Banking Instability and Deposit Insurance: The Role of Moral Hazard

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Abstract

The primary objective of this paper is to investigate the impact of moral hazard on the effectiveness of deposit insurance in achieving banking stability. If moral hazard explains banking instability arising from the adoption of deposit insurance, then deposit insurance will be associated with bank insolvency more than with bank runs. To test the hypothesis, we develop a new empirical framework distinguishing between banking instability initiated by bank runs or panic withdrawals of deposits, and banking instability initiated by the insolvency problem of banks. Using a panel dataset covering 118 countries over the period 1980-2004, we find that deposit insurance per se has no significant effect either on bank insolvency or on bank runs. However, when the deposit insurance is coupled with increasing credit to the private sector, it has a positive and significant effect on bank insolvency but not on bank runs, suggesting that moral hazard outweighs the positive effect of deposit insurance in achieving banking stability.

Keywords: Banking Crises, Deposit Insurance, Moral hazard

JEL classification: G21, G28, E44

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1 Introduction

Countries adopting deposit insurance aim at minimising the risk of banking crises arising from self-fulfilling expectations[1]. The seminal paper of Diamond and Dybvig (1983) supported by several subsequent studies (see, for example Hazlett, 1997; Chang and Velasco, 2001; Green and Lin, 2003; Andolfatto, Nosal and Wallace, 2006) rationalises the adoption of deposit insurance as a way of ensuring banking stability. The paper demonstrates that in a fractional reserve banking system, full deposit insurance is able to rule out bank runs, which are self-fulfilling prophecies of depositors. In the absence of such deposit insurance, rumours that a bank is on the brink of failure lead to fears (expectations) that the bank may not be able to repay all depositors in full and on time because its funds are tied up in loans and other interest earning assets that cannot be easily converted into cash. This prompts the depositors to rush and simultaneously attempt to withdraw all their deposits before the bank runs out of cash, bringing about failure of the bank and hence fulfillment of the prophecy.

Deposit insurance, however, also creates a moral hazard problem by freeing economic agents from the consequences of their actions (see Calomiris, 1990; Gennote and Pyle, 1991; MacDonald, 1996) on both the liability and the asset sides of a bank's balance sheet. On the liability side, depositors feel no longer obliged to assess the credit-risk associated with depositing money in a particular bank and end up choosing a bank based on the attractiveness of interest rates on offer rather than the bank's financial condition; while on the asset side, the knowledge that depositors will not suffer in the event of bank failure persuades banks to pursue high return risky business strategies more than they otherwise would (MacDonald, 1996). Thus, the discipline of the market is removed, excess risk taking by existing commercial banks

[1] In the literature, there are two main theoretical views on the causes of banking crises, namely the fundamental banking crises view and the self-fulfilling view. While the fundamental banking crises view perceives banking crises as a consequence of poor economic performance, the self-fulfilling view regards them as a realisation of a bad equilibrium arising from self-fulfilling expectations in a multiple equilibria framework (see Fontenla and Gonzalez, 2007). In this paper, we test the self-fulfilling view while controlling for the fundamental banking crisis view.

is encouraged and depositors of insured institutions have little incentive to discriminate with respect to where and with whom to place their funds (Calomiris, 1990). Using data for 61 countries covering the period 1980-1997, Demirgüç-Kunt and Detragiache (2002) show that deposit insurance increases banking fragility, suggesting that the moral hazard component of deposit insurance is dominant in a general equilibrium framework. Furthermore, they infer from their results that a more generous deposit insurance creates more moral hazard problems which in turn increase banking fragility. Related work with similar findings has been carried out by Wheelock and Wilson (1995), Carapella and Di Giorgio (2004) and Cull, Senbet and Sorge (2005), among others.

To disentangle the conflicting predictions, we develop a new empirical framework where we distinguish between banking instability initiated by a bank run or panic withdrawals of deposits, and banking instability initiated by the insolvency problem of banks. Using this empirical framework, we estimate a baseline model whose primary objective is to investigate how banking system instability is influenced by moral hazard arising from the adoption of deposit insurance. If the negative effect of deposit insurance on banking stability is through moral hazard, then deposit insurance will be associated with banking insolvency and credit more than with bank runs. The study further examines how the likelihood of banking instability is affected by the generosity of deposit insurance payouts, extension of deposit insurance coverage to include foreign exchange and interbank deposits, administration of a deposit insurance scheme, and the nature of legal authority vested in a deposit insurance agency.

The rest of the paper is organised as follows. Section 2 discusses the interrelationships among deposit insurance, moral hazard and banking instability. An overview of the estimation methodology, data analysis techniques, scope of coverage, data sources and variables is presented in Section 3. Estimation results and inferences are outlined in Section 4. A summary and conclusion follow in Section 5.

2 Deposit Insurance, Moral Hazard and Banking Instability

2.1 Deposit Insurance

In most cases, a deposit insurance scheme is viewed as a supplement to other official measures such as a system of bank licensing and supervision, which are designed to protect bank depositors from the risk of loss or to contain that risk (MacDonald, 1996). Thus, even with deposit insurance in place, the central bank continues to provide bank supervision services and playing the role of lender of last resort. The central bank lending is widely regarded as part of the public safety net that supports the stability of the banking system since the bank can avert liquidity crises by providing large amounts of liquidity on short notice (Marini, 2003)

Consistent with Bagehot's principle, the central bank as a lender of last resort is presumed to lend only to illiquid but solvent banks (see, for example Fischer, 1999; Freixas, Giannini, Hoggarth and Soussa, 2000; Wood, 2003; Rochet and Vives, 2004; Kahn and Santos, 2005). In the wake of a run on a bank, the central bank provides credit to pay off depositors without having to liquidate the bank's assets. Deposit insurance, on the other hand, ensures that all depositors are paid off to the coverage limit even if all the bank's assets have been liquidated. The complementary roles of deposit insurance and the central bank's lender of last resort function, therefore, ascertain that depositors do not 'run' on banks, whether they are illiquid or insolvent.

Since the first recorded scheme in history, deposit insurance has been rationalised by the desire to instill confidence among depositors on the safety of their funds, and consequently guard against panic withdrawals of deposits and breakdown of the payments system, which may adversely affect the production sector of the economy[2].

[2]The first recorded deposit insurance in history is the New York Safety Fund in the US, which was established in 1829, funded by limited annual contributions of members and regulated by the state government (see Calomiris, 1990)

Diamond and Dybvig (1983) demonstrate that full deposit insurance is able to rule out bank runs. They argue that while uninsured demand deposit contracts are able to provide liquidity, they leave banks vulnerable to multiple equilibria, one of which is a bank run where all depositors panic and immediately withdraw their funds because of concerns with the possibility of the banks failing. Since deposit insurance provides a safe asset to depositors, they do not rush to withdraw their deposits from insolvent banks, consequently preventing the costly liquidation of the banks' assets that can aggravate the banks' insolvency (Marini, 2003). In a later study, Diamond and Dybvig (1986) re-affirm that deposit insurance is the only known effective measure to prevent bank runs.

2.2 Moral Hazard

While deposit insurance may be regarded as a tool for stopping or minimising bank runs, it is also a source of moral hazard for excessive risk taking, which in turn may lead to more bank failures. With deposit insurance, banks are encouraged to finance high-risk, high-return projects as their ability to attract deposits no longer reflects the risk of their asset portfolio (Demirgüç-Kunt and Detragiache, 2002). This crop-up of moral hazard with deposit insurance has been widely supported in the empirical literature. For instance, Demirgüç-Kunt and Detragiache (2002) conclude that moral hazard matters based on the finding that explicit deposit insurance tends to increase the likelihood of banking crises. Laeven (2002) observed that the cost of deposit insurance has some power in predicting bank failures, which he interpreted as evidence of support for the view that deposit insurance creates moral hazard for banks. His results further show a strong positive correlation between credit growth and the cost of deposit insurance, against which he concludes that deposit insurance promotes excessive risk taking behaviour. In a study of Kansas, Wheelock and Wilson (1995) found out that deposit insurance membership increases the probability of bank failure, consistent with the hypothesis that insurance encourages banks to hold higher risk portfolios than they otherwise would. Similar findings are reported by Carapella

and Di Giorgio (2004), who demonstrate that deposit insurance increases the lending-deposit spread in banking, the main effect of which arises not from the deposit side, but from an increase in the lending rate. They interpret this result as evidence of the presence of moral hazard behaviour emanating from deposit insurance. Cull et al. (2005) use the volatility of credit to the private sector as a proxy for risk in a cross-country analysis and establish that the decision to introduce deposit insurance increases the volatility of credit and hence risky behaviour in the financial sector, particularly in countries with weak institutions.

2.3 Banking Instability

Banking instability can be show-upised either by a bank run or an insolvency crisis. In a bank run, depositors rush to withdraw their deposits in full following expectations of looming bank failure, consequently forcing the bank to liquidate its assets at a loss and fail indeed. A number of studies have presented various explanations of the trigger mechanism of bank runs. Among the earliest are Fischer (1911) and Bryant (1980), who hold that a bank run occurs when the value of the bank's total assets falls short of its holdings of deposits, which incites depositors to rush and quickly withdraw their deposits in order to cut on losses. Diamond and Dybvig (1983) have also argued that a bank run is caused by a shift in expectations, which could depend on almost anything (referred to as sunspots run equilibrium) (see Diamond and Dybvig, 1983; Adao and Temzelides, 1998; Carmona, 2004). In yet another explanation, Chari and Jagannathan (1988) maintain that a bank run can occur even if no one has any adverse information about future returns of the bank. The essence of the model is that if individuals observe long queues of depositors at a bank, regardless of the information content held by the people on queues, they correctly infer that there is a possibility that the bank is about to fail and precipitate a bank run. Unlike the Diamond and Dybvig (1983) model which presents a bank run as a bad equilibrium in a series of possible multiple equilibria, the Chari and Jagannathan (1988) framework models a bank run as an equilibrium phenomenon in a formulation

where all equilibria have bank runs.

Banking instability can also show-up as an insolvency crisis characterised by large amounts of unanticipated non-performing loans. When depositors perceive that the returns on bank assets are going to be unusually low, they rush and quickly withdraw their deposits in full before the bank runs out of cash. This situation is more likely during an economic downturn and after a period of boom in lending to the private sector (see Caprio and Klingebiel, 1997; Allen and Gale, 1998).

3 Methodology and Data

3.1 Data and Data Sources

The study is carried out using a panel dataset covering 118 countries over the period 1980-2004, implying that the subprime financial crisis episode is not taken into account. The choice of both the number of countries and cut-off dates has been dictated by data availability. We started off with 211 countries that appear on the World Bank list of all countries, and eliminated countries where data was not available, losing 93 countries in the process (see Appendix A for a list of countries in the sample). Deposit insurance data was collected from Demirgüç-Kunt, Karakaovali and Laeven's (2005) comprehensive database of deposit insurance around the world. The World Development Indicators, a World Bank database of economic and demographic indicators, was used as a primary source for selected macroeconomic indicators used as control variables. Additional data was sourced from International Financial Statistics (IFS), an International Monetary Fund (IMF) database.

In our sample, only 12 countries had deposit insurance at the beginning of the study period in 1980. The number rose to 27 by 1990 and 52 by 2003 (see Table 1). According to the data, deposit insurance with unlimited coverage (full guarantee) is not popular. It had been adopted only in six of the 52 countries with deposit

insurance (in the sample) as at 2003. Coinsurance and risk adjusted deposit insurance schemes are also rare. In our sample, there were only eight countries with coinsurance mechanisms and seven with risk adjusted premiums as at 2003.

[Insert Table 1]

We further observe that a large number of countries extend coverage of deposit insurance to include foreign exchange deposits (30 of the 52 countries in the sample) while only a few (8 of the 52 countries in the sample) extend coverage to include interbank deposits. In addition, we observe that most deposit insurance schemes have a permanent fund. In our sample, 38 countries out of 52, have a permanent fund in place. On the whole, countries prefer compulsory membership to their deposit insurance systems. Against the 52 countries that adopted deposit insurance in the sample, as at 2003, a total of 40 had compulsory membership.

3.2 Measures of Banking Instability and Moral Hazard

To quantify banking instability, we build on the ideas of Eichengreen, Rose and Wyplosz (1995; 1996a; 1996b) and Von Hagen and Ho (2007). Using monthly time series data, we compute deseasonalised growth rates of demand deposits (DD_t) and time deposits (TD_t) to construct a measure of bank runs ($brun_t$); and credit extended to the private sector (CR_t) to calculate a measure of insolvency ($insolv_t$).

We follow a four-step procedure. Firstly we compute the deseasonalised growth rates of each series. For instance the deseasonalised growth rate of demand deposits (gr_DD_t) is computed as:

$$gr\_DD_t = \frac{(DD_t - DD_{t-12})}{DD_{t-12}}. \tag{1}$$

The deseasonalised growth rates for time deposits (gr_TD_t) and credit to the private sector (gr_CR_t) are calculated analogously, replacing DD_t with TD_t and CR_t,

respectively.

Secondly, we compute an indices of bank runs and bank insolvency. The index of bank runs is given by the formula:

$$run_t = \left[\left(\frac{gr\_DD_t - \overline{gr\_DD_t}}{\sigma_{gr\_DD_t}} \right) + \left(\frac{gr\_TD_t - \overline{gr\_TD_t}}{\sigma_{gr\_TD_t}} \right) \right] /2; \tag{2}$$

while the index of bank insolvency is given by

$$solv_t = \left(\frac{gr\_CR_t - \overline{gr\_CR_t}}{\sigma_{gr\_CR_t}} \right); \tag{3}$$

where $\overline{gr\_DD_t}$, $\overline{gr\_TD_t}$ and $\overline{gr\_CR_t}$ are mean growth rates and $\sigma_{gr\_DD_t}$, $\sigma_{gr\_TD_t}$ and $\sigma_{gr\_CR_t}$ are standard deviations of deseasonalised growth rates of demand deposits, time deposits and credit extended to the private sector, respectively.

Thirdly, given that bank runs and insolvency are generally characterised by a sharp decrease in bank deposits and credit extended to the private sector, in that order, we use extreme values of run_t and $solv_t$ to calculate measures of bank runs and insolvency denoted as $brun_t$ and $insolv_t$, respectively. We distinguish between narrow and broad definitions of banking instability described by these measures. We define the narrow measure of banking instability ($nbrun$, and $ninsolv$) as cases where the calculated indices (run, and $solv$, respectively) fall within the lowest 5 percent of the standard normal distribution and we let the measure take the value 1 reflecting a period of banking instability. When the calculated indices fall within the highest 95 percent of the standard normal distribution, we classify this as a period of banking stability and the measure takes the value zero. The broad definition is characterised analogously. The indices take the value 1 if they fall within the lowest 10 percent of the standard normal distribution, which we define as a period of banking instability, and zero otherwise.

Fourthly, we convert the data from monthly to annual frequency, we describe any

year that has no recording of banking instability as a year of banking stability and the variable takes the value zero; a year that has at least on month of recorded banking instability is defined as a year of banking instability and the variable gets the value one.

To ascertain that our indicators of banking instability are measuring what is intended, we compare our data with similar data compiled in other studies. Our measured insolvency, narrowly and broadly defined, compares very well with major bank insolvencies identified by Caprio and Klingebiel (1997) in selected countries (Table of comparisons not shown here but available on request). Most of Caprio and Klingebiel's (1997) identified insolvencies are captured in our measures of banking instability. The few cases that do not match between the two datasets are a consequence of definitional differences between our measures of insolvency and Caprio and Klingebiel's (1997) measures[3].

A correlation matrix for the constructed indicators of banking instability shows that there is a high degree of cross correlation between the narrow and broad definitions of each of the classifications of banking instability (Table not shown here but available on request). This is not unexpected since the broad definitions contain all the information in the corresponding narrow definitions of banking instability plus some additional information.

On the whole, however, the correlations between the four identifiers of banking instability show relatively low cross correlations, indicating that banking instability may occur due to insolvency or bank runs only. That is, the two need not necessarily occur together. This finding demonstrates the importance of distinguishing between the two forms of banking instability, an approach that has been adopted in this study.

[3]Caprio and Klingebiel (1997) define insolvency as a case where the net worth of the banking system has been entirely or almost eliminated.

3.3 Moral Hazard and Control Variables

We measure moral hazard using the ratio of private sector credit to real GDP ($crgdp$). In fact, many studies have considered a sharp increase of this variable as a sign of moral hazard in the banking system.

We use six control variables, namely, growth of real gross domestic product (GDP) ($gdpgr$), real interest rates (rir), inflation rates ($inflatn$), ratio of M2 to foreign exchange reserves ($m2fxres$), exchange rate depreciation ($xrdepr$) and GDP per capita ($gdppc$) to control for macroeconomic factors that are expected to have a significant impact on banking fragility (the fundamental banking instability view) (see Section B in the Appendix for brief definitions of variables used in the model and how they are measured). Following Demirgüç-Kunt and Detragiache (2002), inflation, real GDP growth and real interest rates are used to capture macroeconomic developments that are likely to affect the quality of bank assets. Higher values of real GDP growth reflect a higher ability of borrowers to repay their loans while higher inflation rates entail higher operating costs and a lower ability of borrowers to repay their loans. Real interest rates are expected to have an adverse effect on banks' profitability through their impact on the cost of funds. Besides being associated with high default rates, high real interest rates indicate high cost of funds to banks. Since bank loans and other assets are usually fixed over long periods, rising real interest rates push up the cost of funds, adversely affecting the liability side of the banks' balance sheets and consequently squeezing the banks' profits.

Exchange rate depreciation and the ratio of M2 to foreign exchange reserves are used to capture commercial banks' vulnerability to sudden capital outflows triggered by a run on the currency and the banks' exposure to foreign exchange risk (Demirgüç-Kunt and Detragiache, 2002). Demirgüç-Kunt and Detragiache (2002) argue that since deposit insurance guarantees the domestic value of deposits and not their foreign currency value, the expectation of a devaluation triggers withdrawals of domestic currency deposits to purchase foreign assets even in the presence of deposit insurance.

Finally, GDP per capita is used to capture institutional as well as regulatory characteristics of countries in every time period. An increase in GDP per capita can be interpreted as an improvement of institutional quality as well as banking system regulatory framework.

3.4 Deposit Insurance Variables

A simple dummy variable, which takes the value 1 when a country has deposit insurance and zero otherwise, is used to investigate the effect of deposit insurance on banking instability. As explained already alluded to, the theory in inconclusive on whether deposit insurance destabilises or stabilises the banking system. Most empirical studies, albeit without distinguishing between banking instability caused by bank runs and banking instability caused by insolvency of banks, have found that deposit insurance increases the vulnerability of a banking system to instability (see Gonzalez-Hermosillo, Pazarbasioglu and Billings, 1997; Demirgüç-Kunt and Detragiache, 1998; Demirgüç-Kunt and Detragiache, 2002).

To examine the behaviour of banking instability in relation to certain features of deposit insurance, we estimate four sets of equations, each characterising particular features in the design of deposit insurance, namely, generosity of payouts, coverage, legal environment and administration of the deposit insurance. 'Generosity of payouts' is represented by a single variable, *guarantee*, which takes the value one if a country has full deposit insurance (unlimited guarantee) and zero if the deposit insurance scheme provides partial coverage (limited guarantee). Demirgüç-Kunt et al. (2005) argue that in any deposit insurance scheme, the amount of coverage matters since it directly affects market discipline exerted by depositors. The sign of the marginal effects of *guarantee* on banking instability, cannot be determined *a priori*. In fact, full deposit insurance is expected to be associated with a marginally low likelihood of banking instability if the Diamond-Dybvig (1983) hypothesis is correct; whereas if the moral hazard problem dominates, full deposit insurance will be associated with a high probability of banking instability.

'Coverage' is captured in two variables namely, whether or not interbank deposits are covered ($intbank$) and whether or not foreign currency deposits are covered ($fxcoverd$). Countries with deposit insurance need to decide on the type of deposits to be covered and the type of financial institutions to be included or excluded from the coverage.

There are three variables capturing the 'Legal environment', each answers one of the following Yes/No questions:

(i) Does the deposit insurance authority have the mandate to intervene in a bank's affairs ($interven$)?

(ii) Does the deposit insurance authority have the legal power to cancel or revoke deposit insurance for any participating bank ($leglcancel$)?

(iii) Can the deposit insurance agency/fund take legal action against bank directors or other bank officials ($leglmgr$)?

An explicit deposit insurance scheme founded on a sound legal system with proper enforcement mechanisms is *a priori* expected to command credibility. Banks are likely to be restrained from indulging in certain activities that interfere with banking stability while depositors are reassured of the safety of their funds even in the event of bank failure. The expected outcome, therefore, is banking stability. This state, however, may also create moral hazard. With a credible deposit insurance scheme, depositors are no longer persuaded to place their deposits in banks chosen on the basis of their financial condition. They will probably choose banks solely in accordance with the interest rates they offer; and banks, on their part, may undertake more risky business strategies than they otherwise would, given the knowledge that depositors will not suffer in the event of bank failure (MacDonald, 1996). For these reasons, the expected signs of the legal environment indicators are indeterminate *a priori*.

'Administration' is covered in six variables, namely, whether the deposit insurance is administered by government, by the private sector or jointly by government and the private sector ($admin$); whether there is coinsurance or not ($coinsur$); whether

the deposit insurance is funded or not ($funding$); whether deposit insurance premiums are risk adjusted or not ($rskadj$); whether membership to the deposit insurance scheme is compulsory or voluntary ($membship$); and whether the deposit insurance is solely funded by government or by the private sector or jointly by the two ($sourcefnd$). In all cases, the signs of the marginal effects may be positive or negative depending on whether the moral hazard problem is dominant or not.

With a coinsurance system, depositors are required to bear part of the cost in the event of bank failure (Demirgüç-Kunt et al., 2005). The system, therefore, is used as a technique for quelling moral hazard (McCoy, 2007). It provides a risk-sharing mechanism between depositors and the insurer, thereby instilling a considerable degree of market discipline (Talley and Mas, 1990) that minimises the probability of banking instability. To the extent that some component of deposits is left uninsured, depositors are incentivised to monitor the financial condition of their banks, which leads to market discipline in the banking industry. By exposing some of the deposits to non-protection, however, coinsurance may also increase the probability of bank runs. On rumours that a bank is likely to fail, its depositors may run on it to secure the uninsured component of their deposits. Since coinsurance is expressed as a component of the deposit, depositors will simultaneously attempt to withdraw all their funds to ensure that they minimise their losses. On their part, banks may undertake high-risk high-return projects proportionate to the level of their clients' deposits that are covered by the deposit insurance, which may increase the probability of insolvency.

3.5 Model and Estimation

We employ the random effects logit model to estimate the probability of banking instability using the maximum likelihood method. The logit is a large-sample technique which has been commonly used in a number of similar studies (see, for example Cole and Gunther, 1995; Gonzalez-Hermosillo et al., 1997; Demirgüç-Kunt and Detragiache, 1998). Our use of the random effects (rather than fixed effects) is aimed

at preserving information. If fixed effects (rather than random effects) are included in the model, it may require omitting from the panel all countries that did not experience banking instability during the period under consideration, which would imply throwing away a large amount of information (see Greene, 2003; Demirgüç-Kunt and Detragiache, 1998). In addition, limiting the panel to countries with banking instability only would produce a biased sample (Demirgüç-Kunt and Detragiache, Ibid).

4 Results Analysis

Prior to the presentation and the analysis of the model results, we provide in Table 2 the summary of the main descriptive statistics of all the variables that we will use. From this table we can observe that data on the design of deposit insurance are most often unavailable. We also provide in Tables 3 , 4 and 5 , the correlations coefficients of variables. We observe from it that generally correlation between variables are low, therefore the risk of multicollinearity in our result is weak.

[Insert Tables 2, 3 , 4 and 5]

4.1 Baseline Model

In this section we present and discuss estimation of the model with broad indicators of banking instability. The narrow indicators are used to study robustness and sensitivity of the result.

Bank Runs and Deposit Insurance. Table 6 presents regression results showing the relationship between bank runs (broadly defined) and deposit insurance controlling for macroeconomic conditions. From this table, we find that deposit insurance *per se* is not statistically significant in explaining bank runs i.e. it appears inefficient in reducing the likelihood of bank runs in a given economy. It is observed, however,

that with deposit insurance in place, the probability of bank runs increases significantly with rising interest rates and decreases with GDP growth. This may be due to the effect of business cycles on the effectiveness of deposit insurance in reducing the probability of bank runs. A rationale of this finding is that deposit insurance schemes may lack credibility in economic downturns, especially in developing countries.

[Insert Table 6].

Bank Insolvency and Deposit Insurance. Table 7 presents regression results showing the relationship between bank insolvency (broadly defined) and deposit insurance. The estimation results reveal that deposit insurance does not significantly explain insolvency, either. The only case where it is significant is when it is interacted with an increase in the ratio of private sector credit to GDP. In this case it increases the probability of banking insolvency. It follows, therefore, that when deposit insurance is coupled with an increase in credit to the private sector relative to the size of the economy (i.e., a measure of moral hazard), it increases the likelihood of insolvency. There are many regulatory tools to control for risky lending in many banking systems. These can mitigate the effect of deposit insurance in increasing moral hazard behaviour. In countries where these tools are missing or where these regulations are not well enforced, deposit insurance can create moral hazard which will then translate into a higher probability of bank insolvency.

[Insert Table 7]

4.2 Design Features of Deposit Insurance

Generosity of Payouts. Estimation results presented in Table 8 and Table 9 show that *guarantee* has significant marginal effects (at 10 percent) and is positively correlated with banking instability characterised by bank runs as well as insolvency, suggesting that full deposit insurance is associated with some susceptibility to banking

instability. More importantly the interaction term of *guarantee* and *crgdp* significantly increases the probability of bank runs and bank insolvency. This result about bank runs is at odds with Diamond and Dybvig (1983) which demonstrates that full deposit insurance rules out bank runs. Increasing the generosity of deposit insurance payouts reassures depositors that higher proportions of their deposits are protected in the event of bank failure, and effectively minimises any incentives the depositors may have of running on a bank on rumours that the bank is on the brink of failure. The theory, however, also counter argues that the moral hazard problem is at the maximum when the coverage of deposit insurance is unlimited (MacDonald, 1996). Effectively, full deposit insurance takes away any incentives from depositors to monitor the financial soundness of their bankers. The banks, on their part, are incentivised to undertake more risky high return projects on the basis that their customers may suffer reduced losses in the event of failure of the projects.

[Insert Table 8 and Table 9]

Our empirical result then suggests than in an economy with a more generous deposit insurance scheme, the moral hazard problem dominates, making it more vulnerable to banking fragility triggered by insolvency problems as well as bank runs. We, therefore, argue that if moral hazard can be triggered by bank insolvency, it has also some probability of causing a bank run. A probable explanation is that when the banking system is facing a crisis, depositors do not know the exact cause and given that some depositors do not trust the government guarantee (specially in low income countries and in countries facing budgetary difficulties), they will run on the bank to cut on their losses that may accrue when the bank eventually fails.

Coverage. Table 10 presents estimation results illustrating the impact of extending deposit insurance coverage to foreign currency and interbank deposits on banking instability. The table shows that marginal effects of both variables are insignificant for both types of banking instability, illustrating that whether foreign currency or interbank deposits are covered by a deposit insurance scheme or not does not significantly affect banking fragility. While a more comprehensive coverage provides

a better guarantee against depositor runs, the theory suggests that it also creates more incentives for excessive risk taking (Demirgüç-Kunt and Detragiache, 2002). Exclusion of interbank deposits in the coverage of insured deposits, for instance, may increase the probability of banking instability because banks, who are regarded as the most well informed depositors, are now without protection and may lead to a run at the slightest suspicion of failure in one of the banks holding their deposits. Also, in the event that one bank fails, other banks that had placed deposits in the failing bank would sustain losses that would weaken their financial position, making them susceptible to failure too (see Talley and Mas, 1990). Inclusion of the interbank deposits in the coverage of insured deposits, on the other hand, may also increase the likelihood of banking instability, since the banks now have no incentive to monitor each other's financial conditions. In the process, market discipline deteriorates leading to excessive risk-taking behaviour by the banks. Our result shows that empirically, none of these two contradictory arguments is dominant.

[Insert Table 10]

Foreign currency deposits coverage in a deposit insurance scheme does not necessarily reassure depositors of the safety of their funds in the event of bank failure. One reason, particularly applicable to developing countries, is that the deposit insurance companies might not be able to acquire needed foreign exchange in order to pay off holders of the foreign currency deposits, which may compel the depositors to force the agency into bankruptcy for failing to honour its obligations (see Talley and Mas, 1990). If insurances companies have the option of paying off the foreign currency deposits in local currency at the prevailing exchange rate, the depositors may end up in a worse off position as the exchange rate may not be realistic enough to compensate them for their foreign currency deposits lost in the failed bank (Ibid, 1990).

Some studies suggest that the inclusion of foreign currency deposits in deposit insurance coverage makes a banking system more vulnerable to instability (Demirgüç-Kunt and Detragiache, 2002). Coverage of foreign currency deposits may also serve

to reassure depositors of the safety of their funds. While this reassurance may take away the depositors' incentives to monitor the financial soundness of their bankers, leading to increased risk-taking behaviour by the banks and hence a higher probability of banking instability, it may also prevent bank runs. Even in the wake of news that a bank is likely to fail, the depositors may not run on the bank because they are assured of the safety of their funds.

Legal Environment. Estimation results illustrating the importance of the legal environment in explaining banking instability are presented in Table 11. Two of the legal environment indicators, *interven* and *leglmgr* have insignificant marginal effects, suggesting that whether or not a deposit insurance agency has the legal mandate to intervene in the affairs of a bank or to take legal action against bank directors or other bank officials has no bearing on a country's banking stability. The third indicator, *leglcancel* is positively related to banking instability and is statistically significant, albeit only for the bank runs equation.

[Insert Table 11]

This outcome demonstrates that conferring a deposit insurance company with legal powers to cancel or revoke deposit insurance for any participating bank increases the likelihood of bank runs (broadly defined with foreign liabilities excluded in the definition of deposits). While deposit insurance assures economic agents of the safety of their insured deposits, the speed at which they can get their money in the event of bank failure remains of concern. A deposit insurance agency that has the legal authority to close a bank, therefore, may indeed fuel a bank run on rumours that the bank is on the brink of failure[4]. In this state, economic agents will simultaneously queue to withdraw their funds, not because they doubt the safety of their funds, but because they want to have access to their money when they need it.

[4]In countries where deposit insurance membership is compulsory, cancellation of a participating bank's deposit insurance membership implies cancellation of the bank's banking licence. Since deposit insurance membership is compulsory in most countries, we generalise that if a deposit insurance agency has the mandate to cancel or revoke membership for any participating bank, it effectively holds the authority to close the bank.

Moreover, an explicit deposit insurance scheme founded on a sound legal system with proper enforcement mechanisms is *a priori* expected to command credibility. Banks are likely to be restrained from indulging in certain activities that interfere with banking stability while depositors are reassured of the safety of their funds even in the event of bank failure. The expected outcome, therefore, is banking stability. This state, however, may also create moral hazard. With a credible deposit insurance scheme, depositors are no longer persuaded to place their deposits in banks chosen on the basis of their financial condition. They will probably choose banks solely in accordance with the interest rates they offer; and banks, on their part, may undertake more risky business strategies than they otherwise would, given the knowledge that depositors will not suffer in the event of bank failure (MacDonald, 1996).

Administration. Table 12 presents estimation results of the deposit insurance administration indicators. We find that the impact of coinsurance on the probability of bank runs is insignificant.

[Insert Table 12]

We also find that countries with a permanent fund of the deposit insurance scheme are more prone to banking instability than countries with a non-funded system of deposit insurance. In a funded deposit insurance (permanent fund) system, members or the government make periodic contributions to the fund, which are then used as a primary resource base for paying out depositors in the event of bank failure; and in a non-funded system, members pay their contributions to the fund after bank failure has already occurred (Demirgüç-Kunt et al., 2005). Consistent with the theoretical literature and the findings of Demirgüç-Kunt and Detragiache (2002), the marginal effects of funding type are positive and significant, indicating that deposit insurance schemes with a permanent fund give rise to moral hazard, which in turn leads to banking instability.

Further, we establish that the source of funding for a deposit insurance scheme does not affect the probability of bank runs. Government funded deposit insurance

schemes, however, increase the probability of insolvency of banks. The table reveals that the probability of insolvency of banks is lowest when a deposit insurance scheme is wholly funded by the private sector, increases in cases of joint funding by the government and the private sector, and it is highest when the government is the sole financier.

4.3 Sensitivity Analysis

To ensure that our estimation results are robust we consider a sensitivity analysis where we re-estimate the regressions using *nbrun* and *ninsolv* as new dependent variables. We find that the results are almost the same. Precisely we find that deposit insurance has no significant effect on the probability of bank runs but that it increases the probability of the banking system to suffer from insolvency crisis in countries where the adoption of the deposit insurance has been followed by moral hazard behavior, captured by an increase of the ratio of credit to the private sector (estimation results not included but available on request).

5 Conclusions

This paper set out to investigate the role moral hazard plays in the effectivity of deposit insurance in achieving banking system stability. Using a new empirical framework that distinguishes banking instability triggered by bank runs from banking instability caused by insolvency of banks, the study finds weak evidence that deposit insurance is associated with moral hazard, which has the consequence of causing bank insolvency that ultimately triggers a run on banks. While our results do not necessarily refute findings in the earlier literature because of differences in measurement of the banking instability variable, we lay claim to having presented more expressive findings following our distinction of bank runs as well as insolvency of the banking system as identifiers of banking instability. In addition to the core findings, the study

also establishes that a country is more vulnerable to banking instability when it has a more generous deposit insurance scheme, when the deposit insurance agency has a legal mandate to cancel or revoke deposit insurance for any participating bank, when the deposit insurance has a permanent fund, and when the scheme is funded jointly by the government and the private sector or solely by the government. We argue that since there are many types of regulation in any given banking system, it may be difficult to study with complete confidence the effect of a given banking regulation alone. Perhaps it is the combination of many types of regulation which matter.

References

Adao, B. and Temzelides, T. (1998). Sequential equilibrium and competition in a diamond-dybvig banking model, *Journal of Economic Dynamics* **1**: 859–877.

Allen, F. and Gale, G. (1998). Optimal financial crises, *The Journal of Finance* **53**(4): 1245–1284.

Andolfatto, D., Nosal, E. and Wallace, N. (2006). The role of economic independence in the green-lin diamond-dybvig model, *Journal of Economic Theory* **137**: 709–715.

Bryant, J. (1980). A model of reserves, bank runs and deposit insurance, *Journal of Banking and Finance* **4**: 335–344.

Calomiris, C. (1990). Is deposit insurance necessary? a historical perspective, *The Journal of Economic History* **50**(2): 283–295.

Caprio, G. J. and Klingebiel, D. (1997). Bank insolvency: Bad luck, bad policy or bad banking?, *Annual World Bank Conference on Development Economics, 1996* .

Carapella, F. and Di Giorgio, G. (2004). Deposit insurance, institutions and bank interest rates, *Transition Studies Review* **11**(3): 77–92.

Carmona, G. (2004). On the existence of equilibrium bank runs in a diamond dybvig environment, *Unpublished Manuscript, Universidade Nova de Lisboa* .

Chang, R. and Velasco, A. (2001). A model of financial crises in emerging markets, *The Quarterly Journal of Economics* **116**(2): 489–517.

Chari, V. and Jagannathan, R. (1988). Banking panics, information, and rational expectations equilibrium, *The Journal of Finance* **43**(3): 749–761.

Cole, R. and Gunther, J. (1995). Separating the likelihood and timing of bank failure, *Journal of Banking and Finance* **19**: 1073–1089.

Cull, R., Senbet, L. and Sorge, M. (2005). Deposit insurance and financial development, *Journal of Money, Credit and Banking* **37**(1): 43–82.

Demirgüç-Kunt, A. and Detragiache, E. (1998). The determinants of banking crises in developing and developed countries, *IMF Staff papers* **45**(1): 81–109.

Demirgüç-Kunt, A. and Detragiache, E. (2002). Does deposit insurance increase banking system instability? an empirical investigation, *Journal of Monetary Economics* **49**: 1373–1406.

Demirgüç-Kunt, A., Karakaovali, B. and Laeven, L. (2005). Deposit insurance around the world: A comprehensive database, *World Bank Policy Research Working Paper No. 3628* (1).

Diamond, D. and Dybvig, P. (1983). Bank runs, deposit insurance and liquidity, *The Journal of Political Economy* **91**(3): 401–419.

Diamond, D. and Dybvig, P. (1986). Bank theory, deposit insurance and bank regulation, *The Journal of Business* **59**(1): 55–68.

Eichengreen, B., Rose, A. and Wyplosz, C. (1995). Exchange market mayhem: The intecedents and aftermath of speculative attacks, *Economic Policy* **21**: 249–296.

Eichengreen, B., Rose, A. and Wyplosz, C. (1996a). Contagious currency crises: First tests, *Scandnavian Journal of Economics* **98**(4): 463–484.

Eichengreen, B., Rose, A. and Wyplosz, C. (1996b). Speculative attacks on pegged exchange rate: An empirical exploration with special reference to the european monetary system, *In "The New Transatlantic Economy" edited by Matthew B. Canzoneri, Wilfred J. Ethier, and Vittorio Grilli* pp. 191–228.

Fischer, I. (1911). *The Purchasing Power of Money: Its Determination and Relation to Credit, Interest and Money*, New York: MacMillan.

Fischer, S. (1999). On the need for an international lender of last resort, *Journal of Economic Perspectives* **13**(4): 85–104.

Fontenla, M. and Gonzalez, F. (2007). Self-fulfilling and fundamental banking crises: A multinomial logit approach, *Economic Bulletin* **6**(17): 1–11.

Freixas, X., Giannini, C., Hoggarth, G. and Soussa, F. (2000). Lender of last resort: What have we learned since bagehot?, *Journal of Financial Services Research* **18**(1): 63–84.

Gennote, G. and Pyle, D. (1991). Capital controls and bank risk, *Journal of Banking and Finance* **19**: 1159–1173.

Gonzalez-Hermosillo, B., Pazarbasioglu, C. and Billings, R. (1997). Determinants of banking system fragility: A case study of mexico, *IMF Staff papers* **44**(3): 295–314.

Green, E. and Lin, P. (2003). Implementing efficient allocations in a model of financial intermediation, *Journal of Economic Theory* **109**: 1–23.

Greene, W. (2003). *Econometric Analysis*, 5th edn, Pearson Education Inc.

Hazlett, D. (1997). Deposit insurance and regulation in a diamond-dybvig banking model with a risky technology, *Economic Theory* **9**(3): 453–470.

Kahn, C. and Santos, S. (2005). Allocating bank regulatory powers: Lender of last resort, deposit insurance and supervision, *European Economic Review* **49**: 2107–2136.

Laeven, L. (2002). Bank risk and deposit insurance, *The World bank economic Review* **16**(1): 109–137.

MacDonald, R. (1996). *Deposit Insurance*, Handibook No. 9 in Central Banking Issued by the Centre for central banking Studies, Bank of England, London.

Marini, F. (2003). Bank insolvency, deposit insurance and capital adequacy, *Journal of Financial Services Research* **24**: 67–78.

McCoy, P. (2007). The moral hazard implications of deposit insurance: Theory and evidence, *Paper presented at a seminar on current developments in Monetary and Financial Law, Washington D.C., October 23-27, 2006* .

Rochet, J.-C. and Vives, X. (2004). Coordination failures and the lender of last resort: Was bagehot right after all?, *Journal of the European Economic Association* **2**(6): 1116–1147.

Talley, S. and Mas, I. (1990). Deposit insurance in developing countries, *World Bank Policy, Research and External Affairs Working Paper Series* **WP No. 548**.

Von Hagen, J. and Ho, T.-K. (2007). Money market pressure and the determinants of banking crises, *Journal of Money, Credit and Banking* **39**(5): 1037–1066.

Wheelock, D. and Wilson, P. (1995). Explaining bank failures: Deposit insurance, regulation and efficiency, *The Review of Statistics* **77**(4): 689–700.

Wood, J. (2003). Bagehot's lender of last resort: A hollow hallowed tradition, *The Independent Review* **VII**(3): 343–351.

APPENDIX

A Country Sample

A.1 Countries with Explicit Deposit Insurance

Argentina, Austria, Bahamas, Bahrain, Bangladesh, Brazil, Canada, Chile, Congo, Cyprus, Denmark, Dominican Republic, Ecuador, El Salvador, Finland, Germany, Greece, Guatemala, Honduras, Iceland, India, Indonesia, Ireland, Italy, Jamaica, Japan, Jordan, Kenya, Republic of Korea, Kuwait, Malaysia, Malta, Mexico, Netherlands, Nicaragua, Nigeria, Norway, Oman, Paraguay, Peru, Philippines, Portugal, Spain, Sri Lanka, Switzerland, Tanzania, Thailand, Trinidad and Tobago, Turkey, Uganda, United Kingdom, and Zimbabwe.

A.2 Countries with Implicit Deposit Insurance

Antigua and Barbuda, Australia, Barbados, Belize, Benin, Bhutan, Bolivia, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, China, Costa Rica, Cote d'Ivoire, Dominica, Egypt (Arab Republic), Equatorial Guinea, Ethiopia, Fiji, Gabon, Gambia, Ghana, Grenada, Guyana, Iran (Islamic Republic), Israel, Lesotho, Libya, Madagascar, Malawi, Macao China, Maldives, Mali, Mauritius, Morocco, Nepal, New Zealand, Niger, Pakistan, Papua New Guinea, Samoa, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Solomon Islands, South Africa, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Sweden, Togo, Tonga, Tunisia, Uruguay, Vanuatu, Venezuela (Bolivarian Republic of), Yemen (Republic), and Zambia.

B Definitions and Measurement of Deposit Insurance Variables

- *admin*: Administration of deposit insurance. It takes the value 3 if administration is private, 1 if it is official and 2 if it is joint.
- *coinsur*: Coinsurance. It takes the value 1 if there is coinsurance of the deposit insurance scheme and zero otherwise.
- *crgdp*: Ratio of domestic private sector credit to GDP.
- *dinsur*: Deposit insurance. It takes the value 1 when a country has explicit deposit insurance and zero otherwise.
- $funding$: Permanent fund. It takes the value 1 if the deposit insurance is funded and zero otherwise. In a funded deposit insurance system, members or government make periodic contributions to the fund, which is then used as the main source for paying out depositors in the event of bank failure (Demirgüç-Kunt et al., 2005). In a non-funded system, on the other hand, members pay their contributions to the fund after a bank failure has already occurred. As at 2003, only 14 countries out of 88 had unfunded deposit insurance, 11 of which were European and Chile was the only country with the government as a sole contributor to the fund (Demirgüç-Kunt et al., 2005).
- $fxcoverd$: Foreign currency deposits covered. The variable takes the value 1 if foreign currency deposits are covered by the deposit insurance and zero otherwise.
- *gdpgr*: GDP growth.
- *guarantee*: Deposits guaranteed coverage. The variable takes the value 2 in the case of unlimited guarantee (full coverage), 1 in the case of limited guarantee (partial coverage) and zero otherwise.

- $inflatn$: Inflation measured by year on year percentage changes in the all items national composite consumer price index.

- $intbank$: Interbank deposits covered. The variable takes the value 1 if interbank deposits are covered by the deposit insurance and zero otherwise.

- $interven$: Does the deposit insurance authority make the decision to intervene a bank? The variable takes the the value 1 if yes and zero otherwise.

- $legalcancel$: Does the deposit insurance authority have the legal power to cancel or revoke deposit insurance for any participating bank? The variable takes the value 1 if yes and zero otherwise.

- $legalmgr$: Can the deposit insurance agency/fund take legal action against bank directors or other bank officials? The variable takes the value 1 if yes and zero otherwise.

- $m2fxres$: Ratio of M2 to foreign exchange reserves.

- $membship$: Membership takes the value 1 if affiliating to a deposit insurance scheme is compulsory and zero if it is voluntary. In most countries (almost 90 percent as of 2003), membership to a deposit insurance is compulsory.

- rir: Real interest rates.

- $rskadj$: Risk adjusted premiums. It takes the value 1 in cases where premiums vary according to riskiness of the assessment base and zero otherwise. The number of countries with risk adjusted premiums has risen from only the United States in 1995 to 20 as at 2003 (Demirgüç-Kunt et al., 2005).

- $sourcefnd$: Source of funding. It takes the value 2 if the deposit insurance is solely funded by the government, zero if it is privately funded and 1 if funded jointly by the government and the private sector.

- $xrdepr$: Exchange rate depreciation.

Table 1: Summary Statistics of Deposit Insurance Around the World

	1980	1980 - 1985	1986- 1990	1991- 1995	1996- 2000	2001- 2004
Number of countries with deposit insurance	12	19	27	34	46	52
Number of countries with unlimited guarantee (full) deposit insurance	3	3	4	5	9	6
Number of countries with coinsurance	3	4	6	7	8	8
Number of countries with risk adjusted premiums of deposit insurance	1	2	3	6	7	7
Number of countries with deposit insurance covering foreign exchange deposits	10	14	18	25	31	32
Number of countries with deposit insurance covering interbank deposits	2	3	4	5	8	8
Number of countries with deposit insurance with a permanent fund	10	15	22	29	37	39
Number of countries with a compulsory membership deposit insurance	10	15	23	32	40	42

NOTE: - All figures are for end period

Source: (Demirgüç-Kunt et al., 2005)

Table 2: Summary Statistics of all Variables

Variables	Obs	Mean	Std. Dev	Min	Max
bbrun	2004	.2689621	.549147	0	2
binsolv	2152	.1988848	.4815891	0	2
inflatn	2625	41.83701	437.4305	-13.06	13109.5
gdppc	2625	5345.975	7518.184	102.36	38236
incomgrp	2625	.7371429	.6898183	0	2
m2fxres	2625	85.12849	1584.567	0	72987.56
rir	2625	-.476918	44.43865	-99.24	2104.61
gdpgr	2625	3.370693	4.899869	-41.01	50.69
crgdp	2594	41.46455	36.52356	.02	231.08
xrdepr	2620	-7.826172	17.43592	-99.96	41.55
creditgr	2589	6.416377	29.30584	-100	821.33
dinsur	2625	.2756495	.4462232	0	1
guarantee	1250	.684	.618749	0	2
fxcoverd	692	.7066474	.455628	0	1
intbank	692	.1705202	.3763612	0	1
interven	610	.144459	.3705529	0	2.23
leglcancel	610	.4353115	.6227193	0	5.47
leglmgr	581	.5748709	.4947886	0	1
admin	686	1.54519	.7250463	1	3
coinsur	1248	.0985577	.2981867	0	1
funding	692	.8482659	.3590225	0	1
rskadj	684	.1578947	.3649091	0	1
membship	684	.8845029	.3198548	0	1
sourcefnd	677	.7429838	.4974479	0	2

Table 3: Pairwise Correlations Coefficients between Variables

	binsolv	bbrun	inflatn	gdppc	incomgrp	m2fxres	rir	gdpgr	crgdp
binsolv	1.0000								
bbrun	0.3492	1.0000							
inflatn	0.0278	0.0314	1.0000						
gdppc	-0.0108	-0.0635	-0.0383	1.0000					
incomgrp	-0.0044	-0.0701	-0.0535	0.7812	1.0000				
m2fxres	-0.0336	0.0192	0.0043	-0.0311	-0.0468	1.0000			
rir	-0.0454	-0.0433	0.1575	0.0265	0.0457	-0.0275	1.0000		
gdpgr	-0.1098	-0.1418	-0.0881	-0.0325	0.0054	-0.0368	-0.0322	1.0000	
crgdp	0.0345	-0.0285	-0.0316	0.7086	0.6474	-0.0226	0.0473	-0.0126	1.0000
xrdepr	-0.0840	-0.1123	-0.2966	0.1901	0.1758	-0.0080	-0.0244	0.1532	0.2076
creditgr	-0.1397	-0.0769	0.0389	0.0116	0.0191	0.0111	0.0379	0.1535	0.0686
dinsur	0.0146	-0.0378	-0.0286	0.4572	0.3749	-0.0309	0.0172	-0.0075	0.3511
guarantee	0.0645	0.0095	-0.0832	0.2072	0.1985	0.0345	-0.0182	-0.0203	0.1559
fxcoverd	0.0270	-0.0806	0.0628	-0.1070	0.0750	-0.4113	-0.0149	-0.0194	-0.2346
intbank	0.0462	0.0379	-0.0305	-0.2688	-0.3051	0.1068	-0.0444	0.0053	-0.1366
interven	0.0510	-0.0397	-0.0422	-0.0433	0.0303	0.0964	0.0209	-0.0710	-0.0589
leglcancel	0.0946	0.0110	-0.0711	0.0354	-0.0503	-0.0132	-0.0449	0.0474	-0.0816
leglmgr	-0.0778	0.0134	0.1023	-0.2574	-0.1414	-0.1706	-0.0003	-0.0717	-0.2840
admin	0.0175	0.0230	0.0377	0.3232	0.3038	-0.0088	0.0418	-0.1684	0.2137
coinsur	0.0051	-0.0342	-0.0355	0.2354	0.2771	-0.0240	0.0035	0.0263	0.2551
funding	-0.1183	0.0422	0.0480	-0.1445	-0.2112	0.1941	-0.0261	-0.0018	-0.2030
rskadj	0.0301	0.0036	-0.0047	-0.0270	0.1363	-0.1812	-0.0068	-0.0676	-0.1263
membship	0.0191	-0.0117	-0.2129	0.0213	0.0791	-0.0052	-0.0440	0.0336	-0.0247
sourcefnd	0.0914	-0.0097	-0.0952	-0.3765	-0.3344	0.1313	-0.0851	0.1279	-0.2112

Table 4: Pairwise Correlations Coefficients between Variables, Cont.

	xrdepr	creditgr	dinsur	guarantee	fxcoverd	intbank	interven	leglcancel	leglmgr
xrdepr	1.0000								
creditgr	0.0537	1.0000							
dinsur	0.0777	-0.0140	1.0000						
guarantee	0.1230	-0.0557	0.8708	1.0000					
fxcoverd	-0.1196	0.0068	0.1833	0.2366	1.0000				
intbank	-0.0247	-0.0363	0.0708	-0.0155	-0.0623	1.0000			
interven	0.0614	-0.0146	0.0411	-0.1227	-0.0250	0.4022	1.0000		
leglcancel	0.1157	0.0408	0.0246	-0.0781	-0.1093	0.1068	0.4261	1.0000	
leglmgr	-0.2122	-0.0664	0.0242	0.2140	0.1358	0.2866	0.1577	-0.2008	1.0000
admin	0.0483	-0.0704	0.0685	0.1440	0.0724	-0.1747	-0.0699	0.1119	-0.0925
coinsur	0.1363	0.0031	0.2795	0.1691	0.2569	-0.2115	-0.0864	-0.1494	0.1065
funding	-0.1178	0.0251	-0.0419	0.0440	-0.2725	0.1061	-0.0332	0.1096	0.1090
rskadj	-0.0910	-0.0267	0.0442	0.1563	0.2813	-0.1896	0.0255	-0.0322	0.0759
membship	0.2065	0.0024	-0.0567	-0.2172	0.1557	0.1582	0.1174	-0.1461	0.1983
sourcefnd	-0.0241	0.0049	0.2011	0.2250	0.0378	0.2277	0.2076	0.0367	0.0303

Table 5: Pairwise Correlations Coefficients between Variables, Cont.

	admin	coinsur	funding	rskadj	membship	source d
admin	1.0000					
coinsur	-0.0624	1.0000				
funding	0.0275	-0.2455	1.0000			
rskadj	0.3387	-0.2035	-0.0308	1.0000		
membship	-0.2462	0.1698	-0.1469	0.1565	1.0000	
sourcefnd	-0.2265	-0.1443	-0.0757	0.1441	0.1453	1.0000

Table 6: Bank runs and deposit insurance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	bbrun	bbrun	bbrun	bbrun	bbrun	bbrun	bbrun
gdpgr	-0.0608***	-0.0533***	-0.0604***	-0.0601***	-0.0609***	-0.0610***	-0.0601***
	(0.0124)	(0.0130)	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)
rir	-0.00705*	-0.00731*	-0.00704*	-0.0136***	-0.00821**	-0.00689*	-0.00664
	(0.00409)	(0.00406)	(0.00410)	(0.00526)	(0.00401)	(0.00410)	(0.00407)
inflatn	-0.000219	-0.000207	-0.000213	-0.000276	-0.000251	-0.000210	-0.000207
	(0.000183)	(0.000180)	(0.000181)	(0.000195)	(0.000203)	(0.000181)	(0.000180)
m2fxres	0.000106	0.000101	0.000108	0.000112	0.000114	0.000111	0.000110
	(0.000120)	(0.000119)	(0.000121)	(0.000123)	(0.000122)	(0.000123)	(0.000122)
crgdp	0.00235	0.00206	0.00239	0.00287	0.00250	0.00176	0.000447
	(0.00224)	(0.00225)	(0.00225)	(0.00230)	(0.00227)	(0.00231)	(0.00257)
xrdepr	-0.0136***	-0.0126***	-0.0138***	-0.0131***	-0.0129***	-0.0138***	-0.0139***
	(0.00373)	(0.00376)	(0.00376)	(0.00379)	(0.00385)	(0.00379)	(0.00378)
gdppc	-2.06e-05*	-2.07e-05*	-4.33e-05**	-2.58e-05**	-2.48e-05**	-2.84e-05**	-3.18e-05**
	(1.21e-05)	(1.16e-05)	(1.91e-05)	(1.17e-05)	(1.16e-05)	(1.21e-05)	(1.26e-05)
dinsur	-0.132						
	(0.155)						
gdpgr×*dinsur*		-0.0543*					
		(0.0309)					
gdppc×*dinsur*			2.23e-05				
			(1.73e-05)				
rir×*dinsur*				0.0150**			
				(0.00703)			
inflatn×*dinsur*					0.000779		
					(0.000760)		
m2fxres×*dinsur*						0.0157	
						(0.00995)	
crgdp×*dinsur*							0.00399
							(0.00248)
Constant	-1.198***	-1.193***	-1.187***	-1.239***	-1.219***	-1.201***	-1.170***
	(0.118)	(0.116)	(0.118)	(0.119)	(0.117)	(0.118)	(0.120)
Observations	1980	1980	1980	1980	1980	1980	1980
No. of countries	96	96	96	96	96	96	96

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Bank insolvency and deposit insurance

Variables	(1) binsolv	(2) binsolv	(3) binsolv	(4) binsolv	(5) binsolv	(6) binsolv	(7) binsolv
gdpgr	-0.0561***	-0.0529***	-0.0555***	-0.0564***	-0.0566***	-0.0561***	-0.0547***
	(0.0141)	(0.0149)	(0.0141)	(0.0141)	(0.0141)	(0.0141)	(0.0142)
rir	-0.00420	-0.00432	-0.00392	-0.00222	-0.00347	-0.00411	-0.00340
	(0.00417)	(0.00417)	(0.00412)	(0.00476)	(0.00473)	(0.00416)	(0.00403)
inflatn	-1.63e-05	-1.51e-05	-1.85e-05	-6.46e-06	-1.20e-05	-1.84e-05	-1.48e-05
	(0.000154)	(0.000154)	(0.000154)	(0.000154)	(0.000156)	(0.000154)	(0.000154)
m2fxres	-0.000780	-0.000793	-0.000812	-0.000787	-0.000803	-0.000811	-0.000790
	(0.000754)	(0.000759)	(0.000771)	(0.000759)	(0.000761)	(0.000779)	(0.000758)
crgdp	0.00513	0.00529	0.00488	0.00517	0.00510	0.00510	0.00127
	(0.00339)	(0.00337)	(0.00339)	(0.00336)	(0.00335)	(0.00340)	(0.00405)
xrdepr	-0.0249***	-0.0242***	-0.0250***	-0.0241***	-0.0261***	-0.0247***	-0.0252***
	(0.00468)	(0.00471)	(0.00468)	(0.00474)	(0.00475)	(0.00466)	(0.00469)
gdppc	-1.24e-05	-8.06e-06	-4.36e-05	-8.16e-06	-8.12e-06	-1.12e-05	-1.98e-05
	(2.03e-05)	(1.99e-05)	(2.91e-05)	(1.97e-05)	(1.95e-05)	(2.00e-05)	(2.07e-05)
dinsur	0.135						
	(0.214)						
gdpgr×*dinsur*		-0.0225					
		(0.0355)					
gdppc×*dinsur*			4.13e-05				
			(2.55e-05)				
rir×*dinsur*				-0.0199			
				(0.0162)			
inflatn×*dinsur*					-0.00372		
					(0.00332)		
m2fxres×*dinsur*						0.00704	
						(0.0136)	
crgdp×*dinsur*							0.00646**
							(0.00321)
Observations	2135	2135	2135	2135	2135	2135	2135
No. of countries	105	105	105	105	105	105	105

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Bank run and the generosity of deposit insurance

Variables	(1) bbrun	(2) bbrun	(3) bbrun	(4) bbrun	(5) bbrun	(6) bbrun	(7) bbrun
gdpgr	-0.0772**	-0.0994**	-0.0798**	-0.0727*	-0.0766**	-0.0743**	-0.0772**
	(0.0366)	(0.0435)	(0.0368)	(0.0372)	(0.0368)	(0.0369)	(0.0367)
rir	0.00115	0.00110	0.000811	0.00450	0.00143	0.00156	0.000945
	(0.00637)	(0.00641)	(0.00633)	(0.00733)	(0.00645)	(0.00646)	(0.00631)
inflatn	-0.000198	-0.000321	-0.000209	-0.000443	-0.000248	-0.000244	-0.000201
	(0.000886)	(0.000897)	(0.000879)	(0.00101)	(0.000898)	(0.000900)	(0.000877)
m2fxres	0.000283*	0.000291	0.000261	0.000308	0.000286	0.000302	0.000272
	(0.000171)	(0.000183)	(0.000169)	(0.000190)	(0.000184)	(0.000184)	(0.000170)
crgdp	0.00809**	0.00903**	0.0100***	0.00946**	0.00920**	0.00840**	0.00484
	(0.00379)	(0.00389)	(0.00375)	(0.00404)	(0.00394)	(0.00397)	(0.00415)
xrdepr	-0.0231**	-0.0260***	-0.0235***	-0.0224**	-0.0245**	-0.0249***	-0.0236***
	(0.00920)	(0.00931)	(0.00911)	(0.00956)	(0.00976)	(0.00935)	(0.00914)
gdppc	-1.16e-05	-1.66e-05	-2.85e-05	-1.72e-05	-1.74e-05	-1.06e-05	-1.32e-06
	(1.91e-05)	(1.98e-05)	(1.94e-05)	(2.08e-05)	(2.01e-05)	(2.05e-05)	(1.98e-05)
guarantee	0.631*						
	(0.369)						
gdpgr×*guarantee*		0.0648					
		(0.0626)					
gdppc×*guarantee*			7.12e-05***				
			(2.76e-05)				
rir×*guarantee*				-0.0648**			
				(0.0312)			
inflatn×*guarantee*					0.00276		
					(0.00871)		
m2fxres×*guarantee*						0.0938*	
						(0.0539)	
crgdp×*guarantee*							0.0111**
							(0.00476)
Observations	581	581	581	581	581	581	581
No. of countries	47	47	47	47	47	47	47

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Bank insolvency and the generosity of deposit insurance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	binsolv	binsolv	binsolv	binsolv	binsolv	binsolv	binsolv
gdpgr	-0.0778*	-0.0225	-0.0754*	-0.0841**	-0.0800*	-0.0796*	-0.0752*
	(0.0418)	(0.0452)	(0.0418)	(0.0419)	(0.0420)	(0.0427)	(0.0417)
rir	-0.0489**	-0.0458**	-0.0500**	-0.0638**	-0.0477**	-0.0502**	-0.0512**
	(0.0208)	(0.0220)	(0.0206)	(0.0255)	(0.0212)	(0.0219)	(0.0207)
inflatn	-0.0130	-0.00962	-0.0131	-0.0133*	-0.0129	-0.0126	-0.0125
	(0.00845)	(0.00767)	(0.00821)	(0.00789)	(0.00886)	(0.00859)	(0.00799)
m2fxres	-0.00225	-0.00309	-0.00207	-0.00260	-0.00248	-0.00744	-0.00185
	(0.00540)	(0.0111)	(0.00433)	(0.00705)	(0.00655)	(0.0150)	(0.00354)
crgdp	0.00719	0.00874*	0.00816*	0.00774*	0.00798*	0.00605	0.00263
	(0.00439)	(0.00488)	(0.00420)	(0.00449)	(0.00444)	(0.00473)	(0.00496)
xrdepr	-0.0314**	-0.0263**	-0.0321**	-0.0342***	-0.0318**	-0.0317**	-0.0310**
	(0.0127)	(0.0130)	(0.0126)	(0.0127)	(0.0129)	(0.0129)	(0.0126)
gdppc	-1.47e-06	-1.03e-05	-9.15e-06	-3.99e-06	-6.26e-06	1.26e-05	1.84e-05
	(2.37e-05)	(2.64e-05)	(2.25e-05)	(2.43e-05)	(2.40e-05)	(2.62e-05)	(2.56e-05)
guarantee	0.385*						
	(0.228)						
gdpgr×*guarantee*		-0.202**					
		(0.0855)					
gdppc×*guarantee*			6.16e-05				
			(4.50e-05)				
rir×*guarantee*				0.0390			
				(0.0356)			
inflatn×*guarantee*					0.00269		
					(0.0102)		
m2fxres×*guarantee*						0.182**	
						(0.0717)	
crgdp×*guarantee*							0.0117**
							(0.00549)
Observations	595	595	595	595	595	595	595
No. of countries	48	48	48	48	48	48	48

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Banking Instability and Deposit Insurance Coverage

	(1)	(2)
Variables	bbrun	binsolv
gdpgr	-0.111***	-0.123**
	(0.0427)	(0.0477)
rir	0.000637	-0.0467**
	(0.00644)	(0.0214)
inflatn	-0.000135	-0.0103
	(0.000897)	(0.00776)
m2fxres	0.0193	-0.00238
	(0.0171)	(0.0150)
crgdp	0.00432	0.00861**
	(0.00396)	(0.00409)
xrdepr	-0.0244**	-0.0272**
	(0.00977)	(0.0128)
fxcoverd	-0.523	0.260
	(0.437)	(0.479)
intbank	0.450	0.774
	(0.486)	(0.504)
Observations	541	563
No. of countries	41	44

Standard errors given in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11: Banking Instability and the Deposit Insurance Legal Environment

Variables	(1) bbrun	(2) bbrun	(3) binsolv	(4) binsolv
gdpgr	-0.0738	-0.0660	-0.0893*	-0.0755
	(0.0450)	(0.0466)	(0.0537)	(0.0543)
rir	0.00561	0.00484	-0.0429	-0.0369
	(0.00769)	(0.00784)	(0.0280)	(0.0275)
inflatn	-0.000658	-0.000619	-0.0146	-0.0104
	(0.00109)	(0.00110)	(0.00985)	(0.00778)
m2fxres	0.0240	0.0408*	-0.0106	-0.00684
	(0.0169)	(0.0209)	(0.0166)	(0.0175)
crgdp	0.00765	0.00771	0.0126**	0.0203**
	(0.00501)	(0.00883)	(0.00631)	(0.00878)
xrdepr	-0.0277**	-0.0338***	-0.0515***	-0.0575***
	(0.0108)	(0.0118)	(0.0159)	(0.0160)
gdppc	-2.33e-05	-2.38e-05	-1.90e-05	-3.78e-05
	(2.52e-05)	(2.87e-05)	(3.33e-05)	(3.22e-05)
interven	-0.656	4.168*	0.695	2.620*
	(0.720)	(2.293)	(0.778)	(1.422)
leglcancel	0.940**	1.400*	0.314	1.471*
	(0.461)	(0.831)	(0.538)	(0.811)
leglmgr	0.265	-0.359	-0.417	-1.337
	(0.476)	(0.928)	(0.526)	(0.895)
intervencrgdp		-0.0769**		-0.0314
		(0.0362)		(0.0211)
leglcancelcrgdp		-0.000608		-0.0123
		(0.00942)		(0.00901)
leglmgrcrgdp		0.0157		0.0166
		(0.0133)		(0.0118)
Observations	455	455	465	465
No. of countries	35	35	37	37

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 12: Banking Instability and the Administration of Deposit Insurance

	(1)	(2)
Variables	bbrun	binsolv
gdpgr	-0.0996**	-0.115**
	(0.0443)	(0.0487)
rir	0.000684	-0.0595***
	(0.00643)	(0.0223)
inflatn	-8.29e-05	-0.0118
	(0.000906)	(0.00788)
m2fxres	0.0202	-0.000550
	(0.0180)	(0.0151)
crgdp	0.00256	0.00607
	(0.00560)	(0.00654)
xrdepr	-0.0252**	-0.0292**
	(0.0101)	(0.0131)
gdppc	1.27e-05	2.87e-06
	(2.64e-05)	(3.36e-05)
admin	0.138	0.119
	(0.268)	(0.289)
coinsur	0.858	-0.312
	(0.747)	(0.620)
funding	1.372**	-0.732**
	(0.669)	(0.371)
rskadj	0.106	0.0281
	(0.527)	(0.594)
membship	0.126	0.254
	(0.571)	(0.630)
sourcefnd	0.716*	0.780*
	(0.433)	(0.447)
Observations	529	551
No. of countries	38	41

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1