Deposit Insurance and Financial Development

By

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I. Introduction

Do deposit insurance programs contribute to financial development? Why have so many governments adopted such programs, and what did they expect to achieve? We conduct an empirical analysis to examine the effect of deposit insurance on the size and volatility of the financial sector, using a sample of fifty-eight countries. Governments in advanced economies and many developing economies grant formal deposit insurance in the hope of reducing the risk of systemic failure of banks and hence stabilizing the payments and financial system. On occasions in the past, bank runs have destroyed the payments system, with the resultant depression. Credible deposit insurance is presumed to forestall such runs. Moreover, by bolstering depositors' faith in the stability of the system, deposit insurance may lead to a deeper financial system, which could contribute to higher economic growth rates.[1]

However, deposit insurance can be socially counterproductive if the system is not appropriately structured. Under many 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 weakens market discipline (i.e. monitoring of bank activities by depositors and other bank stakeholders) and creates 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

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

regulatory environments, these incentives are likely to lead to greater systemic instability.

The central question that we address in this paper deals with the impact of deposit insurance programs on financial stability and financial development. The stability question is complementary to existing papers, particularly a recent study by Demirguc-Kunt and Detragiache (DD,2000). Based on evidence for 61 countries between 1980 and 1997, DD 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. We focus on the impact of deposit insurance on financial stability and development in a longer horizon before the financial or banking system collapses into a crisis. Accordingly, our empirics are not based on crisis data.

Thus, our aim is to understand the impact of alternative deposit insurance design features over a longer horizon. We focus on financial development, broadly defined to include the level of financial activity, the stability of the banking sector, and the quality of resource allocation as reflected in real sector performance (i.e., growth). The empirical construct is guided by recent theories of banking regulation that employ an agency framework.

In short, we focus on the steady-state, forward looking effects of deposit insurance. Recent events have shown that in times of crises, no matter whether deposit insurance is explicit or explicit, depositors tend to be bailed out anyway when systemic problems arise. *Ex ante* bail-out expectations, however, do influence bank risk-taking

behavior even in stable circumstances, by truncating the negative tail of the distribution of expected returns, and our empirical tests are designed to measure these effects.

Moreover, our paper extends the empirical analysis of deposit insurance schemes in a couple of ways. First, we directly address the sample selection 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 statistical techniques that account for this selection process. Another reason to adopt this approach is that it may not be easy to categorize variations in coverage or funding within the heterogeneous spectrum of countries lacking an official insurance arrangement.

Further, the same explicit deposit insurance program will likely have different effects depending on the general institutional environment. For example, a recent article by Reint Gropp and Jukka Vesala (2000) 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. In less developed countries, this might not hold – lacking the institutional development to make limits binding, explicit deposit insurance might offer no benefits over implicit. We test, therefore, whether the effects of explicit deposit insurance are dependent on proxies for the quality of banking regulation and supervision.

Second, in our empirical tests, 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. To better account for the complementarities between features of deposit insurance schemes, and to better reflect the totality of those features, we categorize deposit insurance program features as reflecting either the generosity of coverage to depositors or the requirements imposed upon member banks (which we call entry hurdles). We then test whether indices based on these two sets of features lead to higher levels of financial activity, and whether any such financial sector growth comes at a price in terms of instability.

Section II provides a motivation using some stylized facts about deposit insurance programs. In addition, it provides descriptive statistics, and highlights some puzzling relationships between the individual program features, and between program features and financial sector outcomes. The main purpose of this section is to introduce the reader to the complexity of the problem under investigation and to show how simple bivariate econometrics is not enough to draw robust conclusions from our sample data.

We look therefore (in section III) for a conceptual framework of how deposit insurance affects the level and volatility of financial development. A simple model of optimal portfolio selection is presented to illustrate how the introduction of insured deposits tilts the optimal risk-taking behavior of banks.

Section IV spells out the main hypotheses we draw from our theory and describes the estimation techniques we employ to test them empirically. The nature of the data available and the objectives of our analysis require us to summarize design features by means of principal component indices and to adopt a generalized Tobit estimation approach in order to avoid any sample selection bias.

Section V presents our results and section VI concludes. This combination of theory and evidence should, we hope, generate more reliable predictions about the effects of deposit insurance on financial development for policy makers in developed and developing countries alike.

II. Motivation: Stylized Facts

In this section we provide the observed design features of deposit insurance programs and some stylized facts and descriptive statistics as a motivation for a more detailed analysis conducted later.

A. Design Features of Deposit Insurance

Table 1 provides 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 receives 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.

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 (shaded in 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 on funding source and on program management are, perhaps, less clearly identified as aspects of generosity towards insured depositors. Our idea is that both variables may affect depositor perceptions of the credibility of the scheme. A scheme may advertise generous coverage, but that may make 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, or even when we treat them as entry hurdles.

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 premium, 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 twenty-nine countries in our sample that adopted explicit deposit insurance schemes.[2] If two design features are substitutes for one another, we expect a negative correlation – when one of those features appears, the other is less likely to be found. If features are complements, we expect a positive correlation. That is, if a feature is better able to achieve its intended objective when another feature is also adopted, we expect the presence of one of them to make it more likely that the other is present.

The correlations among the generosity variables in Table 1 do not show any clear pattern. Only one is significantly different from zero, a negative relationship between private management and coverage of interbank deposits, which suggests that private schemes are less generous than publicly managed schemes in at least one way. Others approach significance. For example, private management is positively associated with co-insurance, while a government funding source is negatively associated with co-insurance. Both of those relationships also suggest that government-based programs are more generous than privately managed programs. However, taken as a whole, the low significance levels and the relationships between the generosity variables defy a simple summary explanation.

[2] 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 lack of an explicit scheme.

The only significant relationship among the entry hurdle variables is the positive one between premium payment level and *ex ante* funding, which may indicate that, in creating higher entry hurdles, countries have tended to both increase premium payments and require that they be made up front. Other than that, however, there are no other obvious relationships between the hurdles variables. Because there are no strong patterns of substitutability or complementarity between the deposit insurance variables, it may be instructive to treat each feature individually and examine its association with the dependent variables of primary interest, namely the growth rate and the volatility of financial development.

B. Deposit Insurance Features and Financial Development

For the growth rate of financial development we use one variable from the asset side of bank balance sheets, the growth of the ratio of credit to the private sector to GDP, and another from the liabilities side, the growth of the ratio of liquid liabilities to GDP.[3] Similarly, to measure volatility of financial development, we use the coefficient of variation (standard deviation divided by mean) in the private credit ratio and the liquid liabilities ratio.[4] All four variables are measured over all years for which data are available between 1960-1995, but only *after* the country adopted explicit deposit insurance. We focus on bank-based variables because banks are the primary financial

[3] Because this is a study of the effects of insuring bank deposits, we focus on bank-based indicators of financial development. We recognize that bank-based financial development could have implications for development of the rest of the financial sector, although Levine and Zervos (1998) show that greater stock market liquidity implies faster economic growth no matter what the level of banking development. The converse also holds – greater banking development implies faster growth, regardless of the level of stock market liquidity. These results suggest that bank-based development is unlikely to dampen the benefits of market-based development. In addition, Demirguc-Kunt and Maksimovic (1998) show that increases in stock market development actually tend to increase the use of bank finance in developing countries. If anything, the evidence suggests that these two aspects of the financial system may act as complements in fostering growth.

actors in most, if not all, of the countries in our analysis.[5] These indicators are standard measures of financial development that have been used by other authors. King and Levine (1993, 1994) and Levine, Loayza, and Beck (2000) find strong, often causal, links between these bank-based indicators of financial development and economic growth. If we find that these indicators are affected by deposit insurance, therefore, it should have implications for growth.

Late in the analysis, we also examine whether deposit insurance affects a more explicitly structural variable, a concentration ratio measuring the assets of the top three banks relative to total banking sector assets. The Data Appendix provides additional information on the sources and the construction of our variables. Simple correlations between our five dependent variables and individual deposit insurance features also do not yield clear insights as to the effect of deposit insurance on financial development (Table 2). For example, coverage of foreign currency deposits is negatively associated with the volatility of liquid liabilities, while coverage of interbank deposits is positively associated with the same volatility measure. Neither of those coverage measures is, however, significantly linked to the volatility of credit to the private sector. Nor are any of the other deposit insurance features significantly linked to either volatility measure. Based on these results, it would be difficult to conclude that the moral hazard introduced by a generous deposit insurance scheme causes greater financial sector volatility.

Results are just as puzzling for the growth rate variables. The only significant correlations are the negative ones between premium payments and the growth rates for

[4] We refer to these measures as the 'volatility of liquid liabilities' and the 'volatility of credit to the private sector' from this point forward.

both liquid liabilities and private credit. This is somewhat surprising in that higher premium payments, which could be an entry hurdle that might lead to a better roster of banks, were actually associated with *less* financial development. On the other hand, the premium payments may have been higher expressly *because* of the low level of financial development associated with an unstable financial sector prone to systemic failure. Indeed, the correlations between premium payments and our two volatility measures are positive and approach significance.

These premium results may reflect a deeper underlying incentive problem associated with explicit deposit insurance. Due to limited liability, bank equityholders enjoy the upside benefits associated with a risky asset portfolio, but are largely protected against the downside losses associated with non-performing assets. By increasing savers' faith in the formal financial system, credible explicit insurance could increase the level of deposits. Additional deposits imply more investable resources for the bank, and should increase the upside benefits associated with holding a (larger) portfolio of risky assets. However, these results are still puzzling. We will explain the puzzle later in the context of the theoretical analysis and the multivariate empirical analysis.

Finally, the results for the asset concentration variable are intriguing, but not very robust. For example, *ex ante* funding, which we thought of as an entry hurdle, is, as we would expect, associated with greater concentration. Similarly, compulsory membership is negatively (though not quite significantly) associated with concentration. However, the most pronounced relationship is the negative one between co-insurance and

[5] To cite just one example, the United States, a country whose financial sector is dominated by stock markets rather than banks, is excluded from the analysis because it adopted deposit insurance in 1934, well before our sample period.

concentration. Perhaps co-insurance, by limiting generosity, means fewer deposits in total, which implies fewer sector entrants?

Aside from presenting the descriptive statistics and stylized facts, this section illustrates the difficulty in isolating simple relationships between deposit insurance features and financial development in a univariate analysis. These preliminary results indicate that few, if any, of the variables that we thought of as affecting incentives either through generosity or through bank entry hurdles is associated with either financial volatility or financial development in a simple, predictable way. Motivated by these initially puzzling results, we will begin setting out a conceptual foundation as a guide to the more detailed empirics, a foundation that appeals to agency paradigms in finance and specifies how deposit insurance could conceivably affect financial development. We will find that some of the puzzles are consistent with the incentive effects of deposit insurance, which will be examined in greater detail in the multivariate analysis of Section IV.

III. The Role of Deposit Insurance in Financial Stability and Resource Mobilization: Agency Theoretic Framework

We will characterize the potential investment distortion and resultant financial instability that could arise from an ill-designed deposit insurance scheme by appealing to agency paradigms in corporate finance. The view that is widely held in finance is that the firm (say a depostitory institution) is a nexus or network of contracts among various parties or stakeholders, such as shareholders (bank owners), creditors (depositors), employees, and other stakeholders (regulators and tax payers). The rights of each class of stakeholders in the firm are defined in contracts. While most stakeholders contract for

fixed payoffs, the firm's owners hold residual claims on cash flow earnings. This gives rise to potential conflicts among the stakeholders. Left alone, each class of stakeholders pursues its own interest which may be at the expense of other stakeholders. [6]

Consider now just two classes of stakeholders: equityholders (bank owners) and debtholders (bank depositors). The debt contract may enable managers, working on behalf of owners (equityholders), to make investment and financing decisions sub-optimally by departing from the principle of value maximization. The reason is that equityholders and creditors hold disjointed interests and that equity value maximization would not be equivalent to overall firm value maximization (optimal resource allocation). The primary concern for equity value maximization is over the cash flows in the non-bankrupt states, rather than the entire region of firm cash flows. Now management, working in the best interests of existing shareholders, has an incentive to alter the riskiness of the firm's investment activities (asset risk-shifting). Riskier investments, if successful, will benefit equityholders, but they will reduce the value of collateralization to debtholders, if they fail.

Thus, projects that are otherwise profitable may be foregone in exchange for high risk but inferior counterparts, leading to economic inefficiency. [7] Departures from efficient investment strategies are detrimental to economic growth and development. Therefore, the economic and financial environment that fosters efficient contracting among parties with diverse interests, promotes efficient allocation of resources and economic development.

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[6] See Barnea, Haugen, and Senbet (1985) for further discussion of agency issues.

[7] In addition to the asset substitution problem, the existence of outstanding debt inhibits profitable investments, since the benefits would enhance the safety to creditors at the expense of equityholders. This problem manifests itself in the form that has come to be known as "underinvestment."

Now we wish to pursue the agency analogy to bank deposits and deposit insurance. Consider a bank that issues equity and makes investments in loans (e.g., commercial real estate). The bank faces a menu of investment opportunities characterized by rewards (loan quality) and risks or volatilities. In this case, the *all-equity* bank makes a risk choice that maximizes bank value (V*). However, from the standpoint of the society at large, all-equity banks may be sub-optimal, if by issuing debt (deposits), they enhance liquidity services. This presumes that bank deposits and equity are not perfect substitutes in terms of liquidity provision.[8] In this setting, the objective function of the social planner can be thought of as being guided by these 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 considers the entire picture of the role of banks as informed agents (asset side) and liquidity providers (liability side).[9]

[8] Diamond and Rajan (1998, 1999) provide a theory of how such liquidity services arise. They start from the proposition that entrepreneurs have projects in which the cash flows that they can generate exceed those that anyone else could generate in the same circumstances. They assume that an outside financier who invests in these projects at an early stage develops specific knowledge about how best to re-deploy the project's assets. Such financiers can more credibly liquidate a project. The specific abilities of the entrepreneur and the financier make the project and its financing an illiquid bundle of assets – by construction, no other financier/entrepreneur pair value the project as highly.

Banks act as a commitment device that solves this liquidity problem. Because of its fragile deposit-based capital structure, a bank can commit to pass through to depositors the entire amount that it expects to collect using its specific abilities. Any attempt to extort rents by threatening to withdraw these specific abilities will be met by a run, which disintermediates the bank and drives its rents to zero. When some depositors want their money back in the 'ordinary course of business,' the bank does not have to pressure the entrepreneur, it simply borrows from new depositors that also understand the bank's underlying incentive to behave well. In this way banks, "enter into a Faustian bargain, accepting a rigid and fragile capital structure in return for the ability to create liquidity."

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

In this section, we focus on the economic consequences of deposit insurance by taking it as given that deposit insurance is already in place and that banks issue deposit liabilities, along with equity (bank capital). In the advanced economies and many developing countries, deposits issued by banks and thrift institutions are insured by the governments. Given the risk incentive problems that arise, abolishing deposit insurance may seem reasonable. However, in countries that lack formal deposit insurance schemes, including most African countries, deposits are *implicitly* insured even when they are not explicitly insured.[10]

Consider partitioning of the payoffs to bank shareholders in Figure 1 when deposit financing with a promised payment of F is outstanding. Given that bank asset cash flows are X, bank owners face a residual payoff of MAX (0, X-F), and uninsured depositors face a payoff of MIN (X, F). If deposits were fully insured, the insuring agency picks up the shortfall, MAX (0, F-X), so that depositors end up with the full promised payment, F.

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. When deposits are guaranteed, depositors themselves face no risk. However, 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:

[10] In the empirical tests that follow, we can compare financial sector performance before and after the adoption of explicit insurance. This provides some information about the relative merits of explicit versus implicit insurance, but the findings are based on the subset of countries that eventually adopted an explicit

$$\text{Value of equityholder's option} = f(\text{expected cash flows}, \sigma)$$
$$(+) \qquad (+)$$

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 limited liability. Thus, owners of banks financed by deposits have incentives to take risk beyond that which is optimal for an "all equity" bank. In fact, this risk-shifting behavior by banks has been widely viewed as a major culprit in the savings and loan crisis in the United States. The financial deregulation of the 1980s led to increased incentives for limited liability 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.

In this paper we will draw some testable implications from the agency perspective of risk-shifting on the relationship between deposit insurance and financial stability, as well as development. The analysis needs to be formalized so as to draw such implications. We use the framework of John, Saunders, and Senbet (2000) to provide a reduced form characterization of bank investment incentives.[11] A representative depository institution (bank) has a representative portfolio of risky assets (loans). These investment opportunities can be characterized by their rewards (a schedule of means) and their risks

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scheme. Potential effects may be different for countries in Africa, or elsewhere, that have yet to adopt explicit insurance.

(volatilities) of the terminal cash flows from the loan. A typical investment opportunity set $\{(V(\sigma),\sigma),\sigma \varepsilon \Omega\}$ is shown in Figure 2 as a concave production function. For generality, we also include a function that has a flat region as volatility changes so as to admit banks that have investments with zero net present value.

Central to 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 imperfect external monitoring of the risk choices by outsiders (including regulators).

Given incomplete contracting regarding the risk choices, bank insiders (management) make investment and risk choices to maximize the value of the structure of their own claims, rather than maximizing the total value of the bank, $V(\sigma)$. The value σ^* denotes the bank's value-maximizing risk choice [*i.e.*, σ^* maximizes $V(\sigma)$, see Figure 2]. Consider that deposit financing, with promised payment F, is currently outstanding. Let $\sigma(F)$ be the risk level at which the value of bank equity, $E(\sigma)$, is maximized, presuming management is totally aligned with bank owners. As in Figure 1, bank equity can be viewed as a call option which increases in value as the volatility of bank assets increases. That means bank equity value is maximized along the value frontier on the right hand side of V* in Figure 2. However, the risk incentive effect is limited by the

[11] The more detailed formalization is given in the Appendix.

concavity of the bank investment schedule, since the decline in V adversely affects the value of equity. At the margin, the pure volatility effect is offset by the value effect (see Appendix for a formal representation).

With a sufficiently high level of debt (deposit financing), insiders or bank management (deciding on behalf of bank owners) depart from the first best risk outcome. Thus, the investment implemented will be affected by the amount of bank capital in place and its complement, the level of debt financing. Bank management will invest up to an asset risk choice level of $\sigma_i(F)$, which is higher than σ_i^*, to maximize the value of bank equity. The distortion in risk choice, as represented by the risk deviation, $\sigma_i(F) - \sigma_i^*$ depends on the level of bank capital as well as the investment schedule i faced by the bank. Moreover, since $\sigma_i(F) - \sigma^*$ is decreasing in the fraction of bank capital in place, it provides a motivation for capital regulation, and for linking the level of bank capitalization to the pricing of deposit insurance. Thus, deposit insurance premium should be based on measures of risk, along with measures of bank capital.

Now consider multiple banks with their own unique investment schedules, such as in Figure 3.[12] The value-maximizing level of risk for the investment opportunity i is σ_i^*, i = 1,2,3. For unimodal structures, such as V_1 and V_2, there is a unique value-maximizing level of risk, represented by σ_1^* and σ_2^*, respectively. In other words, the value-maximizing levels of risk differ for different portfolios of bank activities, and this has regulatory implications. *First*, since banks may have different opportunities to exploit risk within any capital zone, categorizing all within the same zone into an identical risk classification is misleading. In this sense, capital ratios may be poor proxies for

measuring bank safety. *Second*, the regulatory corrective actions should not be designed to homogenize all banks to some common pool of risk in the guise of restrictions on asset risk choices. For instance, these measures may push a bank with activity set 2 to go below σ_2*. *Third*, capital regulation can be beneficial for critically undercapitalized banks. As $\sigma_i(F) - \sigma_i^*$ is larger with greater leverage (lower capital ratios), regulatory measures designed to move a bank which is critically undercapitalized to a higher level of capitalization will reduce the risk distortion, $\sigma_i(F) - \sigma_i^*$. In this sense, capital regulation increases bank value or moves the bank closer to an efficiency boundary. *Finally*, it should be mentioned that the deposit insurance premium will now be set corresponding to a level of risk $\sigma_i(F)$, which is a function of the degree of capitalization, which is inversely related to F (see Appendix), along with measures of the risk class of bank activities.

The foregoing discussion underscores that the effectiveness of capital regulation depends crucially on banks' asset characteristics. To dramatize this point further, we can resort to an investment technology or bank asset characteristic for which capital regulation is entirely ineffective. Consider the investment schedule 2, graphed in Figure 2, where σ_2^* is not unique. In fact, all levels of σ_2 yield value $V_2(\sigma_2)$ along the flat stretch of the opportunity curve. This investment schedule is entirely feasible when there is a large supply of risky investments with zero net present value (e.g., risky assets in financial markets). In this limiting case, large premiums may be required to take account of high levels of risk-shifting, even with a high degree of capital regulation.

[12] Consider, for example, the differences between the investment schedules for money center banks and rural credit institutions.

The foregoing simple theoretical framework (and the Appendix) are rich enough to draw some testable implications that guide and motivate the empirics in the next section:

1. Financial Instability and Moral Hazard (Volatility Effect): 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. The excessive risk taking behavior of a bank means that the bank assets have become more volatile beyond the socially optimal level of risk. With many such banks, the financial system becomes more unstable; $\sigma_i(F) - \sigma_i^* > 0$. Thus, with unresolved moral hazard, deposit insurance is counterproductive, and it induces more, not less, stability in the financial system.

2. Economic Inefficiency (Value Effect): Not only do the incentive effects of deposits and deposit insurance lead to excessive risk-taking, they also distort bank investment activities (loans) away from the socially optimal level of investments. In essence, the existence of deposit insurance leads to a decline in the overall economic performance as the overall bank values diminish in association with increased risk taking and financial instability (see figure 2); $V(F) - V^* < 0$. The regulator may also impose mandatory restrictions on bank asset risk choices so as to limit risk-taking, as done in certain regulatory regimes, such as the US. However, this would lead to socially counterproductive outcomes. This is because, direct monitoring of bank asset portfolio (loans) through mandating its risk levels may push the bank to levels below the socially optimal level of bank risk, $\sigma(q^*)$. Suppose the regulator wishes to induce banks to a

common pool of risk (or more generally to minimal risk). This would be distortionary, given that banks are characterized by differential investment opportunity sets as in Figure 3, with different risk choices and hence differential maximal (q^*_i), that are optimal from the standpoint of overall value maximization or efficiency.

3. Capital Regulation Effect (Entry Hurdle and Limited Effectiveness):

Various reforms have been proposed to correct the distorted incentives facing bankers. Some proposals, such as risk-based deposit insurance premium and risk-based capital, attempt to replicate the incentives that would be provided by the market. Like risk-based premium, risk-based capital has some intuitive appeal as an entry hurdle. Theory predicts, however, that neither will be a completely satisfactory solution, but for different reasons. Risk-based premium payments suffer from a time inconsistency problem described in more detail below. Similarly, risk-based capital regulation is of limited effectiveness for the reasons listed next.

a. Capital Regulation: The motivation for capital-based regulation is clear from the Appendix. As shown there [see (b) and (c) of A4], the extent of risk undertaken beyond the optimal level, $\sigma[q(F)] - \sigma(q^*)$, as well as the value lost due to risk-shifting, $NPV(q^*) - NPV[q(F)]$, are *both* functions of bank equity capital. With higher bank capital, (i.e., lower F), the incentive for risk-shifting is mitigated, so that σ is lower. Looking at Figure 2, additional capital infusion moves the bank back toward the efficient level of risk and investment value.

Unfortunately, there are limitations with capital regulation. We begin dramatizing them by considering the limiting case of an all-equity bank. By definition, such a bank receives no deposit funding and thus poses no risk to anyone but its owners. In that

sense, one incentive problem is resolved regarding the riskiness of bank assets. But, as described above, a key component of the social value of financial services comes from the liquidity that banks provide, and an all-equity bank does not adequately serve that purpose.

Capital regulation also has limitations under more realistic conditions because: (a) although the incentives are improved with more infusion of bank capital, the distortions and excessive risks are never eliminated for deposit insurance which even minimally imposes risk on the insuring agency. In the parlance of the Appendix, there will be risk-shifting for all values of F > L, although the magnitudes of the costs are reduced;[13] and (b) given the variation in bank asset risk characteristics (portfolios), capital regulation has to be *bank-specific*, and hence hard to implement. This also brings home that standardized capital requirements are sub-optimal, and casts serious doubt on the usefulness of rules-based approaches, such as in the Basle Accord.

b. Deposit Insurance Premium Effect (Time-Inconsistency and Ineffectiveness as Entry Hurdle): Our framework is rich enough to allow for the specification of a fair deposit insurance premium which can be structured as a function of the bank capital ratio (F) and the observable parameters of the bank investment schedule as specified in the Appendix {I, H, L}. The pricing of deposit insurance is possible despite the existence of the moral hazard problem arising from imperfect observability of private investment incentives controlled by bank insiders or decision-makers. This is because the regulator can calculate the incentive-based risk choices induced by the level

[13] Ideally, we would perform cross-country tests on whether higher capital standards imply lower sector volatility. However, at this point, cross-country data on capital standards are not nearly as comprehensive as for deposit insurance programs. As a result, the empirical section of the paper focuses only on deposit insurance features.

of bank capitalization employed by the institution and the parameters of the bank asset investment schedule. From the Appendix, a deposit level F > L induces an investment policy [q(F)] so that a fairly priced, revenue neutral insurance premium can be specified as follows:

$$\pi(F) = q(F) \max(0, F - I) + (1/2)(1 - q(F))^2 \max(0, F - L)$$

where q(F) is specified in A4 of the Appendix. Under the preceding specification, a fair deposit insurance should only cover the states of nature yielding low investment returns (L) and possibly intermediate returns (I) for high levels of deposits. If the bank can obtain an insurance with a premium $\pi < \pi(F)$, the equityholders gain a transfer of wealth of $\pi(F) - \pi$ from the regulator. However, it should be noted that, although a fair insurance premium covers the regulator's loss, it does not induce the Pareto optimal investment policy, since NPV(q(F)) is still lower than NPV(q^*). Due to a time *inconsistency* problem, higher premium payment does not generally imply that banks will hold less risky assets. There is a need for incentive based regulation in view of the inadequacy of deposit insurance premia.[14]

There is another way to see the time inconsistency problem of deposit insurance premium. The government agency or private entity that offers deposit insurance might set risk-adjusted premia that account for these incentives. However, once such premia are paid, bank equityholders have no incentive to reduce the risk profile of their assets. To maximize the value of equity under limited liability, they will continue to hold the

[14] An appropriately designed incentive compatible compensation may help alleviate managerial agency problems. In particular, if the incentive features of compensation are tied to performance through stock appreciation rights, stock option contracts, and deferred compensation, managers may have incentives to increase the value of the firm (see John, Saunders, Senbet, 2000).

portfolio of risky assets that maximizes their expected upside benefits. The choice of bank assets may be completely divorced from the premia level. If the benefits associated with additional deposits and a larger risky portfolio outweigh premium costs, deposit insurance may be ultimately destabilizing. By broadening the pool of savings in the formal banking sector, explicit deposit insurance may therefore contribute to increased volatility, and risk-adjusted premia may be unable to prevent it. This may be what underlies the insignificant univariate relationships between risk-adjusted premium payments and financial volatility. We will investigate this more thoroughly in the multivariate tests that follow.

4. Optimal Regulation and the Rule of Law: The preceding discussion underscores the distortionary effects of deposit insurance in a poorly regulated environment. Capital regulation is one way to mitigate the problem, but its effectiveness is limited (see 3 above). However, as John, Saunders, and Senbet (2000) show, it is possible to come up with a more efficient banking regulatory scheme by exploiting the incentive features of bank management compensation. The existence of explicit deposit insurance facilitates this, since the insurance premium can be determined on the basis of not only capital rules but also incentive features that include base salary, equity participation, and bonus. The basic idea is these features can be designed to make bank management sensitive to the interests of both depositors (and regulators) and bank owners. Of course, the environment that fosters the rule of law and enforceability of contracts will facilitate the effectiveness of such an incentivized regulation. For instance, in an environment where regulators themselves have distorted incentives, the optimally designed banking regulation may not be implemented (see Hauswald and Senbet, 1999).

In the following empirics we control for optimal regulation through rule of law indicators.[15]

IV. Empirics

A. Motivation for Indices and Estimation Technique.

Our central predictions are centered around the effects of deposit insurance features on financial volatility and growth. The specific hypotheses are spelled out in Section B below. To construct empirical tests of our predictions on the effects of deposit insurance, we re-packaged the data described in Tables 1 and 2. We first synthesized the information contained in our database regarding the generosity and selectivity (entry hurdles) of deposit insurance systems into two main principal component indices.[16] As noted above, using the original features instead of a few conglomerate indices makes it more difficult to produce a simple, coherent analysis of the extremely diverse regulatory schemes adopted around the world.

On a practical level, the effects of deposit insurance programs on the structure and performance of the banking sector may not be evident for some time. As a result, we computed our indicators of financial sector growth and stability at the country level, and aggregated the data over long periods of time. The study is, therefore, more akin to a cross-sectional rather than a time series analysis. This limits our degrees of freedom, thus making it unwise to include each design feature as a separate explanatory variable. However, our approach yields correlations that are quite robust.

In addition, the use of indices makes for a more direct correspondence between our regression variables and the theoretical concepts outlined above; this greatly facilitates

[15] We recognize that adequate rule of law is necessary but, in some cases, not sufficient for an optimal regulatory scheme.

the task of studying simple linear relationships between deposit insurance features and financial performance. It also makes it possible to formulate more flexible policy recommendations, allowing for tailor-made country specific solutions. In other words, if high scores on a conglomerate index are found to be positively (or negatively) correlated with financial performance indicators, there is still a number of possible configurations of the underlying design features that a country may be advised to pursue. As the same purpose is conceivably achieved in different settings by different means, a one-size-fits-all, best practice approach (in terms of single design features) may not be optimal in the face of country-specific socioeconomic constraints.

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 in the regression highly correlated design features) and of omitted variable bias (in case we decided to omit some arbitrarily due to our limited degrees of freedom). As a technical note, 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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[16] See pp. 5-7 for detailed description of both generosity and entry hurdle variables.

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

A few remarks should be made to motivate our generalized Tobit estimation approach. An important goal of this line of research is to advise countries contemplating the adoption of explicit deposit insurance whether they should do so, and what types of programs have worked best in fostering financial development. It would be ideal, therefore, if the estimated relationships between deposit insurance features and financial performance consistently extended to the whole population of countries. Such hopes are dashed, however, because data on design features are available only for the restricted (clearly non-random) sub-sample of countries that have adopted an explicit deposit insurance system in the first place.

We address the risk of estimating a relationship which only suits a subset of selected countries by adopting a two-step sample selection model. We first estimate for all countries, the probability of adopting explicit deposit insurance and then use these "sample weights" in the second stage (the actual regression), to minimize the distortionary impact of the observations which are most likely to be selected in the first stage. The second stage regressions, which describe the effects of different types of explicit deposit insurance (as summarized by our indices) on banking sector growth and stability, can also offer comparisons of average sector performance before and after the adoption of a program. In that sense, they do provide information about the relative merits of implicit versus explicit deposit insurance, but based on the subset of countries selected in the first-stage regression.

As described more fully below, selected countries, those that adopt explicit insurance, tend to be more institutionally developed and display lower financial sector volatility than countries that retain implicit schemes. In that sense, our results may not be

an adequate guide as to the effects of explicit insurance on less institutionally developed countries. But to foreshadow our results a bit, we do find that, even *within* the subset of countries that adopt explicit insurance, subsequent sector volatility *is relatively high* and long-run sector growth *is relatively low* in those countries that have relatively weak institutions. We suspect that, had they adopted explicit insurance, the results might have been even more devastating for the subset of countries that retained implicit schemes throughout. Finally, as for concerns of simultaneity bias, if it is well possible that the decision to adopt explicit deposit insurance (or none at all) may depend on financial performance, it is perhaps conceptually less likely that specific deposit insurance features are designed conditional on these macro-indicators.[18]

B. Hypotheses

Armed with variables (indices) that better summarize the generosity and entry hurdle concepts, we conduct empirical tests which are motivated by an incentive-based theory of depository institutions as discussed in the last section. The indices enable us to state our hypotheses succinctly. Before we do, however, we need to introduce one additional variable. As noted above, any adverse effects of deposit insurance may be mitigated by effective bank regulation and supervision. Even if depositors have little incentive to monitor their banks, a sound regulatory environment may limit some abuses and lead to healthier bank asset portfolios.

Lacking a perfect summary statistic for the quality of the regulatory environment, we rely on a six-point measure of the quality of the rule of law created by the

[18] Moreover, in a very similar setting, Demirguc-Kunt and Detragiache (1999) provide a series of instrumental variable tests refuting the hypothesis that the specific program features are endogenous.

International Country Risk Guide (ICRG).[19] 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 (Demirguc-Kunt and Detragiache, 1997).[20]

Using simple interaction terms, the ICRG legal index enables us to measure the effects of generosity and entry hurdles in weak versus strong regulatory environments. As laid out in the theory section, more generous deposit insurance schemes should increase F, the level of deposits outstanding, and σ, the riskiness of banking sector asset portfolios. We expect these effects to be reflected in increases in our two volatility measures. Again, however, the incentive to increase riskiness, and thus volatility, should be more effectively curtailed in sound regulatory environments. These thoughts lead to our first two hypotheses:

[19] Legal tradition data are averaged over 1985-1991 for each of our countries.

[20] More specifically, because the index is a good predictor of the use of long-term debt by large firms in their cross-country sample, Demirguc-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. (1999) 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 a summarizing both the quality of the regulations on the books and the quality of enforcement of those regulations. Finally, Barth, Caprio, and Levine (2000) 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

H_1: Generous deposit insurance schemes lead to greater financial sector volatility. 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 regulatory environment. If so, the coefficient for 'generosity x law' should be negative and significant.

Hypotheses regarding entry hurdles are qualitatively similar to those for generosity, but they tie into the theory section 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, because of the time inconsistency problem discussed in the theoretical section, even well-priced deposit insurance may have no impact on risk incentives. We leave it to our empirical tests to sort between these hypotheses.

For purposes of exposition, it will be 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 financial sector volatility. 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 regulatory environment. If so, the coefficient for 'poor selection x law' should be negative and significant.

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a proxy for the quality of regulation and supervision that has been widely used in the empirical financial literature.

Our theory does not unambiguously resolve whether increased riskiness (σ) coincides with improvements or declines in V, the value of financial intermediation. Some volatility (riskiness) is probably necessary to create a vibrant financial sector capable of identifying new, relatively productive ventures. Too much volatility can be a sign of too much risk taking. Moreover, the dislocation associated with frequent systemic collapses is likely to lead to slower long-run financial development and economic growth. As proxies for V we use the growth rates in our financial indicators described above. We view them as measures of long-run financial development. The mechanism by which generosity affects, first, the level of deposits, and, second, the riskiness of sector assets and the value of financial intermediation, makes it the more natural channel through which deposit insurance could affect financial development, and thus our growth rates. The mechanism by which entry hurdles affect long-run financial development is less clear, at least in the context of the theory section, but we also test whether they, too, have an effect on growth rates. We expect that the potential positive effects of deposit insurance on financial sector growth are likely to be most pronounced in a sound regulatory environment, one less prone to systemic collapse. Our final two hypotheses are, therefore:

> ***H_5:*** Overly generous deposit insurance and poor selection of member banks may lead to sector instability and slower long-run financial development. If so, the coefficients for 'generosity' and 'poor selection' should be negative in the financial sector growth rate regressions.
>
> ***H_6:*** The adverse growth effects of generosity and poor selection should be reduced by a sound regulatory environment. If so, the coefficients for 'generosity x law' and 'poor selection x law' should be positive in the financial sector growth rate regressions.

We can state our central testable predictions with the following simple regression model:

$$Y_i = a_0 + b_{G1}G_i + b_{G2}G_i Law_i + b_{H1}H_i + b_{H2}H_i Law_i + b_X X_i + b_r R_i + e_i$$

where Y_i is the growth rate of an indicator of financial development, 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; Law is an index of the quality of the rule of law; X is a set of macroeconomic control variables that could also affect financial sector development and volatility; and R represents other potentially relevant aspects of the deposit insurance program or the banking sector. For the regressions in which financial volatility is the dependent variable, Hypothesis 1 (H_1) implies that $ß_{G1}>0$; H_2 implies $ß_{G2}<0$; H_3 implies $ß_{H1}>0$; and H_4 implies $ß_{H2}<0$. For the regressions in which the growth rate of a indicator of financial development is the dependent variable, H_5 implies that $ß_{G1}<0$ and $ß_{H1}<0$, while H_6 implies that $ß_{G2}>0$ and $ß_{H2}>0$.

In addition, as described above, we include a first-stage regression to control for the selection bias associated with the adoption of explicit deposit insurance. In that stage we rely on two measures – prior financial sector volatility and the legal index – to separate countries that adopted deposit insurance from those that did not. As in Cull (1998) we expect that strong legal tradition is positively associated with adoption of explicit deposit insurance, while prior volatility is negatively associated with adoption, as countries have been less apt to enact deposit insurance in turbulent periods.[21]

[21] 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 1960-1997 (although data availability implied that, in practice, most observations were calculated over a smaller subset of that period). For countries that

The control variables in the second-stage regressions (which use either volatility or growth rates of our financial indicators as the dependent variable) include inflation, real growth, the years since deposit insurance has been in place, and the banking sector asset concentration ratio (described above). High inflation, which may make some types of financial contracting more problematic, should have an adverse effect on financial growth rates. The effect on sector volatility is more difficult to predict. Real growth should have a positive effect on growth rates, but a less clear effect on volatility. Years since adoption may be positively associated with both volatility and financial growth as it may take time before the effects of deposit insurance are evident.

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 financial sector growth. While not our central focus, these control variables should help us to estimate more accurately the effects of generosity and entry hurdles on financial development. Like the dependent variables in the second-stage regressions, these control variables are averaged over all years since the adoption of deposit insurance.

V. Results

Regardless of the dependent variable (the volatility of either private credit or liquid liabilities), all specifications in Table 3 provide support for hypotheses one and two. The significant positive coefficient for generosity indicates that relatively generous

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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

deposit insurance schemes do coincide with greater subsequent financial sector volatility. The significant negative coefficient on the generosity/law interaction term indicates that a sound regulatory environment can mitigate the volatility associated with generous deposit insurance. 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 little or no increase in financial volatility due to the generosity of their deposit insurance scheme. None of the developing countries in our sample satisfy that criterion.

The specifications in Table 3 provide no support for hypotheses three and four. The insignificant coefficients for the index of weak selection criteria and for the selection/law interaction term indicate that the entry hurdles imposed on member banks have little effect on subsequent volatility, regardless of the quality of regulation and supervision. 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 overall quality of regulation and supervision 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. Again, the ineffectiveness of entry hurdles, especially risk-adjusted premium payments, may stem from time inconsistency problems.

The specifications in Table 4 help us assess whether the increased volatility associated with deposit insurance accelerates or retards long-run financial development. The negative significant coefficient for generosity indicates that depositors that feel relatively secure may inadvertently contribute to slower long-term financial development.

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interval just prior to adoption. Results for the three-year period appear below.

However, the positive significant coefficient on the generosity/law interaction term indicates that a sound regulatory environment may act as an adequate substitute for monitoring of banks by depositors. Indeed, the estimated coefficients imply that countries with better legal traditions experience greater long-term financial development after introducing generous deposit insurance. By drawing more savers into the formal financial system generous deposit insurance can, therefore, have a positive impact on financial development, but only if the appropriate regulatory and supervisory safeguards are in place. Again, most of the World Bank's client countries appear to lack those safeguards.

A few words should be said about differences between the results for private credit growth (specifications 1-4, Table 4) and for liquid liabilities growth (specifications 5-8, Table 4). The estimated coefficients imply that liquid liabilities grow more rapidly after the introduction of generous deposit insurance for all but the countries with the weakest legal traditions (i.e., a zero score on the legal index). By contrast, the models indicate that generosity coincides with a higher subsequent private credit growth rate, but only in countries that score five or six on the legal index. The two results suggest that the effects of generous deposit insurance are reflected differently on the asset versus the liability side of bank balance sheets. Generosity will prompt more savers to deposit in banks in all but the most chaotic situations. But the increase in deposits coincides with increased credit to the private sector in only those countries with sound institutional structures. This suggests that, for countries with weak, but not atrocious, institutional

development (i.e., 2-4 on the legal index), additional deposits attracted through insurance are not intermediated effectively.[22]

A. Implicit Versus Explicit Deposit Insurance

In order to obtain unbiased coefficients in our financial development regressions, we have corrected for potential sample selection bias associated with the adoption of explicit deposit insurance using a two-stage estimation procedure. Although we are convinced that this is the correct methodological approach, it does not permit us to compare directly the financial development of countries with explicit schemes with that of countries that retained implicit deposit insurance. In this sub-section, we use simple estimation techniques to make some comparisons between these two groups of countries.

Controlling for income and the average level of inflation from 1990-92, the partial correlation between explicit deposit insurance and financial depth in 1992 is actually *negative* (specifications 1 and 2, Table 5). The estimated coefficients for the explicit deposit insurance variable imply large reductions M2/GDP (roughly ten percentage points). However, the t-statistic for that coefficient is not significant. The models in Table 5 are taken from Cull (1998). Here we report results only for one indicator of financial development M2/GDP, but similar results hold for additional indicators.

Regression analysis of short-term financial deepening provides a somewhat stronger indication that explicit deposit insurance is negatively associated with financial development. Controlling again for inflation, and for income (both changes and levels),

[22] In many African countries, a majority of banks' assets are in government bonds, which is partially responsible for our results. That is, in those countries, there is a much greater propensity to channel

the dummy variable for explicit deposit insurance is negatively and significantly associated with changes in M2/GDP (Table 5, specifications 3-4). The estimated coefficients indicate that, holding other factors constant, countries with explicit deposit insurance experienced 2-3% less growth in M2/GDP after the program's inception than did the typical country that retained implicit insurance. The overall fit of the change in financial depth regressions is good – income level enters positively and significantly; income changes also enter positively, though insignificantly; and, inflation enters negatively and significantly. On the basis of models 1-4, one could conclude that explicit deposit insurance has typically been *negatively* correlated with financial development.

However, models 5 and 6 provide some support for the idea that explicit deposit insurance can contribute to a deeper financial system, but only under the right circumstances. In model 5, the interaction of past volatility with explicit deposit insurance has a negative and significant relationship with short-term changes in M2/GDP; by contrast, the dummy variable for explicit insurance enters positively and significantly. In model 6, the interaction of the rule of law and explicit insurance is positively linked to changes in M2/GDP; the dummy variable for explicit insurance enters negatively and significantly.

We have less faith in these results because of the sample selection bias described above, and because the explicit insurance dummy variable contains no information about the design of the program. However, the results in Table 5 suggest that explicit deposit insurance has been associated with greater financial depth, but only if past sector volatility was low or the rule of law (a proxy for the quality of regulation) was well

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deposits to the government rather than private endeavors.

established. The conditional nature of these results squares well with the others in the paper.

B. Deposit Insurance and Banking Sector Concentration

As with the volatility specifications in Table 3, the growth rate specifications in Table 4 indicate that entry hurdles have no significant effect on subsequent financial development. We found it somewhat surprising that the requirements imposed on member banks had no effect on the structure (and, therefore, the subsequent performance) of the sector. As a final empirical exercise, we decided to look a bit more closely at the relationships between deposit insurance features, sector concentration, and financial development. In Table 3, concentration is negatively and significantly linked to volatility in all four specifications in which it appears. In Table 6, we present a simple reduced form to better explain concentration. Neither index of deposit insurance features, selection nor generosity, is significantly associated with concentration. Nor are control variables like per capita GNP or the legal index. The only variable with significant explanatory power is the years since deposit insurance has been in place. The longer a deposit insurance scheme has been in place, the less concentrated the sector, regardless of the specific features of the program.

Although we are not sure about the channel through which deposit insurance affects the competitive structure of the banking sector, the results in Table 6 might indicate that, regardless of features such as high entry hurdles, the lure of insured deposits eventually leads to less concentration. Those in Table 3 indicate that concentration is associated with lower financial sector volatility. The two results may point to another

channel through which deposit insurance affects financial development. Its mere presence may contribute to an increasingly fragmented sector over time, which brings with it higher volatility, and the specific selection criteria applied to screen member banks appear to do little to stop it. We admit that the results on concentration are a bit more speculative than the others, but they do provide additional support for the notion that entry hurdles have not been an effective way to curtail the increased volatility that often accompanies deposit insurance.

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 financial development and stability is quite limited. This paper has provided empirical evidence on the impact of deposit insurance on financial development and stability, broadly defined to include the level of financial activity, the stability of the banking sector, and the quality of resource allocation as reflected in real sector performance (i.e., growth). We use a unique dataset capturing a variety of deposit insurance features, such as coverage, entry hurdles, premium structure, etc.

The 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, and it is used to state several testable hypotheses on the impact of deposit insurance. The overall empirical evidence is consistent with the likelihood that

deposit insurance leads to financial instability in lax regulatory environments. However, the deposit insurance schemes have a desired impact on financial development and growth in sound regulatory environments as proxied by quality indices of the rule of law. Thus, the introduction of deposit insurance scheme needs to be accompanied by a sound regulatory scheme; otherwise, the scheme would lead to instability and deter financial development.

On the other hand, the results on entry hurdles are rather surprising. The entry hurdles, such as the insurance premium requirements on member banks, have no significant effect on subsequent financial development. These results can be explained in the context of our theory which suggests that *ex ante* premia are time-inconsistent and have no incentive effects once they are in place. Thus, one cannot expect to impact bank risk-taking behavior by putting into place entry hurdles alone, unless they are somehow linked to incentives. Finally, we have a subsidiary empirical result showing that bank sector concentration is negatively and significantly linked to volatility, but not to deposit insurance features. On the other hand, the longer a deposit insurance scheme has been in place, the less concentrated the sector, regardless of the specific features of the program.

The paper lends itself to a number of 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. Our theory suggests that such regulation has limited effectiveness in reducing financial volatility, and that, because banks have different investment opportunity sets, a one-size-fits-all approach to capital regulation is likely inappropriate. Given adequate cross-country data, we could incorporate capital regulation into our empirical tests. The results

would have implications for the debate on standardization of regulation (e.g., through the Basle Accord).

More generally, if cross country data were available on multiple aspects of the regulatory and supervisory environment, we could incorporate better indicators of institutional development than the rule of law in our empirical work. Finally, we focus on bank-based indicators as a proxy for overall financial sector development and performance. 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 (and the growing attention they receive in the literature) suggests that it may be worthwhile to extend the analysis of this paper to a broader range of agents and mechanisms which constitute the financial system.

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Appendix

A Model of Deposit Insurance and Risk Shifting

The main issues in the risk incentive effects of bank deposits and deposit insurance can be captured in a more formal, but simple framework following John, John and Senbet (1991) and John, Saunders, and Senbet (2000).

Bank Investment and Financing Environment

Consider a three-date time line. At the initial date, t=0, the bank collects deposits while promising depositors an amount F and finances residually through equity (bank capital). Bank capital infusion is subject to existing regulatory constraints. For sharper focus, we assume that bank deposits are insured in their entirety (i.e., *complete coverage*) by an insuring government agency (e.g., US FDIC). The agency charges the relevant insurance premium, π, to be paid by the bank. Thus, we restrict the financing claims to debt and equity. Contracts are written and priced at the initial date (i.e., t = 0), given the information available and the admissible contracting opportunities.

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.[23] 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.

There is a moral hazard problem in this framework, since the investment decisions are taken as "private action" to be undertaken by bank insiders (bank management). This notion is captured as follows. Bank management observes the parameter q at t=1 before a choice is made between the riskless invesments and risky invesments. The outside stakeholders include bank depositors, bank equityholders, and regulators, and they do not not observe q. However, bank management is presumed to work in the best interests of bank owners or those with equity stake.[24] 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).

[23] 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 at the terminal date, t=2.

[24] See John, Saunders, and Senbet (1999) for the analysis that incorporates conflicts between management and bank owners.

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. If there is a shortfall relative to the deposit obligations, the government insurance agency honors the guarantee, since deposits are all insured. Thus, the government guarantee payoff is isomporhic to that of a put option, max(0, F-X).

Bank Risk-Shifting Incentives

Now let us go back to the initial date, t=0, when all contracts are priced. Let us assume that deposits are in the form of pure discount debt of promised payment F due at t = 2. Since the deposits are fully insured, they will be priced as riskless instruments. In addition, this framework allows us to determine the deposit insurance on a rational expectations basis as the fair value of the deposit insurance provided. The risk-shfiting incentives and the resulting investment distortions can be characterized by using as a benchmark the optimal decisions that would be undertaken when the bank faces no depository financing (say an all-equity bank funding its loans through bank capital alone). The optimal investment policy would be one of choosing between risky and riskless investments (say risky loans and government bonds). Thus, at the intermediate date, t=1, bank management, working in the best interests of bank owners, observes q and decides to invest in the risky project if:

$$qH + (1 - q)L > I \qquad \text{(A1)}$$

That is, bank management only invests in the risky project if it has positive NPV; otherwise they invest in the riskless project, since it has a zero NPV. Given (A1), there is a cut-off value, q*, of q, such that the risky investment dominates the riskless one. In other words, q* is the lowest value of q that satisfies (A1). This signifies an investment policy characterized by [q*], a policy of investing in the risky asset (loan) for $q > q^*$, and in the riskless asset (loan) for $q < q^*$. The optimal investment policy is now given below:

$$q^* = (I - H)/(H - L) \qquad \text{(A2)}$$

The risky projects are chosen only for values $q > q^*$. Given that q is uniformly distributed over the interval [0,1], an investment policy [q*] produces the distribution of terminal cashflows as follows:

H with a probability $1/2[1-q^{*2}]$
I with a probability q* and
L with a probability $1/2[1-q^*]^{2.}$

Thus, the net present value of an investment policy [q*] is given by

$$V(q^*) = q^* I + L/2 [1 - q^*]^2 + H/2 [1 - q^{*2}] - I \qquad \text{(A3)}$$

An all-equity bank chooses investment policy [q*]. Then, NPV(q*) is the value achieved if q is perfectly observed by all the parties. Alternatively, NPV(q*) is the maximum value that can be achieved under full information and complete contracting. Then, [q*] is the Pareto efficient investment strategy that we can use as a benchmark for evaluating the distortions arising from risk shifting due to the introduction of deposits. The cut-off probability that departs from q* is distortionary relative to the optimal risk choice.

Now introduce bank deposits, with deposit claims of promised payment F. Deposits are complements to bank equity capital so that lower F is reflected in larger bank equity (capital). Thus, for analytical purposes, it is convenient to parameterize the level of bank equity capital in terms of F, where F and bank capital are inversely related. For sufficiently high deposits (or low bank capital), the bank asset cashflows would be insufficient to repay the depositors in some state of the world (i.e., L < F), inducing the management to implement a riskier investment policy than [q*]. Formally, the distorted investment incentives can be characterized as follows. For bank deposits of promised payment F > 0, the manager will implement an investment policy [q(F)], where q(F) is given as:

(a) Riskless Deposits (F < L): $q(F) = q^*$

(b) Risky Case (L<F<I): $q(F) = (I - F)/(H - F)$ (A4)

(c) Risky: Extreme (F > I): $q(F) = 0$

The proofs are straightforward and they are given in John, John, and Senbet (1991) and John, Saunders, and Senbet (2000). Here we wish to provide the intuition. For any value of deposits with F > L , where in some states the bank fails to honor the deposit claims, the manager implements an investment policy [q(F)] which is sub-optimal (i.e., NPV(q(F) < NPV(q*)) and riskier than the efficient one, [q*] s, i.e., q(F) < (q*) . To see this, consider an arbitrary cut-off probability level. When the cut-off probability (q_c) is varied from 1 to 0, the value of the terminal cash flows, expressed as (A3), increases from I to V (q_c) and then decreases to (H +L)/2. The maximum value is achieved when $q_c = q^*$. The volatility of the terminal cash flows, $\sigma(q_c)$ can also be specified in the like manner. As the cut-off (q_c) is varied from 1 to 0, $\sigma(q_c)$ varies from 0 to $[(H - L)/2]^2$. Thus, the cut-off probability can be thought of an index of volatility (risk), and risk increases with *decreasing* q_c.

We can actually characterize the pair of value-risk [V (q), σ(q)] so that, as risk σ (q_c) increases from 0 to σ (q*), the value increases first I to V (q*). With any further increases in risk beyond σ(q*), the value declines. The investment opportunity shape that would be generated would be similar to Figure 2 in the text. Now in the presence of depository financing, the bank insiders will invest for values of q > q(F), where the residual pay-offs of the equity-holders are higher than those for safe investment [(q max(0, H - F) + (1 - q) max(0, L - F) > max (0, I - F)], and hence

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

Thus, in the range of (b) above, the terminal cashflow distribution resulting from the investment policy [q(F)], implemented by the manager is strictly increasing in risk for increasing F, such that $\partial \sigma(q(F)) / \partial F > 0$, and decreasing in value, i.e.,$\partial NPV(q(F)) / \partial F\} < 0$. This establishes the basis for the predictions on volatility effect of deposits (*financial instability* effect) and value effect (*economic inefficiency* effect) in the text.

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	Compul-sory	Funded *Ex ante*?	Premium	Risk-Adjusted
Coverage	1.00									
(2.13)	(n=29)									
Foreign	-0.13	1.00								
(0.55)	(n=29)	(n=29)								
Interbank	0.15	-0.05	1.00							
(0.21)	(n=29)	(n=29)	(n=29)							
Source	0.07	0.40	0.08	1.00						
(0.76)	(n=29)	(n=29)	(n=29)	(n=29)						
Management	-0.12	-0.03	-0.37**	-0.25	1.00					
(1.59)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)					
Co-insurance	-0.12	0.02	-0.09	-0.21	0.19	1.00				
(0.24)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)				
Compulsory	0.14	0.03	0.14	0.14	0.20	0.15	1.00			
(0.93)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)			
Funded ex ante	0.14	0.06	0.32*	0.16	-0.51***	-0.37**	0.14	1.00		
(0.72)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)		
Premium	-0.10	-0.22	0.06	-0.04	-0.22	-0.19	0.15	0.38*	1.00	
(0.31)	(n=27)	(n=27)	(n=27)	(n=27)	(n=27)	(n=27)	(n=27)	(n=27)	(n=27)	
Risk-adjusted	0.01	0.41**	-0.23	0.22	0.23	-0.04	0.12	0.08	-0.07	1.00
(0.17)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=29)	(n=27)	(n=29)

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 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. * indicates significantly different from zero at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level.
Deposit insurance system features are taken from Demirguc-Kunt, Asli, and Enrica Detragiache, "Does Deposit Insurance Increase System Stability? An Empirical Investigation," July, 1999. Demirguc-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.

Table 2: Financial Development and Deposit Insurance Features, Pairwise Correlations

Deposit Insurance Feature	Concentration Ratio (assets of top 3 banks relative to sector)	Coefficient of Variation, (Liquid Liab /GDP)	Coefficient of Variation, (Credit to Private Sector /GDP)	Growth Rate (Liquid Liab /GDP)	Growth Rate (Credit to Private Sector /GDP)
	Mean .63 St Dev .16 Min .36 Max .88	Mean .12 St Dev .10 Min .02 Max .34	Mean .18 St Dev .16 Min .03 Max .68	Mean 0.7% St Dev 4.0% Min -10.9% Max 6.9%	Mean 0.5% St Dev 6.1% Min -15.4% Max 9.9%
Coverage	-0.03 (n=29)	0.02 (n=27)	-0.29 (n=28)	0.10 (n=28)	0.12 (n=28)
Foreign Curr.	-0.07 (n=29)	-0.46** (n=27)	-0.07 (n=28)	-0.04 (n=28)	-0.18 (n=28)
Interbank	-0.00 (n=29)	0.36* (n=27)	0.06 (n=28)	-0.11 (n=28)	0.00 (n=28)
Source	0.11 (n=29)	-0.10 (n=27)	-0.10 (n=28)	-0.24 (n=28)	-0.18 (n=28)
Management	-0.22 (n=29)	-0.01 (n=27)	0.28 (n=28)	-0.02 (n=28)	-0.05 (n=28)
Co-insurance	-0.52*** (n=29)	0.18 (n=27)	0.16 (n=28)	0.29 (n=28)	0.23 (n=28)
Compulsory	-0.27 (n=29)	0.20 (n=27)	0.17 (n=28)	-0.00 (n=28)	-0.07 (n=28)
Funded	0.33* (n=29)	0.17 (n=27)	-0.09 (n=28)	-0.04 (n=28)	-0.07 (n=28)
Premium	0.12 (n=27)	0.28 (n=25)	0.30 (n=26)	-0.59*** (n=26)	-0.44*** (n=26)
Risk-adjusted	0.07 (n=29)	-0.19 (n=27)	-0.16 (n=28)	-0.06 (n=28)	-0.19 (n=28)

Table 2 provides pairwise correlations between deposit insurance program features and indicators of financial development. The indicators include a measure of sector concentration equal to the assets of the three largest banks relative to the total for the sector, and two measures of banking sector volatility, one measured as the coefficient of variation (standard deviation divided by mean) for the ratio of liquid liabilities to GDP, and another measured as the coefficient of variation for the ratio of credit to the private sector to GDP. Finally, there are two indicators measuring the growth rate of indicators of financial development, one for the ratio of liquid liabilities to GDP, another for the ratio of credit to the private sector to GDP.

Deposit insurance features are explained in the text and in the notes to Table 1.

* indicates significantly different from zero at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level.

Table 3: Effects of Deposit Insurance on the Volatility of Financial Development Indicators

Explanatory Variable	**Dependent Variable**					
	Ln(Coeff Var BNK)[a]	Ln(Coeff Var BNK)	Ln(Coeff Var BNK)	Ln(Coeff Var LL)[b]	Ln(Coeff Var LL)	Ln(Coeff Var LL)
	(1)	(2)	(3)	(4)	(5)	(6)
First Stage						
Rule of Law	.415*	.364**	.344*	.325**	.366**	.299**
	(1.84)	(2.13)	(1.71)	(2.16)	(2.36)	(2.04)
Past Volatility of	-9.80	-7.05	-7.83	-7.45**	-7.63**	-7.13*
BNK	(1.22)	(1.57)	(1.31)	(2.12)	(2.48)	(1.88)
Second Stage/ Conditional on Adoption of Deposit Insurance						
Generosity	1.84*	0.97*	0.98*	1.78**	1.40***	1.34***
	(1.84)	(1.89)	(1.79)	(2.06)	(5.08)	(2.91)
Generosity x Law	-0.37	-0.21*	-0.23*	-0.36*	-0.30***	-0.32**
	(1.60)	(1.74)	(1.81)	(1.79)	(4.25)	(2.28)
Poor Selection			.085			-.379
			(0.09)			(1.09)
Poor Selection xLaw			-0.96			.038
			(0.39)			(0.27)
Inflation	-.014	.005	-.014	-.066	.011	.012
	(0.39)	(0.02)	(0.50)	(0.24)	(0.43)	(0.05)
Real Growth	-.174	-.065	-.027	-.273	-.011	.029
	(0.64)	(0.38)	(0.14)	(1.41)	(0.10)	(0.22)
Years in Place	-.039	.014	.095	-.047	.085	.017
	(0.98)	(0.51)	(0.29)	(1.29)	(0.67)	(0.61)
Concentration		-2.80***	-2.57*		-3.82***	-3.87***
		(2.97)	(1.84)		(4.04)	(3.57)
Observations	56	56	53	56	56	53
# with Explicit DI	27	27	24	27	27	24
Log Likelihood	-53.08	-43.78	-37.98	-60.68	-47.75	-43.80

(a) BNK is the ratio of bank credit to the private sector to GDP. (b) LL is the ratio of liquid liabilities to GDP. The dependent variables are the log of the coefficient of variation (standard deviation divided by mean) for BNK and for LL. They are intended to measure the volatility of financial development.

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 'Law,' a six-point measure of the quality of the rule of law averaged over 1985-1992 (see data appendix 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 all years *prior* to the adoption of explicit deposit insurance (from 1960-1997). 'Volatility BNK' is the coefficient of variation (standard deviation divided by mean) for BNK. 'Volatility LL' is the coefficient of variation for LL.

The second stage estimation is conditional on the adoption of deposit insurance. Regressors include 'generosity' a principal components index derived from six deposit insurance program features – coverage limits, coverage of foreign currency deposits, 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 four program features that describe the requirements that are imposed upon member banks: compulsory membership requirements, 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 as an interaction term in the second stage, is computed as described above.

Inflation and real growth are averaged over all years for which data are available from 1960-97 (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.

* indicates significantly different from zero at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level.

Table 4: Effects of Deposit Insurance on the Growth Rate of Financial Development

Explanatory Variable	**Dependent Variable**							
	BNK[a] Growth Rate	BNK Growth Rate	BNK Growth Rate	BNK Growth Rate	LL[b] Growth Rate	LL Growth Rate	LL Growth Rate	LL Growth Rate
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
First Stage								
Law	.442***	.590***	.418***	.419***	.349***	.496***	.320***	.350***
	(4.01)	(4.85)	(4.06)	(4.26)	(3.79)	(3.14)	(3.23)	(3.79)
Volatility BNK		-10.6***				-10.18**		
		(3.66)				(2.18)		
Volatility LL	-13.01**		-13.55**	-11.5***	-10.2***		-9.79***	-10.2***
	(2.01)		(2.45)	(2.72)	(3.26)		(2.89)	(3.22)
Second Stage/ Conditional on Adoption of Deposit Insurance								
Generosity	-.071***	-.059**	-.064**	-.067***	-.034**	-.038	-.036**	-.033**
	(3.24)	(2.24)	(2.35)	(2.72)	(2.15)	(1.57)	(2.20)	(2.05)
Generosity x Law	.018***	.015**	.014**	.017***	.075**	.086	.074**	.074**
	(3.72)	(2.39)	(2.00)	(3.22)	(2.06)	(1.56)	(1.97)	(1.99)
Poor Selection			-.020				.018	
			(0.42)				(0.36)	
Poor Selection xLaw			.067				-.052	
			(0.50)				(0.47)	
Inflation	-.044***	-.037**	-.044***	-.037***	-.024***	-.023***	-.025***	-.024***
	(4.82)	(2.55)	(2.94)	(2.82)	(4.00)	(4.27)	(2.87)	(3.77)
Real Growth	.014***	.014**	.013	.014**	.098***	.096***	.098	.096***
	(2.81)	(2.03)	(1.33)	(2.41)	(3.41)	(3.29)	(1.62)	(3.13)
Years in Place	.011	.006	.011	.016	.004	.004	.004	.004
	(1.04)	(0.50)	(0.66)	(1.10)	(0.78)	(0.78)	(0.55)	(0.53)
Concentration				-.023				.212
				(0.51)				(0.08)
Observations	57	57	54	57	57	56	54	57
# with Explicit DI	28	28	25	28	28	27	25	28
Log Likelihood	33.20	33.31	29.86	32.41	46.17	47.17	40.83	46.18

(a) BNK is the ratio of bank credit to the private sector to GDP. (b) LL is the ratio of liquid liabilities to GDP. The dependent variables are growth rates for BNK and for LL. They are intended to measure the rate of financial sector development. 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 1960-1997.

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 'Law,' a six-point measure of the quality of the rule of law averaged over 1985-1992 (see data appendix 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 all years *prior* to the adoption of explicit deposit insurance (from 1960-1997). 'Volatility BNK' is the coefficient of variation (standard deviation divided by mean) for BNK. 'Volatility LL' is the coefficient of variation for LL.

The second stage estimation is conditional on the adoption of deposit insurance. Regressors include 'generosity' a principal components index derived from six deposit insurance program features -- coverage limits, coverage of foreign currency deposits, 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 four program features that describe the requirements that are imposed upon member banks: compulsory membership requirements, 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 as an interaction term in the second stage, is computed as described above.

Inflation and real growth are averaged over all years for which data are available from 1960-97 (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.

* indicates significantly different from zero at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level.

Table 5: Effects of Implicit Versus Explicit Deposit Insurance on Levels and Growth Rates of Financial Development

Explanatory Variable	Dep Variable: Level of M2/GDP, 1992		Dep Variable: Average Change in M2/GDP, 1980-95			
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.275***	0.283***	2.268***	1.800**	-1.48	.333
	(7.06)	(7.02)	(3.15)	(2.01)	(1.11)	(0.25)
Per Capita Inc	0.043***	0.043***	0.247**	0.276**		
	(6.51)	(6.48)	(2.29)	(2.21)		
Explicit	-0.097	-0.104	-2.980***	-2.867**	3.79**	-3.02*
	(1.53)	(1.62)	(3.58)	(2.85)	(2.36)	(1.85)
Explicit x Past Volatility					-.576***	
					(3.67)	
Past Volatility					.357***	.211**
					(3.54)	(2.16)
Explicit x Law						.688**
						(2.08)
Avg Inflation		-.004	-0.084***	-0.080***	-.093***	-.093***
		(0.83)	(5.71)	(4.70)	(5.42)	(4.85)
% change, Real Per Capita GDP				0.276	.108	.174
				(1.39)	(0.79)	(1.16)
Adj. R-Squared	.49	.47	.52	.46	.58	.47
Observations	51	51	43	40	40	40

Table 5 provides partial correlations between explicit deposit insurance and the level of financial depth in 1992 (models 1 and 2). It also provides partial correlations between explicit deposit insurance and average changes in financial depth from 1980-1995 (models 3-6). The table is designed to provide information on the effects of explicit versus implicit insurance on financial development. See Cull (1998) for models that use additional indicators of financial development as dependent variables.

Models (1) and (2): The dependent variable is M2 divided by GDP in 1992. 'Per capita income' in 1992 is taken from the Summers and Heston database, and is measured in $US 1985. 'Explicit' is a dummy variable = 1 if a country had an explicit deposit insurance program in 1992. 'Avg. Inflation' is measured as an average percentage change in the consumer price index from 1990-92.

Models (3)-(6): The dependent variable is the three-year change in M2/GDP (i.e., $M2/GDP_3 - M2/GDP_0$). For countries that adopted explicit insurance, the dependent variable is measured over the three years just after the program's adoption. For those countries that maintained implicit deposit insurance (the control category), changes in financial depth were first calculated over all possible three year periods from 1980-95; those three-year figures where then averaged. The same procedure was used to compute average inflation rates, % changes in real per capita GDP, and 'past volatility.' Past volatility is defined as the coefficient of variation in M2/GDP (standard deviation divided by mean).

As in models 1 and 2, 'Per capita income' in 1992 is taken from the Summers and Heston database, and is measured in $US 1985. 'Law' is a six-point measure of the quality of the rule of law averaged over 1985-1992 (see data appendix for further description).

* indicates significantly different from zero at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level.

Table 6: Effects of Deposit Insurance on Banking Sector Concentration

Explanatory Variable	Dep: Concentration Ratio (Top 3 banks)
Poor Selection	-.005
	(0.17)
Generosity	.009
	(0.37)
GNP Per Capita	-.012
	(1.14)
Law	.041
	(1.49)
Years in Place	-.005**
	(2.15)
Observations	39
R-square	.27
Adj R-square	.17

The dependent variable, 'Concentration Ratio,' is intended to measure the degree of concentration in the banking sector. It is equal to the share of total sector assets attributable to the three largest banks. There is one observation per country, and the concentration ratio is calculated as an average over all years for which data are available from 1960-1997.

Regressors include 'generosity' a principal components index derived from six deposit insurance program features -- coverage limits, coverage of foreign currency deposits, 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 four program features that describe the requirements that are imposed upon member banks: compulsory membership requirements, 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,' a six-point measure of the quality of the rule of law is averaged over 1985-1992 (see data appendix for further description). Higher values indicate greater adherence to the rule of law. GNP per capita is taken from Summers and Heston. 'Years in Place' is simply the number of years that explicit deposit insurance has been in place.

* indicates significantly different from zero at the 10% level; ** indicates significance at the 5% level; *** indicates significance at the 1% level.

Data Appendix

Countries included in active observation set (57)

Explicit Deposit Insurance: Austria, Belgium, Bangladesh, Brazil, Canada, Chile, Colombia, Denmark, Finland, France, Great Britain, Greece, Hungary, Ireland, Italy, Kenya, Luxembourg, Nigeria, Netherlands, Philippines, Poland, Portugal, Spain, Sri Lanka, Sweden, Switzerland, Trinidad and Tobago, Venezuela.

Implicit Deposit Insurance: Australia, China, Cote d'Ivoire, Costa Rica, Egypt, Ghana, Guatemala, Guyana, Hong Kong, Honduras, Indonesia, Iran, Iraq, Israel, Jordan, Libya, Malaysia, New Zealand, Pakistan, Paraguay, Saudi Arabia, Singapore, South Africa, Syria, Togo, Thailand, Uruguay, Zambia, Zimbabwe.

NOTE: Our empirical analysis of the impact of different deposit insurance features on financial development employs a *post hoc, ergo propter hoc* approach. In other words, our indicators of financial development and volatility are averaged for each country over all the years in the sample following the adoption of an explicit deposit insurance system. The years of adoption of explicit deposit insurance for all countries in our sample are shown in the following table.

country	Year adopted			country	Year adopted
AUT	1979			HRV	1997
BEL	1974			HUN	1993
BGD	1984			IRL	1989
BRA	1995			ITA	1987
CAN	1967			KEN	1985
CHE	1984			LUX	1989
CHL	1986			NGA	1988
COL	1985			NLD	1979
DNK	1988			PHL	1963
ESP	1977			POL	1995
FIN	1969			PRT	1992
FRA	1980			SWE	1996
GBR	1982			TTO	1986
GRC	1993			VEN	1985

Variable names, definitions and sources.

Variable Name	Definition	Source
Growth Rate of Bank Credit	Average annual growth rate in the ratio of bank credit to the private sector to GDP	Ratio equals IFS (line 55l) divided by IFS (line 99b)
Growth Rate of Liquid Liabilities	Average annual growth rate in the ratio of liquid liabilities to GDP	Ratio equals IFS (lines 22a-d) divided by IFS (line 99b)
Law and Order	Index of the quality of the rule of law ranging from 0 to 6; scores for each country average over data for 1985-1991.	ICRG
Generosity	Principal components index of six deposit insurance features (Table 4)	Features are from Demirguc-Kunt and Detragiache (1999)
Entry Hurdles	Principal components index of five deposit insurance features (Table 4)	Features are from Demirguc-Kunt and Detragiache (1999)
Volatility in Bank Credit	Coefficient of variation (standard deviation/mean) in the ratio of bank credit to nominal GDP.	IFS (see above)
Volatility in Liquid Liabilities	Coefficient of variation in the ratio of liquid liabilities to GDP	IFS (see above)
Inflation	Average inflation	SIMA (wdi, ifs)
Real Growth	Rate of growth of real GDP	SIMA (wdi, ifs)
Years in Place	Years since the adoption of explicit deposit insurance	Demirguc-Kunt and Detragiache (1999)
Concentration	Assets of largest three banks divided by total banking assets	Beck, Demirguc-Kunt, Levine (1999) [from Bankscope]

ICRG is the International Country Risk Guide, published by Political Risk Service, Syracuse, NY. IFS is International Financial Statistics, published by the IMF.

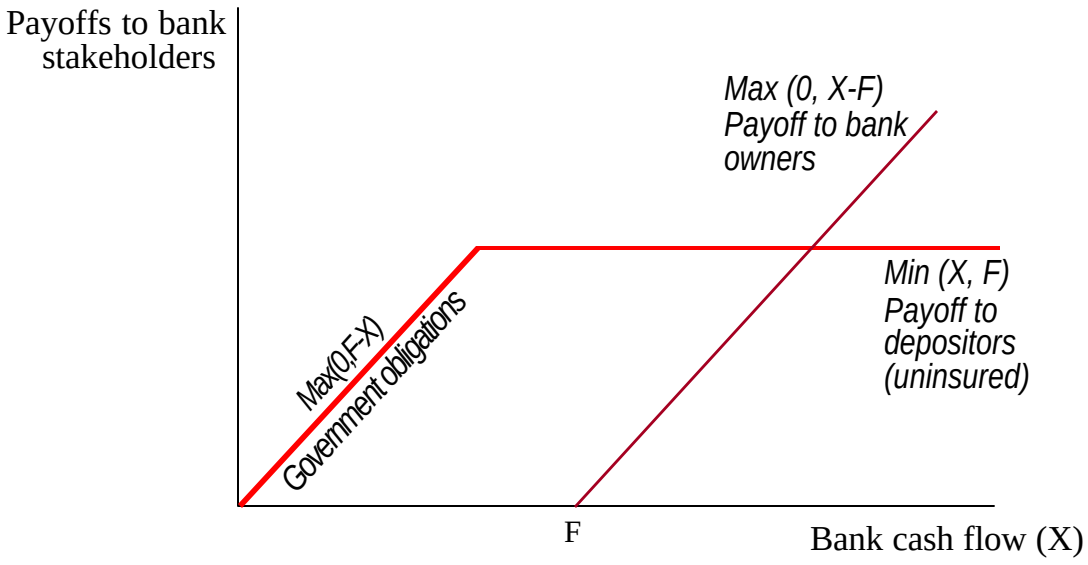

Figure 1: Partitioning of Income from Bank Asset Portfolio

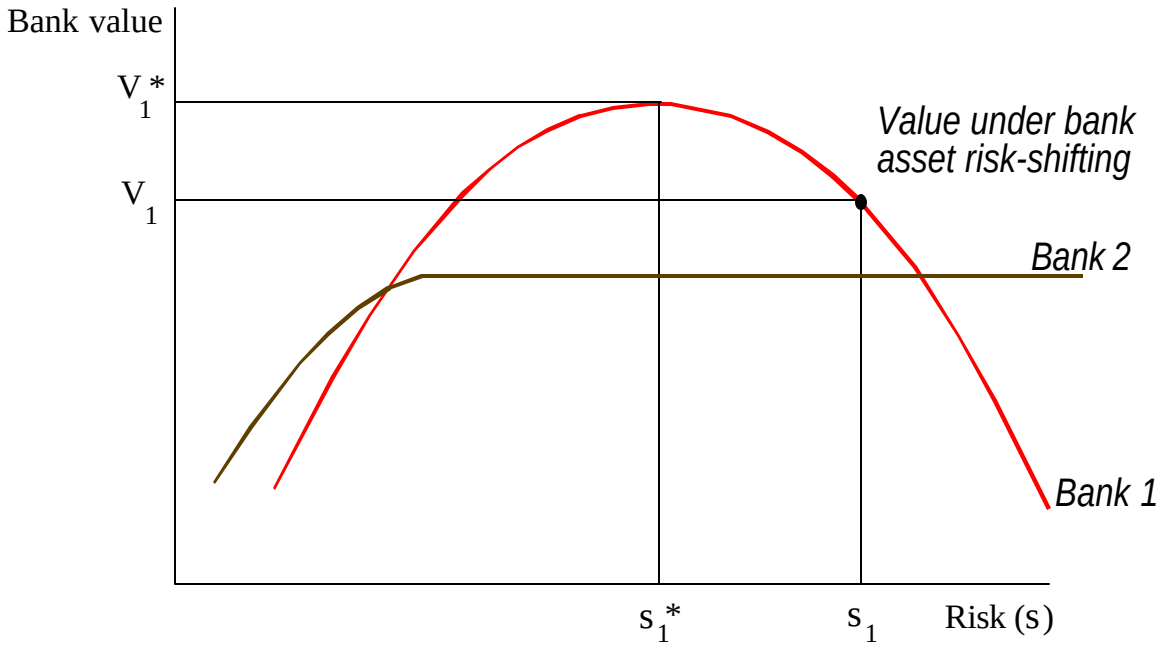

Figure 2: Bank Investment Opportunities

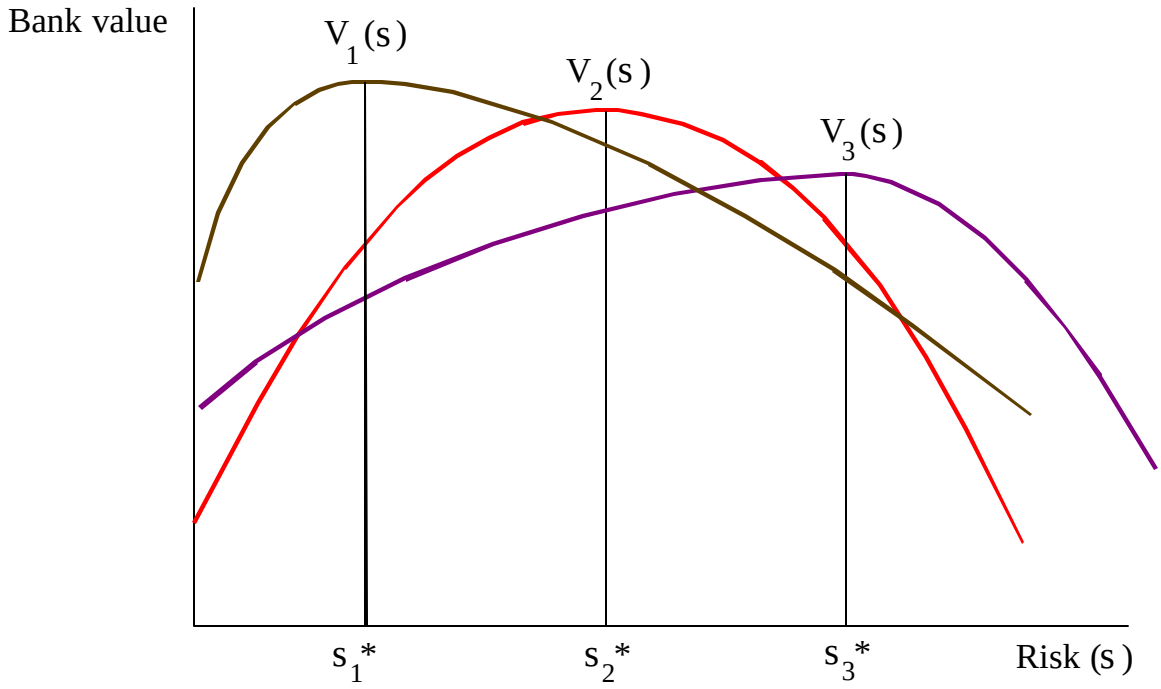

Figure 3: Capital Requirements and Multiple Banks