, if the terminal cash flow at time t=2 is not enough to cover all deposit obligations, the insurance agency will honor the insured deposits of the bankrupt bank, while uninsured depositors will potentially be exposed to losses, given the limited liability of bank owners.

We capture here the concept of market discipline by assuming that uninsured depositors will demand an extra premium ρ(G) in order to be compensated in case the bank chooses a risky investment.[7] Supported by recent evidence analyzed by Bartholdy et al (2003), we assume that the risk premium ρ(G) is a negative (not necessarily linear) function of the generosity of the deposit insurance coverage. In other words, the less generous the coverage, the more risk uninsured depositors will face and therefore the higher the risk premium they will require from the bank in the event it chooses a risky investment.

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[5] To focus on risk incentives, we ignore issues of discounting by assuming that the base risk free interest is zero, so that investments of I in riskless projects yield I at the terminal date, t=2.

[6] While small, fully insured depositors might have little incentive to monitor their banks, large, partially uninsured depositors do, as will be discussed later in the text. The latter might therefore seek access to find out at least whether the bank chose risky versus safe investments, even if the details of the project riskiness are private information of the managers and therefore not contractible.

[7] As will be discussed later, one could alternatively think of ρ as representing any risk-control device besides market discipline, such as risk-based deposit insurance premia or bank (capital) regulation and supervision. They introduce an additional cost for the bank in case it takes on more risk. That is intended to discourage the bank's risk-shifting behaviour.

Figure 1 summarizes the payoffs accruing to bank stakeholders when deposit financing with a promised payment of F is outstanding and assuming that the risky investment is chosen. Denoting bank random terminal cash flows with X, bank owners face a residual payoff of MAX (0, X-F-ρ), depositors receive from the bank the payoff of MIN (X, F+ ρ). If deposits are fully insured[8], the insuring agency picks up the shortfall, MAX (0, F+ρ - X), so that depositors end up with the full promised payment, F+ ρ.

Now the incentive effects of deposit insurance are analogous to private agency conflicts. The payoff to the bank owners is isomorphic to that of a call option and the government obligation is equivalent to a put option. Risk due to the risk-increasing incentives of the banker is transferred to an insuring agency. For bank equityholders, the value of their option increases with *both* the value of future cash flows *and* the volatility of those flows. However, it decreases due to the risk-control mechanism ρ (representing here market discipline):

Value of equityholder's option = f(expected cash flows, σ , ρ)

$$(+) \qquad (+) \quad (-)$$

where σ is the volatility of bank asset cash flows. Because the option becomes more valuable as the volatility of cash flows increases, the portfolio of bank assets that generates those flows is riskier than it otherwise might be.

In short, bank owners gain by choosing riskier asset portfolios. Due to the convexity of payoffs to bank equity capital, they take full advantage of the up-side benefits but face limited down-side risk due to the deposit insurance guarantee. In fact, this risk-shifting behavior by banks has been widely viewed as a major culprit in the recent savings and loan crisis in the United States. The financial deregulation of the 1980s led to increased incentives for US thrifts and banks to engage in excessively risky lending, such as LDC loans and real estate loans, hoping for big payoffs under favorable conditions and transferring losses to the insurance agencies under adverse conditions.

Given the pay-off structure described above, bank management, working in the best interests of bank owners, observes q at the intermediate date, t=1, and decides to invest in the risky project only if it has positive NPV; otherwise they invest in the riskless project, since it has a zero NPV. There is a cut-off value, q_c, of q, such that the risky investment dominates the riskless one. This signifies an investment policy characterized by [q_c], a policy of investing in the risky asset (loan) for $q > q_c$ and in the riskless asset (loan) for $q < q_c$. Given that q is uniformly distributed over the interval [0,1], an investment policy [q_c] produces the distribution of terminal cash flows as follows:

H with a probability $1/2[1- q_c^{\,2}]$

I with a probability q_c and

L with a probability $1/2[1- q_c]^2$

where the probabilities are simply obtained by integrating the uniform distribution over the relevant areas depicted in figure 2.

Thus, the NPV to the bank as a whole (equityholders + debtholders, i.e. depositors) of an investment policy [q_c] is given ex ante at time t=0 by

$$V(q_c) = q_c I + L/2 [1 - q_c]^2 + H/2 [1 - q_c^{\,2}] - I \qquad (1)$$

When the cut-off probability (q_c) is varied from 1 to 0, the value of the terminal cash flows, expressed as (1), increases from I to V (q*) and then decreases to (H +L)/2 (see figure 3). The volatility of the terminal cash flows, $\sigma(q_c)$, can also be specified in this way. As the cut-off (q_c) is varied from 1 to 0, $\sigma(q_c)$ varies from 0 to $[(H - L)/2]^2$ (see figure 4). Thus, the cut-off probability can be thought of as an index of volatility (risk), and risk increases with *decreasing* q_c. We can actually characterize the pair of

[8] As documented by Bartholdy et al (2003), the evidence is such that, as the generosity of the deposit insurance coverage G increases, the deposit risk premium ρ(G) will decline but cannot be expected to fall to zero (even when coverage is full) due to credibility and/or moral hazard concerns.

value-risk [V (q), σ(q)] so that, as risk σ (q_c) increases from 0 to σ (q*), the value first increases from I to V (q*). However, with any further increases in risk beyond σ(q*), the value declines (see figure 5).

From the discussion above, it is clear that the pay-offs of all bank stakeholders critically depend on the optimal investment policy [q_c] chosen by the bank managers. As a useful benchmark, we will first characterize the first-best optimal investment policy [q*] that would be implemented under perfect information, without agency problems, i.e. in the event bank owners/managers were "forced" to maximize not their own welfare but the total welfare of bank equity holders + debt owners. In this case, the first-best investment policy would consist in choosing the risky asset for all q>q* with the cut-off value q* obtained from the indifference condition below:

$$qH + (1-q)\, L = I$$

$$q^* = (I-L) / (H-L)$$

Let us now consider the more realistic case under imperfect information, in which bank owners/managers choose the optimal investment policy to maximize their own pay-off as shown in figure 1.

For sufficiently high deposits (or low bank capital), the bank asset cash flows would be insufficient to repay the depositors in some state of the world (i.e. L < F). In that case, the bank goes bankrupt. However, equityholders have limited liability and their pay-off is therefore bounded from below. Moreover, as described earlier, if a risky investment is chosen, the bank will have to pay a risk premium ρ(G) on deposits, if it wants to retain its customers. Formally, the distorted investment incentives can be characterized as follows.

Having observed q, bank managers will invest in the risky asset if and only if:

$$\{ q \max [0 , (H-F- \rho)] + (1-q) \max [0 , (L-F- \rho)] \} > \max [0 , (I-F)] \quad (2)$$

For bank deposits of promised payment F + ρ > 0, the manager will implement an investment policy [q(F+ ρ)], where q(F+ ρ) is given as:

(a) Riskless deposits (F+ ρ < L): q(F) = q*

(b) Extremely risky case (F > I): q(F) = 0

(c) Most interesting case : (L < F+ ρ < I)

In this intermediate range of F, it is easy to verify that the minimum cut-off value of q for which (2) will hold as an equality is given by q_G such that:

$$q_G (H-F- \rho) = I - F \text{ , i.e. } q_G = (I-F) / (H-F- \rho)$$

For reasonably low levels of ρ, the optimal risk choice under risk-shifting will be q_G < q*. With asymmetric information and a sufficient level of deposits (F+ ρ > L), where in some states the bank fails to honor the deposit claims, the manager implements an investment policy [q_G] which is riskier than the first-best choice [q*], as q_G < q* implies σ_G > σ*, and also sub-optimal from a social perspective, i.e. V(σ_G) < V(σ*) (see figures 3, 4 and 5). Higher market discipline, i.e. higher values for ρ(G), contributes to counter-act banks' risk-shifting incentives, bringing the optimal investment policy closer to the first-best solution.

Moreover, in the most interesting parameter range of (c) above, the terminal cash flow distribution resulting from the investment policy [q_G] implemented by the manager is ceteris paribus strictly increasing in risk for increasing G, such that $\partial\, \sigma_G / \partial G > 0$. In other words, an over-generous deposit insurance system with full coverage might reduce market discipline and induce higher risk-taking on the part of banks, as opposed to a system that would leave some fraction of deposits uninsured.

However, from the standpoint of society at large, limited deposit insurance may be sub-optimal, if it reduces depositors' confidence in the safety of the banking system, thus hindering the growth of bank intermediation. In this setting, the objective function of the social planner can be thought of as being

guided by the following conflicting goals: (1) minimizing the loss of value resulting from distortionary investment policy (agency costs); (2) maximizing the value of banking activity in the liquidity services that banks provide (bank liability side) and in their role as informed agents in an environment of imperfect information – screening and monitoring of borrowers, for instance (bank asset side). Thus, the social value should consider the entire picture of the role of banks as informed agents (asset side) and liquidity providers (liability side).[9]

The stylized model presented in this Section has shown how any beneficial effect of deposit insurance on bank intermediation may be jeopardized by moral hazard incentives.

Ignoring agency problems might induce governments to design over-generous deposit insurance systems in the hope of boosting depositor confidence and increasing bank intermediation. However, as we have seen, moral hazard incentives may actually lead to excessive risk-taking and overall slower growth of bank intermediation in the long run.

In order to solve this trade-off, risk-control mechanisms are needed to avoid the inefficiencies associated with deposit insurance and bank risk-shifting. Three such risk-control devices[10] are: (1) uninsured depositors' market discipline (which is fostered by limiting the coverage of deposit insurance); (2) effective bank supervision; (3) risk-adjusted deposit insurance premia.

The empirical analysis that follows will investigate their effectiveness in promoting the soundness of the banking system, and in particular a stable growth of bank intermediation in the long run.

III. Empirics

We rely upon a cross-country database of deposit insurance features compiled by researchers at the World Bank. That database is described in detail in Demirgüç-Kunt and Sobaci (2001). We recognize that those data, although clearly the best available, may carry some limitations. In particular, the published guidelines of a deposit insurance scheme may not always be followed when crises occur. For example, Barth, Caprio and Levine (2001c) find that 27% of countries with deposit insurance coverage limits have actually exceeded them during some crisis event. While it does introduce non-negligible measurement error, this need not affect the central results of our analysis. As mentioned earlier, unlike the previous literature, we do not focus on crisis events alone, but rather analyze the long-term risk-taking incentives stemming from different deposit insurance schemes. In other words, we believe that the existence of official coverage limits (which have never been actually exceeded in 73% of countries) influences banks' *ex ante* bail-out expectations and consequently their optimal risk choices. Furthermore, it can be argued that, even in those countries where official coverage limits have been exceeded at some point in time, not all banks might have equally benefited from the exceptional bail-outs, and in general the expectation of unlimited coverage repeating itself in the future might not at all be warranted.

Thus, in conducting this analysis, our basic assumption is that the published features of deposit insurance schemes reflect reality enough to permit meaningful cross-country comparisons. In addition, we synthesize the information from this database in a few principal component indices, so as to minimize the amount of measurement error (that might be attached to specific individual features) or country-specific inconsistencies entering our regressions.

Table 1 presents design features of deposit insurance categorized as reflecting either *generosity* or *entry hurdles*. By generosity, we mean those features that determine how much compensation a depositor expects to receive in the event that her bank fails. This group also contains features that determine the credibility of that compensation. Entry hurdles are the requirements imposed on banks in order to become a member of a deposit insurance program.

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[9] See John, John, and Senbet (1991) for a complete discussion of the social planner's objective function in the context of depository institutions.

[10] They can all be thought of as curtailing banks' risk-taking and would fit very well into a broader interpretation of the variable ρ in our stylized theoretical framework.

The six variables grouped under the heading *generosity* are (1) coverage per depositor, (2) a dummy indicating whether foreign currency deposits are covered, (3) a dummy indicating whether interbank deposits are covered, (4) a categorical variable indicating whether the source of the program's funding is banks, government, or joint, (5) a categorical variable indicating whether the program is managed officially (by government), privately, or jointly, and (6) a dummy indicating whether the program requires depositor co-insurance (a deductible). The *entry hurdle* variables (see Table 1) include (1) a dummy to indicate whether membership is compulsory, (2) a dummy to indicate whether funding is on an *ex ante* or an as needed basis, (3) the annual premium payment by member banks (expressed as a percentage of insured deposits), and (4) a dummy indicating whether the premium payments are risk-adjusted (for the member bank's asset portfolio).

The two variables associated with funding source and program management are less clearly identified as features of generosity towards insured depositors. It is reasonable to assume that governmental involvement in funding and managing a deposit insurance system may be perceived to enhance its solvency. The deposit insurer's ability to meet its claims is more credible if backed by the legal authority of governments, given their ultimate control of fiscal and economic policy.

In other words, both variables may affect depositor perceptions of the credibility of the scheme. A scheme may advertise generous coverage, but that makes little difference for financial development if potential depositors do not find it credible. In that sense, these variables measure the credibility of generosity. In the empirical analysis that follows, however, the qualitative results remain largely unchanged when we drop these variables as measures of generosity.

"Entry hurdles" should be viewed as those characteristics of the deposit insurance scheme designed to avoid adverse selection problems or make member banks internalize the cost of the additional risk they bring to the system. For example, one way to make banks internalize the social costs of excessive risk-taking is to charge risk-adjusted annual premia, i.e. insurance premia that increase with the overall risk of banks' portfolios[11].

Policy makers could conceivably achieve the same objectives regarding generosity or selectivity of member banks through different deposit insurance provisions. The design features, therefore, may be either *substitutes* or *complements* for one another. For example, a generous scheme may be one that grants high coverage per depositor, or one that covers a wider variety of deposits (including, perhaps, foreign currency or interbank deposits). A less generous scheme might impose co-insurance on depositors, which obligates them to pay a "deductible" before their coverage is activated. High entry hurdles could be achieved through high member premia, or through risk-adjusted premium payments. Programs that require *ex ante* funding might also impose higher costs on members than those that do not.

Table 1 presents simple pairwise correlation coefficients for deposit insurance features for the thirty-seven countries in our sample[12] that adopted explicit deposit insurance schemes.[13] The correlations among the generosity variables in Table 1 seldom achieve significance. Probably the most significant result is that privately managed systems appear in most cases to be also privately funded and have relatively limited coverage. In addition, as logic would predict, deposit insurance systems offering higher coverage levels also require higher premium payments from member banks. Moreover, it appears that in creating higher entry hurdles, countries have tended to both increase premium payments and require that they be risk-adjusted.

We also find a significant negative correlation between *ex post* funding and government management, which we believe can reasonably be explained in accordance with our underlying theoretical

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[11] Although this holds in principle, our analysis will show how risk-adjusted premia might in fact have only limited effects.

[12] The latest version of the World Bank database on deposit insurance contains information for 178 countries, 68 of which have explicit insurance schemes. Of those 68, eight adopted deposit insurance in the 1960s or earlier. We lack sufficient IFS data for those countries to include them in the regressions. Ten others adopted deposit insurance in 1998 or 1999. Because their adoption was so recent, we lack sufficient IFS data for them to enter the regressions. For thirteen other countries, there are missing data problems that do not stem from the timing of adoption. Five are transition countries. Of the remaining eight, most do not have information on one or more of the deposit insurance features that enter our indices of generosity and entry hurdles. This leaves us with 37 countries with complete data. See Appendix E.

[13] Variable means are also included in parentheses in the far left column of Table 1. Throughout the analysis, implicit deposit insurance is simply defined as the lack of an explicit scheme.

framework. In fact, allowing a deposit insurance system to be funded only ex post may reduce banks' incentives for prudent behaviour[14]. In that case, a more stringent private management of the system can have a useful counterbalancing effect.

A. Generosity, Entry Hurdle and Bank Supervision Indices

Our key predictions are centered around the effects of deposit insurance features on the long-run growth and volatility of bank intermediation. The specific hypotheses are spelled out in Section B below. Here we provide some background to motivate the choice of both the dependent and independent variables that will enter our regressions.

As dependent variables we use measures from both the asset and the liability side of bank balance sheets. From the liability side, in line with the literature in this area - for example Demirgüç-Kunt and Levine (2001) and King and Levine (1993)- we use the ratio of liquid liabilities over GDP. From the asset side, following Levine and Zervos (1998), we use the ratio of bank credit to the private sector over GDP.

On the right hand side of our regressions, we have a number of indices that capture the main features of deposit insurance systems across countries. In particular, we have synthesized the information contained in our database regarding the generosity and selectivity (entry hurdles) of deposit insurance systems into two main principal component indices.[15]

The exact statistical procedure used to derive the principal component indices is illustrated in Appendix D. Here we would like to underscore the key conceptual and technical reasons for the use of principal component indices in our analysis.

First, the use of indices makes for a more direct correspondence between our regression variables and the theoretical concepts outlined in the previous Section; this greatly facilitates the task of studying simple linear relationships between deposit insurance features and the long-run growth and volatility of bank intermediation. *Second*, since there are multiple variables that enter the indices, it also makes it possible to formulate more flexible policy recommendations, allowing for tailor-made country specific solutions[16]. *Third*, from an econometric perspective, since some design features are closely related (as they express different aspects of coverage, etc.), including principal component indices in the regression analysis represents a way to avoid, at the same time, potential problems both of multicollinearity (if we were to include all individual features in the same regression) and of omitted variable bias (in case we decided to omit some arbitrarily due to our limited degrees of freedom). *Finally*, we employ principal component analysis rather than alternative techniques, such as factor analysis, because the resulting indices are simple linear combinations of the original design variables using "optimal" weights.[17] Therefore, regression results involving such indices can easily be translated in terms of a package of single design features, with the additional flexibility noted above.

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[14] Consider the incentives facing a high-risk bank in a system funded only ex post. The bank will not be called upon to contribute to the fund unless a crisis occurs. But when a crisis occurs, there is a non-negligible probability for the high-risk bank to go bankrupt. In that event, once its net worth has dropped to zero, due to limited liability, there is no further room for any additional costs to the shareholders from having to contribute to the deposit insurance fund. In other words, a high-risk bank might reasonably expect that its ex post contribution to the fund will in fact never be paid. In this sense, the commitment to contribute to the deposit insurance fund only ex post might not be credible and could fail to effectively constrain banks' risk-shifting incentives.

[15] See Section II for a more detailed description of both generosity and entry hurdle variables.

[16] As explained in more detail in Appendix D, each index may be interpreted as a linear combination of deposit insurance design features. As a consequence, the same score on a given index can be obtained with different combinations of deposit insurance features. This means that recommending (as this paper does) not to exceed critical levels in the generosity of the deposit insurance system does not translate into a one-size-fits-all recommendation of specific levels for coverage limits or specific arrangements regarding the system's funding, management, etc. In this framework, each country retains considerable degrees of freedom in designing individual features, based on its political, institutional and economic constraints, such that the overall score on the generosity index be kept below recommended critical levels.

[17] By contrast, in factor analysis, weights are obtained by minimizing the information lost in replacing a whole matrix of design features with one or more vectors that account for most of the variation in the original component variables. Those vectors

One implication of this paper is that the potential adverse effects of deposit insurance may be mitigated by effective bank regulation and supervision. Even if depositors have little incentive to monitor their banks, sound supervision may limit some abuses and lead to healthier bank asset portfolios. Therefore, in addition to our own principal component indices described above, we borrow from the empirical literature in this area one standard index of the rule of law and three alternative indices of the quality of bank supervision.

The rule of law index is a six-point measure created by the *International Country Risk Guide* (ICRG).[18] Higher scores indicate "sound political institutions, a strong court system, and provisions for an orderly succession of power." While not a perfect indicator (the U.S., for example, which scores well on the index, did suffer the S&L crisis) the index has been used in the empirical financial literature for purposes similar to ours. Authors have used the index in growth regressions as a general measure of institutional development Knack and Keefer (1995) and as a proxy for institutional development in the financial sector Demirgüç-Kunt and Detragiache (1997).[19] Demirgüç-Kunt and Detragiache (2002) show that explicit deposit insurance contributes to increased banking-sector fragility in countries where institutional quality is poor.[20] Among the institutional indicators in their regressions, they note that the rule of law and the quality of the bureaucracy best explain variation in the occurrence of banking crises. In the regressions that follow, therefore, we rely on the rule of law as one of our proxies for institutional development and effective bank supervision.

To capture specific aspects of the incentives and powers of bank supervisors, we rely on three additional variables from Barth, Caprio, and Levine (2001c), based on a new database of bank regulation and supervision in 107 countries. The first is a fourteen-point index of official supervisory powers. This index is based on fourteen questions that ask whether the supervisory authorities have the power to take specific actions to prevent and correct problems. The second is an index of supervisory discretion based on four questions which ask whether authorities may engage in forbearance when confronted with violations of laws and regulations or other imprudent behavior.[21] Finally, we use a dummy variable that indicates whether supervisors are independent from legal reprisals from banks and other parties. Using simple interaction terms, the ICRG legal index and the three Barth, Caprio, and Levine (2001a,c) supervisory variables enable us to measure the effects of generosity and entry hurdles in weak versus strong regulatory environments.

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do not correspond directly to any particular design feature. This makes it more difficult to provide specific policy advice regarding program design.

[18] Legal tradition data are averaged over 1984-2001 for each of our countries.

[19] More specifically, because the index is a good predictor of the use of long-term debt by large firms in their cross-country sample, Demirgüç-Kunt and Maksimovic (1998) use it as an indicator of the ease with which firms can enter into long-term contracts. They point out that it is a better indicator of the quality of the contracting environment than specific differences in legal codes because firms may be able to compensate for the absence of specific legal protections by altering the provisions of contracts. La Porta et al (1998) demonstrate that countries with legal codes that afford a relatively high level of protection for investors tend also to have stronger enforcement of laws, as reflected in higher ICRG index scores. Our index, therefore, might be thought of as summarizing both the quality of the regulations on the books and the quality of enforcement of those regulations. Finally, Barth, Caprio, and Levine (2001a) create a general measure of good government by computing the average value of three variables: our rule of law index and the ICRG indices for "risk of expropriation by the government" and for "the degree of corruption." They find that those countries that score well on their good government index tend to impose fewer regulatory restrictions on their banks and have less state ownership of the banking sector. While each of these studies illustrates a slightly different aspect of financial sector development that is captured by the rule of law, it is a proxy for the quality of regulation and supervision that has been widely used in the empirical financial literature.

[20] One might be concerned that these proxies only imperfectly control for the quality of regulation and supervision. However, using a comprehensive cross-country database on the regulation and supervision of commercial banks, Barth, Caprio, and Levine (2001a) confirm the Demirgüç-Kunt and Detragiache (2002) results controlling for variation in the nature of government oversight.

[21] The questions for both the index of official supervisory powers and the index of supervisory discretion are reported in Appendix C.

B. Hypotheses

As laid out in Section II, deposit insurance may prevent panic and bank runs, but it transfers risk to the insuring agency. In a poorly regulated environment, banks have an incentive to engage in investment (loan) activities which are excessively risky, relative to the socially desirable level of risk ($\sigma_G > \sigma^*$). With unresolved moral hazard, the more generous the deposit insurance system is, the less effective market discipline will be in curbing banks' risk-shifting incentives ($\partial\ \sigma_G / \partial G > 0$). We expect these effects to be reflected in more volatile returns to banking with alternating periods of booms and busts in bank intermediation. However, the incentive to increase riskiness, and thus volatility, should be more effectively curtailed in sound regulatory and supervisory environments. These thoughts lead to our first two hypotheses:

H_1: Generous deposit insurance schemes might lead to greater volatility in the growth rates of bank intermediation over the long run. If so, the coefficient for "generosity" should be positive and significant in the volatility regressions.

H_2: Any increased volatility due to relatively generous deposit insurance should be mitigated by a sound supervisory environment. If so, the coefficients for "generosity x supervision" should be negative and significant.

We note also that volatility is reduced only by *effective* supervision. While the rule of law is likely positively associated with effective supervision, the powers, discretion, and independence measured by the three Barth, Caprio and Levine (2001a,c) variables could result in effective or ineffective supervision. For example, the discretion to forbear on the part of supervisors could provide important flexibility in difficult situations, or it could be abused by authorities reluctant to impose discipline on poorly performing banks. Therefore, the interaction terms in our regressions should be viewed as joint tests of whether different types of supervisory arrangements can mitigate potentially adverse effects of explicit deposit insurance.

Hypotheses regarding entry hurdles are qualitatively similar to those for generosity, but they tie into our theory slightly differently. In particular, one could view entry hurdles as a selection device that creates a roster of insured banks less prone to take on risky assets. In that sense, much like some forms of bank regulation or supervision, the entry hurdles could contribute to a less volatile financial sector. Indeed, risk-adjusted premium payments, a component of the entry hurdle index, may provide an incentive for banks with riskier asset portfolios to eschew insurance. On the other hand, requiring higher premia of insured banks that take on higher risks could be a mechanism to make them internalize the social costs of their risky business.

For purposes of exposition, it is easier to invert our entry hurdle index (a "good" thing) into an index of weak selection criteria (a "bad" thing). In that way, predictions about the coefficients for generosity (also a "bad" thing) and its interaction with the legal index are now identical to those for poor selection:

H_3: Lower entry hurdles lead to greater volatility in the growth rates of bank intermediation over the long run. If so, the coefficient for "poor selection" should be positive and significant.

H_4: Increased volatility due to low entry hurdles should be mitigated by a sound supervisory environment. If so, the coefficient for "poor selection x supervision" should be negative and significant.

Not only can generous deposit insurance lead to excessive risk-taking, but it might also distort banks' choices away from the optimal profit-maximizing portfolio. In other words, the overall performance of the banking sector and the growth in bank intermediation might be negatively affected. As before, a sound regulatory and supervisory environment may mitigate the potential negative incentive effects of deposit insurance. Therefore, our final two hypotheses are:

H_5: Overly generous deposit insurance and poor selection of member banks may lead to inefficient investment choices with potential negative effects for the long-run performance of the banking sector and growth of bank intermediation. If so, the coefficients for "generosity" and "poor selection" should be negative in our growth rate regressions.

H_6: The adverse growth effects of generosity and poor selection should be reduced by a sound supervisory environment. If so, the coefficients for "generosity x supervision" and "poor selection x supervision" should be positive in our growth rate regressions.

We can formalize the six key hypotheses spelled out above with the following simple regression model:

$$Y_{1i} = \alpha_0 + \beta_{G1} G_i + \beta_{G2} G_i Supervision_i + \beta_{H1} H_i + \beta_{H2} H_i Supervision_i + \beta_M M_i + \beta_r R_i + \varepsilon_{1i} \quad (1)$$

where Y_{1i} is an indicator of the long-run growth rate of the depth of bank intermediation, or a measure of the volatility of that indicator in country *i*; *G* is the generosity of deposit insurance; *H* represents the weakness of the entry hurdles, or requirements, imposed by the deposit insurance program on member banks; *Supervision* is either the index of the quality of the rule of law or one of the three Barth, Caprio and Levine (2001a,c) indices of bank supervision; *M* is a set of macroeconomic control variables and *R* represents other potentially relevant aspects of the deposit insurance program or the banking sector. For the regressions in which the dependent variable is the volatility of growth rates in bank intermediation over the long run, Hypothesis 1 (H_1) implies that $\beta_{G1}>0$; H_2 implies $\beta_{G2}<0$; H_3 implies $\beta_{H1}>0$; and H_4 implies $\beta_{H2}<0$. For the regressions in which the dependent variable is the long-run growth rate of bank intermediation, H_5 implies that $\beta_{G1}<0$ and $\beta_{H1}<0$, while H_6 implies that $\beta_{G2}>0$ and $\beta_{H2}>0$.

Deposit insurance design features exhibit considerable variance across countries but, once in place, tend to remain fairly stable over time. We chose, therefore, to run a cross-section analysis (as opposed to a time-series or panel regression) as that allows us to capture most of the variability in our sample.

We computed long-run averages of Y_1 and M by aggregating data over all the years between 1960 and 2001 following each country's adoption of an explicit deposit insurance system. In other words, we focus the analysis on how the adoption of specific deposit insurance features might impact *subsequent* growth and volatility in banks' balance sheets by altering the incentives of both borrowers and lenders.

The set of macroeconomic control variables in M includes inflation and real growth. High inflation, which may make some types of financial contracting more problematic, might be an obstacle for stable growth of bank intermediation. Real growth should in general have a positive effect on the growth rates of banking activity, but a less clear effect on volatility. We also include the initial level of private sector credit to GDP or banking sector liabilities to GDP to control for convergence. In the financial development and growth literature, initial income per capita is used to control for convergence; its coefficient is negative and significant Beck, Levine, and Loayza (2000). Similarly, we expect our measures of initial financial depth to show negative coefficients in both our growth and volatility regressions.

These explanatory variables have also been used by other authors to test whether deposit insurance affects banking system stability, except that GDP per capita replaces the initial level of financial depth (Demirgüç-Kunt and Detragiache (2002)).[22] While these are our basic control variables, in the robustness checks Section we include a number of additional variables in our regression equation.

IV. Results

OLS estimates for equation (1) appear consistent with most of our predictions[23]. However, we cannot rely on least squares estimates given the truncated nature of our deposit insurance dataset. Underlying common factors (income, legal tradition, past financial volatility, etc.) might be driving a non-random selection of the countries in our sample such that OLS estimates of (1) might be biased.

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[22] Demirgüç-Kunt and Detragiache (2002) model the occurrence of crises and thus also include the terms of trade, short-term interest rates, and the availability of reserves as explanatory variables. Because we are modeling long-term financial development, those controls are not relevant. We note also that we do control for income per capita in the first stage of our regressions.

[23] Full OLS results are available from the authors upon request.

That is, they fail to extend to the whole population of countries with and without explicit deposit insurance.

Most of the previous empirical literature in this area tends to neglect this sample selection problem. We instead specifically address this issue by estimating a generalized Tobit sample selection model[24], which allows us to endogenize the selection of the sample of countries that adopted explicit deposit insurance based on three key variables: prior financial sector volatility, ICRG rule of law and per capita income.[25] We expect that strong legal tradition and general institutional development as reflected in high per capita income are positively associated with adoption of explicit deposit insurance (in fact governments offering explicit deposit insurance are mostly those of industrialized countries), while prior volatility is negatively associated with adoption, as countries have been less apt to enact deposit insurance in turbulent periods.[26] Moreover, in order to show that our results are robust to multiple estimation techniques, we estimate the model using both Heckman (1979)'s two-stage regression method and maximum likelihood.

The results obtained with sample selection correction are shown in Tables 2 and 3. Regardless of the dependent variable (the volatility of either private credit or liquid liabilities), almost all specifications in Table 2 provide support for hypotheses 1 and 2. The significant positive coefficient for generosity indicates that relatively generous deposit insurance schemes do coincide with greater subsequent financial sector volatility. The significant negative coefficient on the generosity/law interaction term indicates that the rule of law can mitigate the volatility associated with generous deposit insurance. These results are consistent with those found in Demirgüç-Kunt and Detragiache (2002) and Barth, Caprio and Levine (2001a), who find that countries with generous deposit insurance have a higher likelihood of suffering a major banking crisis, and that the rule of law can help mitigate the negative impact of deposit insurance on banking fragility.

Recall that the legal index is measured on a six-point scale. At the risk of reading too much into our model, the estimated coefficients imply that only countries with the highest scores on the legal index (five or six) can expect to experience no increase in financial volatility due to the generosity of their deposit insurance scheme. For example, the estimated coefficient for generosity in Table 2, model 6 is .444, while the coefficient on the generosity/law interaction term is –.074. The net effect of generosity for a country scoring six on the legal index is therefore: .444 – (.074 x 6) = 0. The model implies that all of the countries with average legal scores below six would experience an increase in volatility. Similar qualitative results apply for all of the models in Table 2. None of the developing countries in our sample score six on the legal index; most score well below.

As it appears to be an important control variable, we include the share of banking assets in majority state-controlled banks, which is negative and generally significant in models 5-12. In specifications 7-12, we add additional interaction terms between generosity of deposit insurance and the indices of bank supervision.[27] In specifications 7 and 8, the index of official supervisory powers interaction term is positive and nearly significant. Although the generosity variable loses significance in these two specifications, its coefficient remains positive, and it and the interaction term are jointly significant. Contrary to hypothesis 2, official supervisory power is associated with increased sector volatility in countries that adopted generous deposit insurance. Barth, Caprio and Levine (2001a) also find that official supervisory power does not mitigate the negative impact of generous deposit insurance on the likelihood of suffering a major crisis.

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[24] See Maddala (1983) or Amemiya (1985) for more details on generalized Tobit regression models for truncated data.

[25] We also experimented with including a variable indicating whether a systemic banking crisis had occurred in the five years prior to adopting deposit insurance. That variable was never significant.

[26] Like our other volatility measures, prior volatility is measured as the coefficient of variation in our two financial indicators. For countries that never adopted explicit deposit insurance, the prior volatility measure was calculated over the entire period 1960-2001 (although data availability implied that, in practice, most observations were calculated over a smaller subset of that period). For countries that adopted explicit deposit insurance, the prior volatility measure was calculated over the period just prior to adoption. Qualitative results are similar regardless of whether we use the three-year or the five-year interval just prior to adoption. Results for the three-year period are shown here.

[27] When all four interaction terms enter the regression simultaneously, significance levels fall. This is likely because we have only 25-29 observations in the second stage regression.

The index of supervisory discretion is insignificant in models 9 and 10, and the index of supervisory independence is negative in models 11 and 12, but significant only in model 11, which employs Heckman's two-stage selection estimation procedure. Based on models 5-12, only the rule of law and supervisory independence from legal reprisal help mitigate the financial sector volatility associated with generous explicit deposit insurance. Barth et al and others have argued that the rule of law is a measure of the security of property rights. Our results also indicate that in countries where the value of deposits is uncertain because contracts are easily abrogated, the volatility of liquid liabilities to GDP is high in countries with generous deposit insurance (although the result is significant at only the ten percent level in Table 2, model 3). The value of bank assets is also uncertain in these environments, which likely implies a higher share of short-term credit, which must be repeatedly renegotiated. As a result, the combination of generous deposit insurance and uncertain property rights also implies greater volatility in the ratio of private sector credit to GDP.

The specifications in Table 2 provide little support for hypotheses 3 and 4. Coefficients for the index of weak selection criteria and for the selection/law interaction term are never of the hypothesized signs, and are insignificant in most specifications. This indicates that the entry hurdles imposed on member banks have little effect on subsequent volatility, regardless of the nature of supervision or the rule of law. Taken together, the generosity and the selection results imply that, if a country adopts a generous deposit insurance program, it should not expect to curtail subsequent increases in financial volatility through careful selection of member banks. The rule of law and supervisory independence from legal reprisal may help limit volatility associated with deposit insurance, but the specific rules governing which banks have access to insured deposits appear to play no role.

The specifications in Table 3 help us assess whether the inefficient risk-taking associated with deposit insurance accelerates or retards long-run growth in bank intermediation. The negative significant coefficient for generosity provides some support for our hypothesis H_5. An over-generous deposit insurance might distort savings and investment decisions away from the profit-maximizing choices, thus contributing to poorer banking sector performance and slower growth of bank intermediation in the long run. The generally insignificant coefficients on the generosity/supervisory powers interaction term indicate that such powers do not mitigate this effect. Nor does the rule of law (see models 3 and 4 in the robustness checks, Table 4). However, the positive significant coefficients on the generosity/discretion and the generosity/independence interaction terms in models 3-8 indicate that some types of supervision may act as an adequate substitute for monitoring of banks by depositors. Note that in models 1 and 2 we include all countries that adopted deposit insurance from 1960 to 2000. Because many countries adopted deposit insurance only recently, their experience is probably too short to be statistically reliable. Therefore, in specifications 3-12 we include only those countries that adopted deposit insurance prior to 1996.

Because the index of generosity enters models 3-8 in four ways (on its own and through three separate interaction terms), assessing its net effects on long-run growth in bank intermediation based solely on the estimated coefficients is difficult. Therefore, we illustrate our main results with a couple of examples. In many cases, for countries that permit their supervisors greater discretion and afford them independence from legal reprisal, introducing generous deposit insurance appears beneficial. If we set the explanatory variables (except for generosity of deposit insurance and the index of supervisory independence) equal to the median value for the sample of countries that adopted deposit insurance, the predicted private credit growth rate is 10.7% per year for those countries with full supervisory independence and the most generous deposit insurance. For those that do not afford supervisors independence from legal reprisal but have the most generous deposit insurance, the predicted growth rate is 2.2%, which is well below the predicted rate had explicit deposit insurance not been adopted (8.8%). If we set the explanatory variables equal to the 25th percentile of the sample of countries that adopted deposit insurance, the predicted growth rate for a country with no supervisory independence from the legislature and the most generous deposit insurance is –8.0%. With full supervisory independence, the predicted growth rate for that country is 0.2%. Both are well below the predicted rate without explicit deposit insurance (6.4%). With or without supervisory independence, the predicted private growth rate is declining in generosity for the country at the 25th percentile. This second example is probably more reflective of the situation faced by most developing countries.

Similar qualitative results apply for the index of supervisory discretion. For the median country that adopted deposit insurance, generosity has a positive net effect on long-run growth in bank intermediation if supervisors have wide discretion. With little or no discretion, generosity has a negative effect. For countries at the 25th percentile of the distribution, generosity tends to have a negative effect on long-run growth in bank credit regardless of the level of supervisory discretion. For

those countries, long-run growth rates in private credit are almost always higher without explicit insurance. In conclusion, by drawing more savers into the formal financial system generous deposit insurance can boost bank intermediation, but only if macroeconomic stability and the appropriate supervisory flexibility and autonomy are in place.

In specifications 1-8, we control for poor selection of insured banks, which is negative but generally insignificant. In specifications 9-12, the generosity and poor selection variables switch roles – we control for generosity and we interact the poor selection variable with the supervisory indices. Although the index of poor selection is negative and significant in the private credit growth models (9 and 10), it is insignificant in the liquid liabilities growth models (11 and 12), and the selection/supervision interaction terms are insignificant in eleven of twelve possible cases. As in the volatility regressions, poor selection of member banks has much less effect on the growth of bank intermediation than generosity. We note also that in models 9-12 the index of generosity is insignificant.[28] In conjunction with models 1-8, this once again indicates that generous deposit insurance cannot be associated with faster or slower growth of bank intermediation per se, but that the regulatory and legal environment in which it is adopted greatly matters.

V. Robustness Checks

An additional advantage of using a Heckman approach is that estimating simultaneously the determinants of the decision to adopt an explicit deposit insurance system along with its impact on financial sector volatility and growth helps to dismiss concerns of reverse causation or simultaneity bias.

A priori, while it is possible that the decision to adopt explicit deposit insurance (or none at all) may depend on the growth rates of bank intermediation and their volatility[29], it is much less likely that specific deposit insurance features are designed conditional on these indicators. In a similar setting, Demirgüç-Kunt and Detragiache (2002) provide a series of instrumental variable tests refuting the hypothesis that the specific program features are endogenous.

As a robustness check, we also perform a set of Hausman tests following Davidson and MacKinnon (1993). Results reported in Appendix B show no evidence of endogeneity affecting either one of our principal component indices. Furthermore, coefficient estimates are consistent and confirm our basic findings in the previous Section.

As additional robustness checks, in the remainder of this Section we test whether our baseline results are sensitive to the inclusion of additional variables that describe the nature of bank ownership, market power, the age of the deposit insurance program, and the independent effects of supervisory variables.

A. State Ownership of Banks

As noted, the percentage of total banking sector assets held by majority state-owned banks is negatively and often significantly associated with the volatility of bank intermediation. The coefficient on state ownership of banks is also negative and nearly significant in private credit growth specifications 1 and 2, Table 4.[30] In addition, state ownership is negatively, though insignificantly,

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[28] Barth, Caprio and Levine (2001a) also find that generosity on its own is not significantly linked to the level of financial development.

[29] Our two-step Heckman estimation technique controls for that.

[30] In many African countries, a majority of banks' assets are in government bonds, which might be partially responsible for our results. That is, in those countries, there is a much greater propensity to channel deposits to the government than to private endeavors. To the extent that state-owned banks are more likely to purchase government bonds than private banks, the negative coefficients on the state ownership variables in the volatility and the private credit growth regressions are reflective of this phenomenon. We tried to test this hypothesis directly by including in the regressions the share of deposit money

associated with the probability that deposit insurance is adopted (results not reported). Our results on the generosity of deposit insurance and the supervisory interaction variables remain unchanged when we add state ownership of banks to either stage of the regressions.

B. Banking Sector Concentration

Market structure might also impact the volatility and growth of bank intermediation. We add the share of banking sector assets held by the three largest banks to our base private credit growth specifications in models 5 and 6, Table 4. Predictions regarding concentration are ambiguous. It may be associated with reduced volatility, but have a negative effect on growth rates, because a small number of dominant banks may be less inclined to hunt down new investment opportunities than would a higher number of less-established banks. Risk-taking on the part of less-established banks may, however, be so destabilizing as to retard long-term growth in bank intermediation. The banking literature is still divided on the merits and faults of concentration. In neither of our specifications is our proxy for concentration significant, and our main results regarding the generosity of deposit insurance are unchanged. The main results for the volatility regressions are also unchanged when we add the concentration measure (results not reported).

C. Age of Deposit Insurance Program

The number of years since adoption may be associated with both volatility and growth of bank intermediation since it may take time before the effects of deposit insurance are evident. Therefore, we control for the age of the deposit insurance program in specifications 7 and 8, Table 4. In neither of those specifications is the "years in place" variable significantly associated with the growth rate of private sector credit. This could be because in those regressions we include only countries that adopted deposit insurance prior to 1996, and thus sufficient time had elapsed for the program's effects to manifest themselves. Our results regarding generosity and the supervisory interaction terms are unaffected by the inclusion of the age of the deposit insurance program.

D. Supervisory Variables

The three supervisory indices – for supervisory powers, discretion, and independence from legal reprisal – could impact the growth and volatility of bank intermediation on their own, and not just through their interaction with deposit insurance features. To test this, we add these variables to our base models in specifications 9-12, Table 4. Because we have so few second stage observations, this is a strong test of the robustness of our results. None of the indices are significant on their own in specifications 9 and 10, which use private credit growth as the dependent variable. Using an instrumental variables approach, Barth, Caprio and Levine (2001a) also find no significant link between the level of private sector credit to GDP and indices of supervisory power and discretion. With respect to supervisory independence, they find a positive significant association with private sector credit. Somewhat similarly, among the supervisory interactions with generosity of deposit insurance, only independence from legal reprisals is positive and significant in specifications 9 and 10. Although the Barth Caprio and Levine (2001a) dependent variable and estimation method differs from ours, we derive similar qualitative results regarding supervisory variables. Most importantly, adding the supervisory variables to our base specifications does not alter our main results – the generosity of deposit insurance is negatively and significantly associated with private sector credit growth and supervisory independence from legal reprisal appears to mitigate that effect. Supervisory discretion remains positive, but its coefficient just misses significance.

In specifications 11 and 12, we add the supervisory indices to our base volatility regressions. As in the private credit growth regressions, none of the indices are themselves significant.[31] Our main results

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banks' assets devoted to claims on local, state, and federal governments. We did not have enough observations (14) to provide meaningful results.

[31] Barth, Caprio and Levine (2001a) also find no significant association between supervisory powers and the likelihood of banking crises.

are unaltered, except that the generosity/law interaction term just misses significance in the maximum likelihood regression (specification 12). In the Heckman selection model, that variable remains negative and significant. In both specifications, the generosity of deposit insurance is positively and significantly linked to the volatility of private credit.

VI. Conclusions

Although many countries in advanced and developing economies grant formal deposit insurance so as to reduce the risk of systemic failure of depository institutions, our knowledge of the impact of deposit insurance programs on the long-run growth and volatility of bank intermediation is quite limited.

In this paper, we have analyzed several deposit insurance features (such as coverage, premium structure, etc.) by means of principal component indices, paying particular attention to potential sample selection and endogeneity concerns in our estimations.

Our empirical construct is guided by recent theories of banking regulation that employ an agency framework. The basic moral hazard problem studied is the incentive for depository institutions to engage in excessively high-risk activities, relative to socially optimal outcomes, in order to increase the option value of their deposit insurance guarantee.

Overall we find empirical evidence to be consistent with this theory. Generous government-funded deposit insurance tends to have a negative effect on the long-run growth of bank intermediation, except in countries where the rule of law is well established and both sufficient supervisory discretion and independence from legal reprisal are in place.

Thus, the main conclusion of this paper is that the introduction of generous deposit insurance schemes in countries lacking adequate bank supervision and rule of law might not help but may rather be an obstacle for stable growth of bank intermediation in the long run. In other words, either effective bank supervision or attentive market discipline by uninsured depositors is necessary to curb banks' moral hazard incentives associated with deposit insurance.

An additional finding of this paper is that "entry hurdles", such as the insurance premium requirements on member banks, have little effect on discouraging banks' risk-taking behaviour. This is consistent with recent research that has shown how deposit insurance is largely under-priced in most countries, in the sense that banks seldom pay a fair premium in exchange for the insurance they get.[32] This might suggest that deposit insurance premia are generally so low that – even when risk-adjusted - their effectiveness as entry hurdles to constrain banks' risk-taking incentives might be seriously compromised.

We need to place a caveat on our findings as they are based on cross-country evidence and might therefore not necessarily reflect the complexity of the specific situation in any particular country. However, we believe that the use of principal component indices, as a linear combination of deposit insurance design features, partly addresses the concern of recommending one-size-fits-all solutions. In fact, the same score on a given index can be obtained with different combinations of deposit insurance features. In other words, recommending not to exceed critical levels in the generosity of the deposit insurance system does not translate into specific levels for coverage limits or specific arrangements regarding the system's funding, management, etc. In this framework, each country retains considerable degrees of freedom in designing individual features, based on its political, institutional and economic constraints, such that the overall score on the generosity index may be kept below some recommended critical levels.

In addition, our rich set of control variables and robustness checks further helps to account for the diversity of economic and institutional circumstances across countries that remain exogenous to the analysis. Finally, the Heckman estimation technique allows us to compare the subset of countries with explicit deposit insurance with those that only have implicit insurance and to correct for any systematic

[32] Laeven (2002).

difference between the two, in order to ensure that the estimation sample is representative of the full population.

Having said that, country case studies would of course constitute a useful complement to the present analysis in order to investigate the impact of specific deposit insurance systems on bank intermediation over time within a particular economic and institutional context.

This paper lends itself to a number of other natural extensions. For example, deposit insurance is but one aspect of the incentives produced by the regulatory environment. Another important regulatory feature that might affect incentives is capital regulation. More research is needed to analyze the adequacy of capital ratios around the world and their impact on banks' risk-shifting incentives.

Finally, we focus on deposit insurance and bank intermediation. Although banks play a key role in the financial system of most of the countries in our sample, the increasing importance of capital markets as well as of non-bank financial institutions for systemic financial stability suggests that it may be worthwhile to extend the analysis of this paper to the broader range of agents and mechanisms which constitute the financial system.

References

Allen, Linda and Anthony Saunders. (1993) “Forbearance and Valuation of Deposit Insurance as a Callable Put” Journal of Banking and Finance 17 (1993), 629-43.

Amemiya, Takeshi. (1985) *Advanced Econometrics*. Cambridge, MA: Harvard.

Barnea, Amir, Robert A. Haugen, and Lemma W. Senbet. (1985) “Agency Problems and Financial Contracting”, Upper Saddle River, NJ: Prentice Hall.

Barth, James R., Gerard Caprio, Jr., and Ross Levine. (2001a) “Bank Regulation and Supervision: What Works Best?” World Bank policy research working paper 2725.

Barth, James R., Gerard Caprio, Jr., and Ross Levine. (2001b) “Banking Systems Around the Globe: Do Regulation and Ownership Affect Performance and Stability?” In *Prudential Supervision, What Works and What Doesn’t*, edited by Frederic S. Mishkin, pp. 31-94. Chicago: University of Chicago Press.

Barth, James R., Gerard Caprio, Jr., and Ross Levine (2001c). ‘The Regulation and Supervision of Banks around the World: A New Database.’ *Brookings-Wharton Papers on Financial Services* 0, 183-240.

Bartholdy J. et al. (2003) “Deposit Insurance and the risk premium in bank deposit rates”, *Journal of Banking and Finance* 27, 699-717.

Beck, Thorsten, Asli Demirgüç-Kunt, and Ross Levine (2001). “The Financial Structure Database.” In *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development*, Edited by Asli Demirgüç-Kunt and Ross Levine, pp.17-80. Cambridge and London: MIT Press.

Beck, Thorsten, Ross Levine, and Norman Loayza. (August 2000) “Finance and the Sources of Growth,” *Journal of Monetary Economics*, 46:1, 31-77.

Buser, Stephen A., Andrew H. Chen, and Edward J. Kane. (March 1981) “Federal Deposit Insurance, Regulatory Policy and Optimal Bank Capital,” *Journal of Finance*, 36:1, 51-60.

Calomiris, Charles. (June 1990) “Is Deposit Insurance Necessary? A Historical Perspective,” *Journal of Economic History*, 50:2, 283-95.

Chan, Yuk-Shee, Stuart I. Greenbaum, and Anjan V. Thakor. (March 1992) “Is Fairly Priced Deposit Insurance Possible?” *Journal of Finance*, 47:1, 227-45.

Cull, Robert, Lemma W. Senbet and Marco Sorge. (January 2002) “The Effect of Deposit Insurance on Financial Depth: A Cross-Country Analysis,” *Quarterly Review of Economics and Finance*, 42:4, 673-94.

Davidson R and J G MacKinnon (1993): “Estimation and Inference in Econometrics”, Oxford University Press, Oxford.

Demirgüç-Kunt, Asli, and Enrica Detragiache. (1997) “The Determinants of Banking Crises: Evidence from Industrial and Developing Countries,” World Bank policy research working paper 1828.

Demirgüç-Kunt, Asli, and Vojislav Maksimovic. (December 1998) “Law, Finance, and Firm Growth,” *Journal of Finance*, 53:6, 2107-37.

Demirgüç-Kunt, Asli and Ross Levine (2001). *Financial Structure and Economic Growth: A Cross-Country Comparison of Banks, Markets, and Development*, Cambridge and London: MIT Press.

Demirgüç-Kunt, Asli, and Tolga Sobaci. (September 2001) “A New Development Database: Deposit Insurance Around the World,” *World Bank Economic Review*, 15:3, 481-90.

Demirgüç-Kunt, Asli and Enrica Detragiache (2002). ‘Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation.’ *Journal of Monetary Economics* 49, 1373-1406.

Demirgüç-Kunt, Asli and Edward Kane (2002). "Deposit Insurance Around the Globe: Where Does it Work? " *Journal of Economic Perspectives*, 16:2, 175-195.

Diamond, Douglas W., and Raghuram G. Rajan. (December 2000) “A Theory of Bank Capital,” *Journal of Finance*, 55:6, 2431-65.

Diamond, Douglas W., and Philip H. Dybvig. (June 1983) “Bank Runs, Deposit Insurance, and Liquidity,” *Journal of Political Economy*, 51:3, 401-19.

Dreyfus, J.F., Saunders, A. and Allen, L. (1994). „Deposit Insurance and Regulatory Forbearance”, *Journal of Money, Credit and Banking*, 26:3, Part 1, 412-438.

Esty, Benjamin C. (April 1997) “A Case Study of Organizational Form and Risk Taking in the Savings and Loan Industry,” *Journal of Financial Economics*, 44:1, 57-76.

Financial Stability Forum (2001): “Guidance for developing effective deposit insurance systems”.

Garcia, Gillian. (1999) “Deposit Insurance: A Survey of Actual and Best Practices,” International Monetary Fund working paper WP/99/54.

Gropp, Reint, and Jukka Vesala. (2001) “Deposit Insurance and Moral Hazard: Does the Counterfactual Matter?” European Central Bank working paper 47.

Heckman, James. (January 1979) “Sample Selection Bias as a Specification Error,” *Econometrica*, 47:1, 153-161.

Hellmann, Thomas, Kevin Murdock, and Joseph Stiglitz. (March 2000) “Liberalization, Moral Hazard in Banking, and Prudential Regulation: Are Capital Requirements Enough?” *American Economic Review*, 90:1, 147-65.

Hovakimian, Armen, Edward J. Kane, and Luc Laeven (2003). “How Country and Safety-Net Characteristics Affect Bank Risk-Shifting.” *Journal of Financial Services Research*, 23:177-204.

Jensen, Michael C., and William H. Meckling. (October 1976) “Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure,” *Journal of Financial Economics,* 3:4, 305-60.

John, Kose, Teresa A. John, and Lemma W. Senbet. (September 1991) “Risk-Shifting Incentives of Depository Institutions: A New Perspective on Federal Deposit Insurance Reform,” *Journal of Banking and Finance*, 15:4-5, 895-915.

John, Kose, Anthony Saunders and Lemma W. Senbet. (Spring 2000) “A Theory of Capital Regulation and Bank Management Compensation” *Review of Financial Studies*, 13:1, 95-125.

Kane, Edward J. (June 1986) “Appearance and Reality in Deposit Insurance: The Case for Reform,” *Journal of Banking and Finance*, 10:2, 175-88.

Keeley, Michael. (December 1990) “Deposit Insurance, Risk and Market Power in Banking,” *American Economic Review*, 80:5, 1183-1200.

King, Robert G., and Ross Levine. (August 1993) “Finance and Growth: Schumpeter Might Be Right,” *Quarterly Journal of Economics*, 108:3, 717-38.

Knack, Stephen, and Philip Keefer. (November 1995) “Institutions and Economic Performance: Cross Country Tests Using Alternative Institutional Measures,” *Economics and Politics*, 7:3, 207-27.

Kyei, Alexander. (1995) “Deposit Protection Arrangements: A Comparative Study,” International Monetary Fund working paper WP/95/134.

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert W. Vishny. (December 1998) “Law and Finance,” *Journal of Political Economy*, 106:6, 1113-55.

Laeven, Luc. (2002) “Pricing Deposit Insurance,” World Bank policy research working paper 2781.

Levine, Ross, and David Renelt. (September 1992) “A Sensitivity Analysis of Cross-Country Growth Regressions,” *American Economic Review*, 82:4, 942-63.

Levine, Ross. (June 1997) “Financial Development and Economic Growth: Views and Agenda,” *Journal of Economic Literature,* 35:2, 688-726.

Levine, Ross, and Sara Zervos. (June 1998) “Stock Markets, Banks, and Economic Growth,” *American Economic Review*, 88:3, 537-58.

Maddala, G.S. (1983) *Limited-Dependent and Qualitative Variables in Econometrics*, New York: Cambridge University Press.

Merton (1977): “An analytic derivation of the cost of deposit insurance and loan guarantee”, Journal of Banking and Finance, no 1, pp 3-11.

Saunders, Anthony, Elizabeth Strock, and Nickolaos G. Travlos. (June 1990) “Ownership Structure, Deregulation and Bank Risk-Taking,” *Journal of Finance*, 45:2, 643-54.

Talley, Samuel H., and Ignacio Mas. (1990) “Deposit Insurance in Developing Countries,” World Bank policy research and external affairs working paper WPS 548.

Figure 1: Pay-offs to Bank Stakeholders

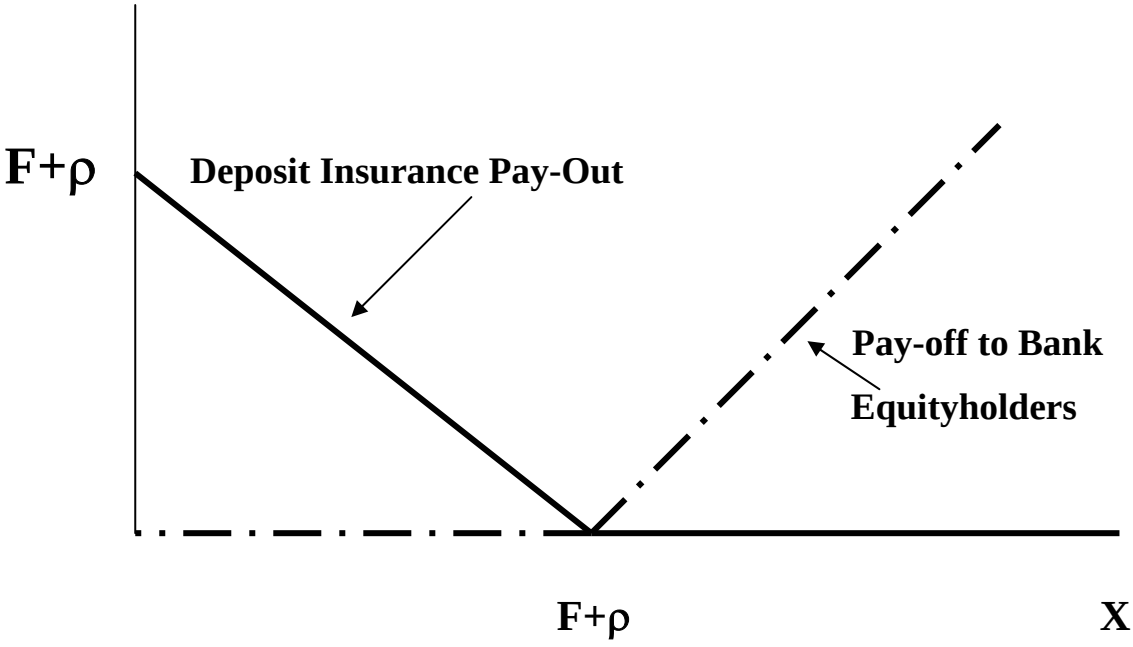

Figure 2: Probability Distribution of Terminal Cash Flows

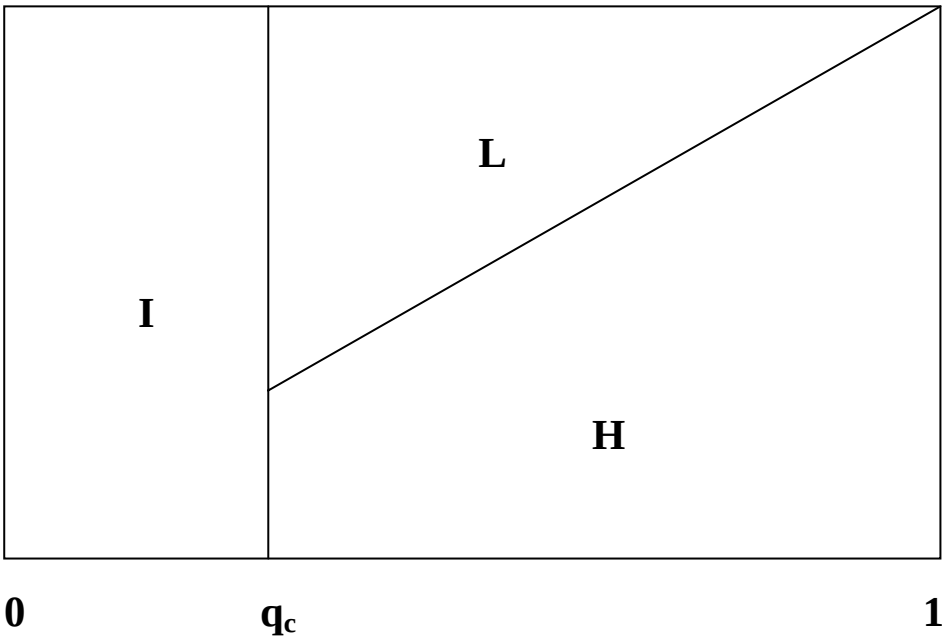

Figure 3: Bank's NPV given asset choice

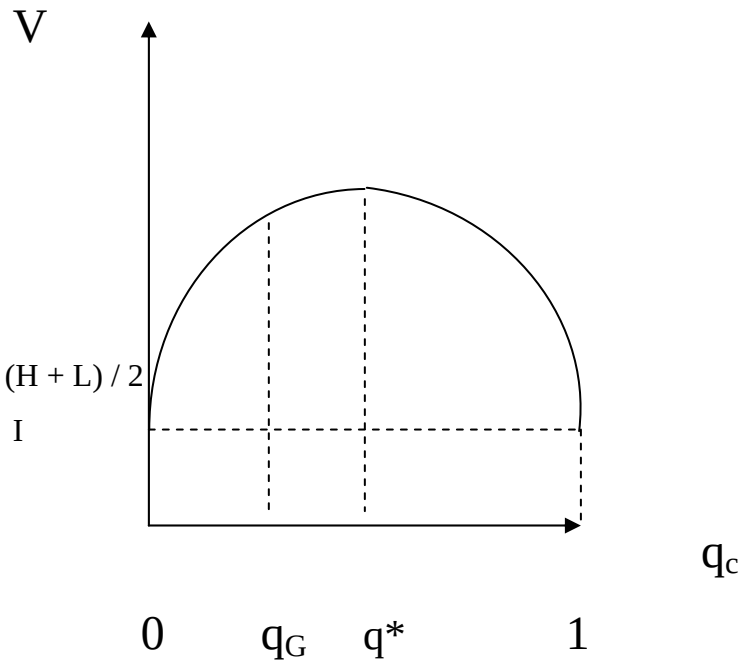

Figure 4: Bank's NPV Volatility given asset choice

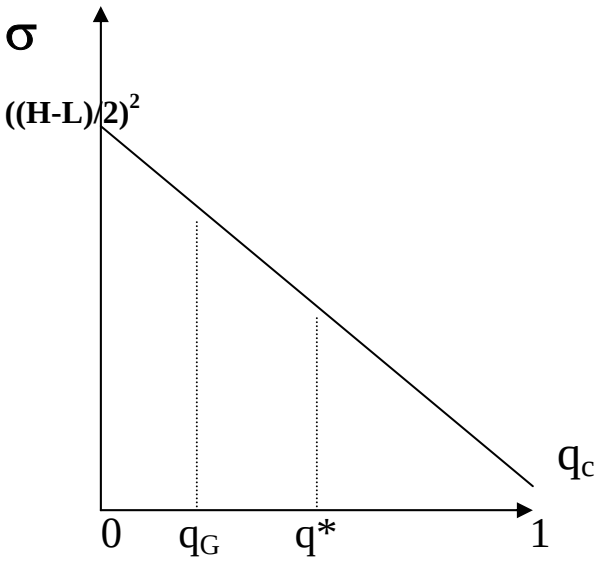

Figure 5 : Bank's Risk and Return

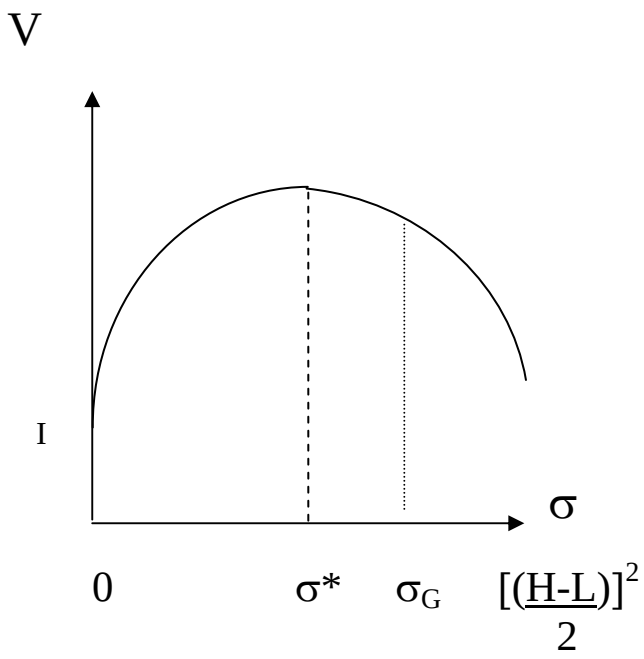

Table 1: Deposit Insurance Program Features, Pairwise Correlations

Variable	Depositor Coverage Variables "Generosity"						Bank Membership Variables "Entry Hurdles"			
	Coverage	Foreign Currency	Interbank	Source	Manage-ment	Co-insurance	Compulsory	Funded *Ex ante*?	Premium	Risk-Adjusted
Coverage	1.00									
(2.92)	(n=37)									
Foreign	-0.18	1.00								
(0.78)	(n=37)	(n=37)								
Interbank	0.31	-0.12	1.00							
(0.16)	(n=37)	(n=37)	(n=37)							
Source	0.15	-0.10	0.20	1.00						
(0.78)	(n=37)	(n=37)	(n=37)	(n=37)						
Management	-0.26	0.18	-0.37*	-0.64**	1.00					
(1.65)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)					
Co-insurance	-0.19	0.31	-0.27	0.02	0.04	1.00				
(0.27)	(n=29)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)				
Compulsory	0.09	0.46**	0.10	0.14	-0.11	0.15	1.00			
(0.94)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)			
Funded ex ante	0.19	-0.14	0.25	0.27	-0.49**	-0.22	0.14	1.00		
(0.76)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)		
Premium	0.36*	-0.03	-0.20	0.11	-0.04	-0.11	0.14	0.21	1.00	
(0.27)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	
Risk-adjusted	-0.12	0.25	-0.21	0.07	0.04	-0.14	0.12	0.11	0.37*	1.00
(0.19)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)	(n=37)

Note:

Table 1 provides pairwise correlations between deposit insurance program features. Coverage is a continuous variable equal to the coverage limit divided by GDP per capita. Foreign Currency is a dummy variable = 1 if foreign currency deposits are covered. Interbank is a dummy variable = 1 if interbank deposits are covered. Source is a discrete variable = 0 if the source of the program's funding is banks, = 1 if banks and government, and = 2 if government only. Management is a discrete variable = 1 if the program is officially managed (i.e. by government), = 2 if jointly managed by official and private entities, and = 3 if solely privately managed. Co-insurance is a dummy variable = 1 if depositors must pay a deductible to receive compensation after a bank closure. Compulsory is a dummy variable = 1 if bank membership in the program is compulsory. Funded ex ante is a dummy variable = 1 if member banks pay contributions *prior* to bank failures (as opposed to in response to them). Premium is the premium payments required of member banks, expressed as a percentage of insured deposits. Risk-adjusted is a dummy variable = 1 if member banks' premium payments are adjusted to reflect the risk of their assets. Variable means in ( ) in first column, except for coverage, where the Median is shown. * indicates significantly different from zero at the 5% level; ** indicates significance at the 1% level. Deposit insurance system features are taken from Demirgüç-Kunt, Asli, and Enrica Detragiache (2002). Demirgüç-Kunt and Detragiache relied on information from numerous sources including Kyei, Alexander, 1995, "Deposit Protection Arrangements: A Survey," IMF working paper WP/90/134 and Garcia, Gillian, 1999, "Deposit Insurance: A Survey of Actual and Best Practices," IMF working paper WP/99/54. The updated Demirgüç-Kunt and Detragiache (2002) database of deposit insurance features can be accessed at: http://www.worldbank.org/research/interest/confs/upcoming/deposit_insurance/dataset2.xls

Table 2: Regressions of Volatility of Financial Development Indicators

Explanatory Variables	*Dependent Variable*											
	Ln(Coeff Variation PRIV)[a] Heckman (1)	Ln(Coeff Variation PRIV) ML (2)	Ln(Coeff Variation LLIAB)[b] Heckman (3)	Ln(Coeff Variation LLIAB) ML (4)	Ln(Coeff Variation PRIV) Heckman (5)	Ln(Coeff Variation PRIV) ML (6)	Ln(Coeff Variation PRIV) Heckman (7)	Ln(Coeff Variation PRIV) ML (8)	Ln(Coeff Variation PRIV) Heckman (9)	Ln(Coeff Variation PRIV) ML (10)	Ln(Coeff Variation PRIV) Heckman (11)	Ln(Coeff Variation PRIV) ML (12)
First Stage												
Volatility PRIV	-11.53**	-11.54**			-11.13**	-11.11**	-11.13**	-11.16**	-11.13**	-11.11**	-11.13**	-11.09**
	(4.79)	(3.32)			(4.55)	(3.35)	(4.55)	(3.31)	(4.55)	(3.42)	(4.55)	(3.10)
Volatility LLIAB			-13.33**	-12.61**								
			(4.99)	(3.48)								
GDP Per Capita	.068	.068	.041	.020	.067	.067	.067	.066	.067	.066	.067	.064
	(1.95)	(1.70)	(1.00)	(0.59)	(1.90)	(1.62)	(1.90)	(1.56)	(1.90)	(1.56)	(1.90)	(1.51)
Constant	1.43**	1.43*	1.56**	1.45*	1.35**	1.34*	1.35**	1.35*	1.35**	1.34*	1.35**	1.35*
	(3.09)	(2.32)	(3.18)	(2.48)	(2.82)	(2.14)	(2.82)	(2.18)	(2.82)	(2.16)	(2.82)	(2.06)
Second Stage												
Generosity	.494**	.494*	.514	.145	.440**	.444*	.262	.265	.428*	.431*	.530**	.533
	(2.84)	(2.44)	(1.84)	(0.43)	(2.68)	(2.16)	(1.47)	(1.40)	(2.49)	(2.03)	(3.40)	(1.92)
Generosity x Law	-.084**	-.084*	-.112*	-.070	-.074*	-.074*	-.065*	-.065*	-.075*	-.075*	-.083**	-.082**
	(2.56)	(2.36)	(2.06)	(1.00)	(2.49)	(2.19)	(2.31)	(2.29)	(2.50)	(2.16)	(2.99)	(2.57)
Generosity x Sup. Power							.0202	.0202				
							(1.93)	(1.73)				
Generosity x Sup. Discretion									.0087	.0099		
									(0.24)	(0.20)		
Generosity x. Sup. Independ											-.096*	-.095
											(2.17)	(1.03)
Poor Selection	-.671**	-.671**	-.418	.007	-.354	-.356	-.394	-.395	-.342	-.341	-.378	-.378
	(3.26)	(3.50)	(1.44)	(0.09)	(1.63)	(1.22)	(1.93)	(1.67)	(1.53)	(1.07)	(1.89)	(1.46)
Poor Selection x Law	.143**	.143**	.089	.002	.076	.077	.094*	.095	.073	.073	.083	.084
	(3.21)	(3.23)	(1.33)	(0.77)	(1.57)	(1.12)	(2.04)	(1.71)	(1.43)	(0.97)	(1.86)	(1.26)
Inflation	1.856	1.855	4.671*	2.284	2.494	2.502	2.901*	2.901	2.487	2.498	2.778*	2.795
	(1.24)	(0.28)	(2.03)	(0.77)	(1.91)	(0.46)	(2.33)	(0.57)	(1.91)	(0.47)	(2.33)	(0.53)
Real Growth	6.754	6.753	-1.665	-10.41	8.158	8.217	6.475	6.543	8.611	8.709	10.01	9.983
	(1.22)	(1.01)	(0.18)	(0.99)	(1.24)	(1.17)	(1.04)	(1.09)	(1.25)	(1.12)	(1.63)	(1.27)

Initial PRIV	-1.576**	-1.576*			-1.108**	-1.104	-1.272**	-1.267*	-1.068*	-1.059	-1.214**	-1.212*
	(3.99)	(2.52)			(2.85)	(1.88)	(3.43)	(2.47)	(2.52)	(1.56)	(3.34)	(2.28)
Initial LLIAB			1.965*	-2.116								
			(2.01)	(1.64)								
% State-Owned					-.016*	-.016	-.013*	-.013	-.017	-.017	-.018**	-.018
Banks					(2.38)	(1.56)	(2.01)	(1.30)	(1.88)	(1.21)	(2.95)	(1.86)
Constant	-1.54**	-1.54*	-1.33	-.008	-1.61**	-1.63**	-1.88**	-1.89**	-1.61**	-1.63**	-1.63**	-1.65*
	(2.98)	(2.42)	(1.35)	(0.01)	(3.43)	(3.11)	(4.09)	(4.20)	(3.43)	(3.05)	(3.78)	(2.30)
Observations	111	111	111	111	107	107	107	107	107	107	107	107
# w/ Explicit DI	29	29	28	28	25	25	25	25	25	25	25	25
Log Likelihood		-39.57		-48.77		-33.45		-31.73		-33.41		-31.31
Wald Chi^2	34.37		24.94		43.32		53.47		43.49		56.18	

Note:

(a) PRIV is the ratio of bank credit to the private sector to GDP. (b) LLIAB is the ratio of liquid liabilities to GDP. The dependent variables are the coefficients of variation (standard deviation divided by mean) for PRIV and for LLIAB. They are intended to measure the volatility of growth rates of bank intermediation from both the asset and liability sides respectively. There is one observation per country, and each is calculated as an average over all years *after* the adoption of deposit insurance for which data are available from 1960-2001. Heckman's two-stage selection model is estimated for columns labeled "Heckman." The maximum likelihood selection model is estimated for columns labeled "ML." For Heckman models, z-statistics are in parentheses (t-statistics for ML models).

We employ a two-stage estimation technique to correct for sample selection bias associated with the adoption of explicit deposit insurance. In the first stage, explanatory variables include per capita income in 1995 as a proxy for general institutional development, and in some specifications "Law," a six-point measure of the quality of the rule of law averaged over 1984-2001 (see Appendix A for further description). Higher values indicate greater adherence to the rule of law. The other first stage regressors are measures of past financial sector volatility, calculated over the three years *prior* to the adoption of explicit deposit insurance. For countries that retained implicit insurance, volatility is calculated over all years from 1960 to 2001. "Volatility PRIV" is the coefficient of variation for PRIV. "Volatility LLIAB" is the coefficient of variation for LLIAB.

The second stage estimation is conditional on the adoption of deposit insurance. Regressors include "generosity" a principal components index derived from five deposit insurance program features – per-depositor coverage limits, coverage of interbank deposits, the program's funding source, its management type, and co-insurance requirements (deductibles). "Poor Selection" is a principle components index of three program features that describe the requirements that are imposed upon member banks: ex ante funding requirements, premium levels, and requirements that premium be risk-adjusted for the assets held by the member bank. Program features are more fully described in the text and in the notes to Table 1. "Law," which is used in interaction terms with deposit insurance variables in the second stage, is computed as described above. Three additional variables are used in interaction terms in the second stage: an index of supervisory powers, an index of supervisory discretion, and a dummy variable indicating whether supervisors are independent from legal reprisal. These variables are described in greater detail in Appendix C.

Inflation and real growth are averaged over all years for which data are available from 1960-2001 (again, all years *after* the adoption of explicit deposit insurance). Concentration is computed in the same way. It measures the share of total banking sector assets held by the three largest banks in the country. "Years in place" is simply the number of years that explicit deposit insurance has been in place. "Initial PRIV" is the level of PRIV in the year that formal deposit insurance was adopted. "Initial LLIAB" is constructed in the same way. "% State-Owned" is the percentage of banking sector assets held by majority state-controlled banks.

* indicates significantly different from zero at the 5% level; ** indicates significance at the 1% level.

Table 3: Regressions of Growth Rates of Financial Development Indicators

Explanatory Variables	*Dependent Variable*											
	Generosity of DI Models								*Poor Selection of Insured Banks Models*			
	PRIV[a] Growth Rate Heckman Full Sample (1)	PRIV Growth Rate ML Full Sample (2)	PRIV Growth Rate Heckman Pre-1996 (3)	PRIV Growth Rate ML Pre-1996 (4)	PRIV Growth Rate Heckman Pre-1996 (5)	PRIV Growth Rate ML Pre-1996 (6)	LLIAB[b] Growth Rate Heckman Pre-1996 (7)	LLIAB Growth Rate ML Pre-1996 (8)	PRIV Growth Rate Heckman Pre-1996 (9)	PRIV Growth Rate ML Pre-1996 (10)	LLIAB Growth Rate Heckman Pre-1996 (11)	LLIAB Growth Rate ML Pre-1996 (12)
First Stage												
Volatility	-10.69**	-13.68**	-11.53**	-16.59**	-12.57**	-17.32**	-12.87**	-14.21	-11.53**	-16.01**	-12.87**	-13.39
PRIV (LLIAB)	(5.23)	(4.53)	(4.79)	(4.03)	(4.58)	(3.50)	(4.74)	(1.94)	(4.79)	(4.83)	(4.74)	(1.93)
GDP Per	.057	.048*	.068	.059	.071	.110	.0379	.0415	.070	.073*	.0414	.0419
Capita	(1.78)	(2.08)	(1.95)	(1.29)	(1.45)	(1.22	(1.00)	(0.49)	(1.95)	(2.23)	(1.00)	(0.49)
Rule of Law					-.134	-.335						
					(0.51)	(0.69)						
Constant	1.54**	1.76**	1.43**	1.92**	2.29*	2.92	1.47**	1.62	1.43**	1.92**	1.47**	1.52
	(3.66)	(3.80)	(3.09)	(3.29)	(2.14)	(1.78)	(2.91)	(1.50)	(3.09)	(3.08)	(2.91)	(1.51)
Second Stage												
Generosity	-.0370*	-.0654**	-.0458**	-.0510**	-.0453**	-.0489**	-.0223*	-.0202	-.0034	.00005	.0042	.0079
	(2.07)	(4.86)	(2.92)	(2.89)	(2.60)	(3.15)	(2.46)	(1.14)	(0.37)	(0.003)	(0.64)	(0.59)
Generosity x	.0023	.0042**	.0025*	.0024	.0023	.0022	.0016*	.0016				
Sup. Power	(1.62)	(3.41)	(1.98)	(1.22)	(1.63)	(1.47)	(2.39)	(1.01)				
Generosity x	.0044	.0056*	.0064*	.0084**	.0062	.0066*	.0048**	.0049				
Sup. Discretion	(1.16)	(2.04)	(2.07)	(3.45)	(1.76)	(2.36)	(2.74)	(1.71)				
Generosity x.	.0087	.0148	.0138*	.0134**	.0137*	.0130**	.0087**	.0093				
Sup. Independ	(1.38)	(3.04)	(2.44)	(2.60)	(2.14)	(2.96)	(2.98)	(1.78)				
Poor Selection	.0001	-.0025	-.0087	-.0162*	-.0091	-.0120	-.0008	-.0003	-.0362	-.0543	-.0146	-.0136
	(0.01)	(0.32)	(1.06)	(1.97)	(0.97)	(1.44)	(0.23)	(0.04)	(1.78)	(1.84)	(1.15)	(0.45)
Poor Selection x									.0018	.0023	.0009	.0009
Sup. Power									(1.35)	(1.02)	(1.22)	(0.43)
Poor Selection x									.0036	.006*	.0026	.0028
Sup. Discretion									(1.15)	(2.06)	(1.32)	(0.69)
Poor Selection x									.0052	.0062	.0012	.0016
Sup. Independ									(0.92)	(0.60)	(0.37)	(0.24)

Inflation	.050	-.065	-.017	.-123	-.030	-.086	.0379	.0503	.010	-.013	.052	.073
	(0.34)	(0.45)	(0.15)	(1.39)	(0.23)	(0.48)	(0.54)	(0.08)	(0.05)	(0.07)	(0.65)	(0.18)
Real Growth	.967	1.449**	.891*	.984	.863	1.307	.502	.616	1.09	1.20	.610	.739
	(1.55)	(3.35)	(2.54)	(1.16)	(1.32)	(1.87)	(1.69)	(1.46)	(1.77)	(0.90)	(1.81)	(1.31)
Initial PRIV	-.054	-.047	-.043	-.029	-.042	-.026	-.0190	.001	-.060	-.037	-.041	-.016
(or LLIAB)	(0.99)	(0.81)	(0.99)	(0.50)	(0.87)	(0.50)	(0.54)	(0.01)	(1.28)	(0.41)	(1.03)	(0.20)
Constant	.071	.075	.097	.119	.102	.102*	.012	-.015	.102	.098	.021	-.014
	(1.16)	(1.67)	(1.87)	(1.95)	(1.71)	(1.98)	(0.31)	(0.19)	(1.73)	(1.16)	(0.45)	(0.18)
Observations	119	119	111	111	92	92	108	108	111	111	108	108
# w/ Explicit DI	37	37	29	29	29	29	25	25	29	29	25	25
Log Likelihood		36.98		40.45		38.92		36.86		36.03		33.97
Wald Chi^2	8.81		20.99		16.34		25.19		13.98		12.87	

Note:

(a) PRIV is the ratio of bank credit to the private sector to GDP. (b) LLIAB is the ratio of liquid liabilities to GDP. The dependent variables are growth rates for PRIV and for LLIAB. They are intended to measure the growth of bank intermediation from the asset and liability sides respectively. There is one observation per country, and growth rates are calculated as an average over all years *after* the adoption of deposit insurance for which data are available from 1960-2001. Heckman's two-stage selection model is estimated for columns labeled "Heckman." The maximum likelihood selection model is estimated for columns labeled "ML." For Heckman models, z-statistics are in parentheses (t-statistics for ML models).

We employ a two-stage estimation technique to correct for sample selection bias associated with the adoption of explicit deposit insurance. In the first stage, explanatory variables include per capita income in 1995 as a proxy for general institutional development, and in some specifications "Law," a six-point measure of the quality of the rule of law averaged over 1984-2001 (see Appendix A for further description). Higher values indicate greater adherence to the rule of law. The other first stage regressors are measures of past financial sector volatility, calculated over the three years *prior* to the adoption of explicit deposit insurance. For countries that retained implicit insurance, volatility is calculated over all years from 1960 to 2001. "Volatility PRIV" is the coefficient of variation (standard deviation divided by mean) for PRIV. "Volatility LLIAB" is the coefficient of variation for LLIAB.

The second stage estimation is conditional on the adoption of deposit insurance. Regressors include "generosity," a principal components index derived from five deposit insurance program features – per-depositor coverage limits, coverage of interbank deposits, the program's funding source, its management type, and co-insurance requirements (deductibles). "Poor Selection" is a principle components index of three program features that describe the requirements that are imposed upon member banks: ex ante funding requirements, premium levels, and requirements that premium be risk-adjusted for the assets held by the member bank. Program features are more fully described in the text and in the notes to Table 1. "Law," which is used in interaction terms with deposit insurance variables in the second stage, is computed as described above. Three additional variables are used in interaction terms in the second stage: an index of supervisory powers, an index of supervisory discretion, and a dummy variable indicating whether supervisors are independent from legal reprisal. These variables are described in greater detail in Appendix C.

Inflation and real growth are averaged over all years for which data are available from 1960-2001 (again, all years *after* the adoption of explicit deposit insurance). Concentration is computed in the same way. It measures the share of total banking sector assets held by the three largest banks in the country. "Years in place" is simply the number of years that explicit deposit insurance has been in place. "Initial PRIV" is the level of PRIV in the year that formal deposit insurance was adopted. "Initial LLIAB" is constructed in the same way.

* indicates significantly different from zero at the 5% level; ** indicates significance at the 1% level.

Table 4: Robustness Checks

Explanatory Variables	*Dependent Variable*											
	PRIV[a] Growth Rate Heckman (1)	PRIV Growth Rate ML (2)	PRIV Growth Rate Heckman (3)	PRIV Growth Rate ML (4)	PRIV Growth Rate Heckman (5)	PRIV Growth Rate ML (6)	PRIV Growth Rate Heckman (7)	PRIV Growth Rate ML (8)	PRIV Growth Rate Heckman (9)	PRIV Growth Rate ML (10)	Ln(Coeff Variation PRIV) Heckman (11)	Ln(Coeff Variation PRIV) ML (12)
First Stage												
Volatility	-11.13**	-14.27*	-11.53**	-15.69**	-11.64*	-15.32	-11.53**	-16.75	-11.53**	-15.45	-11.13**	-11.37**
PRIV	(4.55)	(2.44)	(4.79)	(3.36)	(4.79)	(1.42)	(4.79)	(1.56)	(4.79)	(1.32)	(4.55)	(3.19)
GDP Per	.067	.069	.068	.072	.067	.038	.068	.066	.068	.057	.067	.051
Capita	(1.90)	(1.16)	(1.95)	(1.14)	(1.90)	(0.48)	(1.95)	(0.94)	(1.95)	(0.69)	(1.90)	(0.81)
Constant	1.34**	1.45*	1.43**	1.66*	1.41**	1.87	1.43**	2.02	1.43**	1.64	1.34**	1.45
	(2.82)	(2.16)	(3.09)	(2.55)	(3.04)	(1.30)	(3.09)	(1.46)	(3.09)	(1.00)	(2.82)	(1.90)
Second Stage												
Generosity	-.076**	-.079**	-.043*	-.041	-.042**	-.040**	-.044**	-.054**	-.103	-.117	.483**	.492**
	(5.01)	(4.85)	(2.18)	(1.89)	(2.75)	(2.79)	(2.75)	(2.60)	(1.71)	(1.71)	(3.44)	(3.00)
Generosity x	.0043**	.0042**	.0024	.0021	.0024*	.0016	.0025	.0026	.0050	.0053		
Sup. Power	(3.61)	(2.85)	(1.76)	(1.03)	(2.11)	(1.19)	(1.93)	(1.27)	(1.40)	(1.37)		
Generosity x	.0145**	.0166**	.0064*	.0084	.0052	.0054	.0068*	.0085	.0165	.0192		
Sup. Discretion	(3.81)	(3.43)	(2.02)	(1.39)	(1.60)	(1.87)	(2.12)	(1.83)	(1.62)	(1.57)		
Generosity x.	.0200**	.0220**	.0137*	.0142*	.0138**	.0151*	.0137*	.0149	.0359*	.0422		
Sup. Independ	(4.07)	(4.57)	(2.36)	(2.03)	(2.52)	(2.09)	(2.37)	(1.94)	(2.19)	(1.90)		
Poor Selection	-.0066	-.0085	-.0089	-.0149	-.0114	-.0131	-.0076	-.0140	-.0069	-.0131	-.355	-.343
	(0.98)	(1.02)	(1.05)	(1.16)	(1.42)	(1.23)	(0.90)	(1.39)	(0.84)	(1.44)	(1.89)	(1.44)
Poor Selection x Law											.077	.075
											(1.77)	(1.28)
Supervisory Power									-.0083	-.0098	.0633	.0608
									(0.65)	(0.80)	(1.47)	(0.86)
Supervisory Discretion									-.0308	-.0372	.1516	-.1510
									(0.91)	(1.03)	(1.26)	(0.83)
Supervisory Independence									-.0758	-.0915	-.2618	-.2575
									(1.39)	(1.17)	(1.58)	(0.81)
Inflation	-.0173	.0011	-.0200	-.0392	-.938	-1.325	.0009	-.085	.1128	.1490	2.734*	2.827
	(0.18)	(0.01)	(0.17)	(0.22)	(0.91)	(0.87)	(0.08)	(0.51)	(0.72)	(0.96)	(2.42)	(0.57)

Real Growth	1.017	.966	.880	.939	.970	.836	.855	.788	.826	.944	10.652	10.951
	(1.68)	(0.88)	(1.46)	(0.74)	(1.72)	(0.71)	(1.42)	(0.51)	(1.42)	(1.14)	(1.85)	(1.24)
Initial PRIV	-.0441	-.033	-.042	-.012	-.045	-.101*	-.039	-.030	-.053	-.040	-1.199**	-1.169
	(1.22)	(0.54)	(0.91)	(0.14)	(0.97)	(2.20)	(0.85)	(0.41)	(1.21)	(0.78)	(3.05)	(1.89)
% State-Owned	-.0010	-.0011									-.021**	-.021
Banks	(1.50)	(1.46)									(3.08)	(1.93)
Generosity x			-.0005	-.0017							-.062*	-.061
Law			(0.22)	(0.42)							(2.36)	(1.60)
Concentration					.017	.003						
					(0.28)	(0.06)						
Years In Place							-.0007	-.0003				
							(0.58)	(0.14)				
Constant	.093*	.089	.099	.105	.099	.148	.098	.116	.282	.336	-2.69**	-2.72*
	(2.16)	(1.12)	(1.82)	(1.30)	(1.33)	(1.64)	(1.85)	(1.40)	(1.32)	(1.49)	(3.02)	(2.22)
Observations	107	107	111	111	110	110	111	111	111	111	107	107
# w/ Explicit DI	25	25	29	29	28	28	29	29	29	29	25	25
Log Likelihood		40.87		41.41		38.85		42.64		43.58		-29.28
Wald Chi^2	45.21		19.98		26.08		20.38		26.20		71.89	

Note:

(a) PRIV is the ratio of bank credit to the private sector to GDP. The dependent variable is the growth rate for PRIV. In models 11 and 12, the dependent variable is the coefficient of variation (standard deviation divided by mean) for PRIV. For both types of dependent variables, there is one observation per country, and each observation is calculated over all years *after* the adoption of deposit insurance for which data are available from 1960-2001. Heckman's two-stage selection model is estimated for columns labeled "Heckman." The maximum likelihood selection model is estimated for columns labeled "ML." For Heckman models, z-statistics are in parentheses (t-statistics for ML models).

We employ a two-stage estimation technique to correct for sample selection bias associated with the adoption of explicit deposit insurance. In the first stage, explanatory variables include per capita income in 1995 as a proxy for general institutional development, and in some specifications "Law," a six-point measure of the quality of the rule of law averaged over 1984-2001 (see Appendix A for further description). Higher values indicate greater adherence to the rule of law. The other first stage regressors are measures of past financial sector volatility, calculated over the three years *prior* to the adoption of explicit deposit insurance. For countries that retained implicit insurance, volatility is calculated over all years from 1960 to 2001. "Volatility PRIV" is the coefficient of variation for PRIV.

The second stage estimation is conditional on the adoption of deposit insurance. Regressors include "generosity," a principal components index derived from five deposit insurance program features – per-depositor coverage limits, coverage of interbank deposits, the program's funding source, its management type, and co-insurance requirements (deductibles). "Poor Selection" is a principle components index of three program features that describe the requirements that are imposed upon member banks: ex ante funding requirements, premium levels, and requirements that premium be risk-adjusted for the assets held by the member bank. Program features are more fully described in the text and in the notes to Table 1. "Law," which is used in interaction terms with deposit insurance variables in the second stage, is computed as described above. Three additional variables are used in interaction terms in the second stage: an index of supervisory powers, an index of supervisory discretion, and a dummy variable indicating whether supervisors are independent from legal reprisal. These variables are described in greater detail in Appendix C.

Inflation and real growth are averaged over all years for which data are available from 1960-2001 (again, all years *after* the adoption of explicit deposit insurance). Concentration is computed in the same way. It measures the share of total banking sector assets held by the three largest banks in the country. "Years in place" is simply the number of years that explicit deposit insurance has been in place. "Initial PRIV" is the level of PRIV in the year that formal deposit insurance was adopted.

"% State-Owned" is the percentage of banking sector assets held by majority state-controlled banks.

* indicates significantly different from zero at the 5% level; ** indicates significance at the 1% level.

Appendices

Appendix A. Variable names, definitions and sources

Variable Name	Definition	Source
Growth Rate of Bank Credit (PRIV)	Average annual growth rate in the ratio of bank credit to the private sector to GDP	Ratio equals IFS (line 22d) divided by IFS (line 99b)
Growth Rate of Liquid Liabilities (LLIAB)	Average annual growth rate in the ratio of liquid liabilities to GDP	Ratio equals IFS (line 34 + line35 – line 14a) divided by IFS (line 99b)
Law and Order (LAW)	Index of the quality of the rule of law ranging from 0 to 6; scores for each country average over data for 1984-2001.	ICRG
Generosity (PMHZRD)	Principal components index of six deposit insurance features (Table 1)	Features are from Demirgüç-Kunt and Detragiache (2002)
Entry Hurdles (PADSEL1)	Principal components index of five deposit insurance features (Table 1)	Features are from Demirgüç-Kunt and Detragiache (2002)
Volatility in Bank Credit (COFPRI)	Coefficient of variation (standard deviation/mean) in the ratio of bank credit to nominal GDP.	IFS (see above)
Volatility in Liquid Liabilities (COFLIAB)	Coefficient of variation in the ratio of liquid liabilities to GDP	IFS (see above)
Inflation (POSTINF)	Average inflation	SIMA (wdi, ifs)
Real Growth (PGROWPC)	Rate of growth of real GDP	SIMA (wdi, ifs)
Years in Place (INPLACE)	Years since the adoption of explicit deposit insurance	Demirgüç-Kunt and Detragiache (2002)
Concentration (AVGCONC)	Assets of largest three banks divided by total banking assets	Beck, Demirgüç-Kunt, Levine (2001) [from Bankscope]
% State-Owned (PERSTATE)	Share of banking sector assets held by majority state-controlled banks	Barth, Caprio, Levine (2001c)
Supervisory Powers (SUPPOWER)	14-point index of supervisory powers (see Appendix C).	Barth, Caprio, Levine (2001c)
Supervisory Discretion (SUPDISCR)	4-point index of supervisory discretion to take action(see Appendix C).	Barth, Caprio, Levine (2001c)
Supervisory Independence (SUPINDLEG)	Dummy variable indicating whether supervisors are independent from legal reprisals.	Barth, Caprio, Levine (2001c)

Note: ICRG is the International Country Risk Guide, published by Political Risk Service, Syracuse, NY. IFS is International Financial Statistics, published by the IMF. WDI is the World Bank's database of world development indicators. We use the updated Demirgüç-Kunt and Detragiache (2002) database of deposit insurance features, which can be accessed at:

http://www.worldbank.org/research/interest/confs/upcoming/deposit_insurance/dataset2.xls

Appendix B. Endogeneity Tests

To test for potential endogeneity with respect to both the moral hazard and the poor selection indices, we have performed a number of Hausman tests.

The Hausman test is based on the following hypotheses and intuition:

> H_0: no endogeneity implies that OLS estimates are consistent and efficient. An instrumental variable estimator (IV) will also be consistent but less efficient.
>
> H_A: endogeneity implies that OLS estimates are inconsistent and IV estimates are consistent.

In other words, if there is no endogeneity, OLS and IV should both be consistent estimators, otherwise OLS and IV will be statistically different (one is inconsistent (biased) and the other is still consistent).

To implement the test, one needs to decompose the potential endogenous variable into the part predicted by the instruments (the right hand side variable for IV) and the remainder. The two parts will not enter into the structural equation with different coefficients unless they have different effects on the dependent variable, which implies that IV estimates will not equal OLS estimates.

Operationally, this is done in two steps as follows:

First, the potential endogenous variable (we checked both the moral hazard and poor selection indices) is regressed on all relevant exogenous variables (instruments), and the estimated residuals are defined to form a "residual variable" (In the following regression output, the residual variables have been called “hazardres” and “selectres” for the two indices, respectively). In the second step, the residual variable from the first regression is added to our volatility and growth regressions. As shown below, *“hazardres” and “selectres” never enter our regressions with significant coefficients. Therefore, we cannot reject the null hypothesis of no endogeneity*. The results from this procedure are similar to those that would be obtained using two-stage least squares.

NOTE: The coefficient estimates reported below are consistent, while standard error estimates and therefore t-statistics are not. Interestingly enough, the basic finding that moral hazard is positively correlated with financial volatility and negatively correlated with long-term financial development is confirmed in these regressions.

Legend: LNBCCV = coefficient of variation of growth rates in bank credit to the private sector/GDP;

LNLLCV = coefficient of variation of growth rates in liquid liabilities/GDP; BCREDGA = average growth rate of bank credit to the private sector/GDP after adoption of explicit deposit insurance system;

LLIABGA = average growth rate of liquid liabilities/GDP after adoption of explicit deposit insurance system.

HAUSMAN ENDOGENEITY TESTS

Dependent variable: LNBCCV

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
INFLAA	.781072E-02	.024778	.315226	[.757]
MHAZARD	.740215	.946564	.782002	[.447]
LAWHAZARD	-.241165	.203354	-1.18594	[.255]
GNPGA	-.274140	.120540	-2.27427	[.039]
INPLACE	-.174155	.034722	-5.01563	[.000]
HAZARDRES	.394754	.483748	.816032	[.428]

Dependent variable: LNLLCV

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
INFLAA	.012320	.021345	.577215	[.572]
MHAZARD	1.46949	.800492	1.83574	[.086]
LAWHAZARD	-.401577	.183722	-2.18579	[.045]
GNPGA	-.311945	.099720	-3.12821	[.007]
INPLACE	-.214424	.033592	-6.38312	[.000]
HAZARDRES	.247865	.438966	.564655	[.581]

Dependent variable: BCREDGA

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
INFLAA	-.293153E-02	.124051E-02	-2.36317	[.031]
MHAZARD	-.026731	.046626	-.573296	[.574]
LAWHAZARD	.757003E-02	.966218E-02	.783470	[.445]
GNPGA	.013287	.621051E-02	2.13940	[.048]
INPLACE	.141000E-03	.140524E-02	.100339	[.921]
HAZARDRES	.280891E-02	.023441	.119829	[.906]

Dependent variable: LLIABGA

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
INFLAA	-.208426E-02	.633108E-03	-3.29211	[.005]
MHAZARD	-.039713	.024302	-1.63415	[.122]
LAWHAZARD	.908025E-02	.538404E-02	1.68651	[.111]
GNPGA	.010994	.306578E-02	3.58592	[.002]
INPLACE	-.208927E-03	.820985E-03	-.254484	[.802]
HAZARDRES	.129213E-02	.012744	.101391	[.920]

Dependent variable: BCREDGA

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
INFLAA	-.269580E-02	.154893E-02	-1.74042	[.105]
MHAZARD	-.967046E-02	.043265	-.223518	[.827]
LAWHAZARD	.138241E-02	.012089	.114350	[.911]
GNPGA	.013211	.727906E-02	1.81491	[.093]
INPLACE	-.333103E-03	.146967E-02	-.226651	[.824]
ADSELECT	-.517209E-03	.051740	-.999633E-02	[.992]
LAWSELECT	.839300E-03	.727075E-02	.115435	[.910]
SELECTRES	.646497E-02	.032209	.200717	[.844]

Dependent variable: LLIABGA

Variable	Estimated Coefficient	Standard Error	t-statistic	P-value
INFLAA	-.201618E-02	.800108E-03	-2.51988	[.026]
MHAZARD	-.033477	.025368	-1.31966	[.210]
LAWHAZARD	.571905E-02	.671722E-02	.851401	[.410]
GNPGA	.010804	.344787E-02	3.13345	[.008]
INPLACE	-.327083E-03	.915323E-03	-.357342	[.727]
ADSELECT	-.717859E-02	.029327	-.244776	[.810]
LAWSELECT	-.570743E-03	.443914E-02	-.128570	[.900]
SELECTRES	.013700	.018597	.736671	[.474]

Appendix C. Questions Used in Indices of Supervisory Power and Discretion

Index of Official Supervisory Power: Indicates whether the supervisory authorities can take specific actions to prevent and correct problems.

1. Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? Yes/No
2. Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in elicit activities, fraud, or insider abuse? Yes/No
3. Can supervisors take legal action against external auditors for negligence? Yes/No
4. Can the supervisory authority force a bank to change its internal organizational structure? Yes/No
5. Are off-balance sheet items disclosed to supervisors? Yes/No
6. Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? Yes/No
7. Can the supervisory agency suspend the directors' decision to distribute dividends? Yes/No
8. Can the supervisory agency suspend the directors' decision to distribute bonuses? Yes/No
9. Can the supervisory agency suspend the directors' decision to distribute management fees? Yes/No
10. Can the supervisory agency legally declare – such that this declaration supersedes the rights of bank shareholders – that a bank is insolvent? Yes/No
11. Does the Banking Law give authority to the supervisory agency to intervene – that is, suspend some or all ownership rights –in a problem bank? Yes/No

Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency do the following:

12. Supersede shareholder rights? Yes/No
13. Remove and replace management? Yes/No
14. Remove and replace directors? Yes/No

Index of Supervisory Discretion: Indicates whether the authorities may engage in forbearance when confronted with violations of laws and regulations or other imprudent behavior.

1. Can the supervisory agency or any other government agency forbear to enforce certain prudential regulations? Yes/No
2. Does the Law establish pre-determined levels of solvency deterioration which force automatic actions (like intervention)? Yes/No
3. If an infraction of any prudential regulation is found by a supervisor, must it be reported? Yes/No
4. Are there mandatory actions in these cases? Yes/No

Appendix D. Synthesizing Deposit Insurance Features using Principal Component Analysis: Computation of the Generosity and Entry Hurdle Indices

Below is a brief explanation of the procedure used in computing both the generosity and the poor selection indices.

Let X be the matrix of individual design features across countries (coverage, coinsurance, etc..). Principal component analysis allows us to reduce the dimensionality of X, using in our regression only a few linear combinations of the original features (our generosity and poor selection indices), while still being able to capture most of the variation in the original data.

Let z_1 be a linear combination of the columns of X, i.e.:

$$z_1 = Xc_1 \qquad \text{(A1)}$$

The problem of extracting the first principal component of X can be interpreted as a least squares regression problem: what is the linear combination of the columns of X (z_1) that provides the best fit to the original data in X ?

If we regress each column of X, x_k on z_1 , the sum of squared residuals for each of these regressions can be written as:

$$e_k'e_k = x_k' [I - z_1(z_1'z_1)^{-1} z_1'] x_k \qquad \text{(A2)}$$

If we consider the total sum of squared residuals over all regressions of x_k's on z_1, the problem becomes finding the linear combination z_1 that minimizes:

$$\text{Min} \sum_k e_k'e_k = \text{tr} (X' [I - z_1(z_1'z_1)^{-1} z_1'] X) \qquad \text{(A3)}$$

It is easy to verify that this solution to (A3) is not unique, since for any z_1 minimizing (A3) any other $z_1'' = X c_1''$ with c_1'' being a scalar multiple of c_1 will also be a solution to the minimization problem. To remove the indeterminacy, one introduces the normalizing assumption:

$$z_1'z_1 = 1 \qquad \text{(A4)}$$

The problem therefore becomes to find the unique c_1 that minimizes:

$$\text{Min}_{(c)} \sum_k e_k'e_k = \text{tr} (X' [I - z_1z_1'] X) \qquad \text{(A5)}$$

$$\text{subject to: } z_1'z_1 = 1 \qquad \text{(A5')}$$

This can be solved by setting up the Lagrangean:

$$\text{Max}_{(c,\lambda)} L = \text{tr} (X'z_1z_1'X) + \lambda (1 - z_1'z_1) \qquad \text{(A6)}$$

Which is equivalent to (A5) since X'X does not depend on c_1.

By permuting in the trace and substituting $z_1 = Xc_1$, (A6) becomes:

$$\text{Max}_{(c,\lambda)} L = c_1'(X'X)^2 c_1 + \lambda (1- c_1'(X'X) c_1) \qquad \text{(A7)}$$

The first order condition for c_1 yields:

$$2 (X'X)^2 c_1 - 2 \lambda (X'X) c_1 = 0 \qquad \text{(A8)}$$

Pre-multiplying both sides by $\frac{1}{2}(X'X)^{-1}$ gives:

$$(X'X) c_1 - \lambda c_1 = 0 \text{ or } (X'X) c_1 = \lambda c_1 \qquad \text{(A9)}$$

(A9) identifies c_1 as an eigenvector of the matrix X'X and λ as the corresponding eigenvalue.

Pre-multiplying both sides of (A9) by c_1', one notes that:

$$c_1'(X'X) c_1 = \lambda c_1'c_1 = \lambda \qquad \text{(A10)}$$

given the constraint (A5') that $c_1'c_1 = 1$.

Substituting (A10) into (A7), it is easy to verify that the solution to our problem requires selecting c_1 as the eigenvector of the matrix X'X associated with its largest eigenvalue λ.

For the generosity index, our matrix X includes the following variables:

1. Coverage limit per depositor as a share of GDP per capita (coverage)
2. Dummy = 1 if interbank deposits are covered (intbank)
3. Source of funding dummy =0 if banks only, =1 if banks & Gov't, = 2 if Gov't only (source)
4. Management dummy = 1 if official, =2 if joint, =3 if private (management)
5. Coinsurance dummy = 1 if coinsurance is available, = 0 otherwise (coinsura)
6. Foreign Currency dummy = 1 if foreign currency deposits are covered, = 0 otherwise

Each of the variables is preliminarily standardized so as to avoid a situation where any one of them with larger variance could drive the resulting index alone.

The first eigenvector of the corresponding X'X matrix is as follows:

Variable	
coverage	0.34962
intbank	0.44747
source	0.5416
management	-0.53262
coinsura	-0.31706

The first eigenvector is the one associated with the largest eigenvalue and is therefore chosen as the optimal vector c_1 to construct the generosity index as a linear combination of the standardized original variables in X, as in A(1).

The signs of the individual components[33] of the optimal c_1 vector are such that the resulting linear combination can easily be interpreted as combining all the generosity features of a given deposit insurance system. In other words[34], higher values for the first three variables (coverage, intbank and source) are associated with a higher degree of generosity of the deposit insurance system (and the first three elements of c_1 are in fact positive), whereas higher values for the last two variables (management and coinsura) imply a lower degree of generosity (and in fact the last two elements of c_1 are negative).

[33] Only the foreign currency dummy obtains a negative albeit small value in the eigenvector, and is therefore dropped as it would decrease the index if the coverage of the deposit insurance system extends to foreign currency deposits (which should instead cause the generosity index to increase).

[34] See also Section III.B.

A similar procedure leads to the computation of the poor selection index, where our X matrix is instead composed of the following variables:

1. deposit insurance premium, as a percentage of insured deposits (premium)
2. dummy =1 if a permanent deposit insurance fund is in place, =0 otherwise (funded)
3. dummy =1 if premia are risk-adjusted, =0 otherwise (riskadj)
4. compulsory = 1 if the deposit insurance system is compulsory, = 0 otherwise

The first eigenvector of the corresponding X'X matrix is as follows:

Variable	
premium	0.59771
funded	0.62433
riskadj	0.50295

with the first eigenvector being chosen as optimal c_1 vector to build the poor selection index. In this case, higher values for all the variables[35] are associated with higher entry hurdles and therefore better selection (all elements of c_1 are in fact positive). As a consequence, we extract a "good selection" principal component and than simply reverse the sign of the whole linear combination to obtain a "poor selection" index.

[35] Only the compulsory dummy obtains a negative albeit small value in the eigenvector, and is therefore dropped. In fact, almost all deposit insurance systems are compulsory. As a result, the variance of this component within our sample is negligible and therefore it does not make any meaningful contribution to the index.

Appendix E: Countries Included in Active Observation Set (119)

Countries with Explicit Deposit Insurance

Country	Year adopted
Austria	1979
Bahrain	1993
Bangladesh	1984
Belgium	1974
Brazil	1995
Canada	1967
Chile	1986
Croatia	1997
Denmark	1988
El Salvador	1999
Estonia	1998
France	1980
Greece	1993
Ireland	1989
Italy	1987
Jamaica	1998
Japan	1971
Kenya	1985
Korea	1996
Lithuania	1996
Luxembourg	1989
Mexico	1986
Netherlands	1979
Nigeria	1988
Oman	1995
Peru	1992
Philippines	1963
Poland	1995
Portugal	1992
Romania	1996
Sri Lanka	1987
Sweden	1996
Switzerland	1984
Trinidad & Tobago	1986
United Kingdom	1982
Venezuela	1985
Total	**37**

Countries with Implicit Deposit Insurance

Algeria	Malaysia
Armenia	Mali
Australia	Malta
Bahamas	Mauritania
Barbados	Mauritius
Belarus	Moldova
Belize	Mongolia
Benin	Morocco
Bhutan	Mozambique
Bolivia	Namibia
Bosnia-Herzegovina	Nepal
Botswana	New Zealand
Burkina Faso	Nicaragua
Burundi	Niger
China	Pakistan
Costa Rica	Panama
Cote d'Ivoire	Papua New Guinea
Cyprus	Rwanda
Egypt	Saudi Arabia
Ethiopia	Senegal
Fiji	Seychelles
Gambia	Sierra Leone
Ghana	Singapore
Grenada	Slovenia
Guatemala	South Africa
Guinea-Bissau	St. Lucia
Guyana	Suriname
Haiti	Swaziland
Honduras	Syria
Hong Kong	Thailand
Indonesia	Togo
Iran	Tunisia
Israel	United Arab Emirates
Jordan	Uruguay
Kazakstan	Vanuatu
Kuwait	Vietnam
Kyrgyz Republic	Yemen
Laos	Zaire
Lesotho	Zambia
Madagascar	Zimbabwe
Malawi	
Total	**82**

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