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
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1. Introduction

Countries adopting deposit insurance aim at minimising the risk of banking crises arising from self-fulfilling expectations[4]. 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 fulfilment 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 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

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[4] 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.

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. Methodology and Data

2.1 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.

2.2 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 (brunt); 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 index of bank runs and bank insolvency. The index of bank runs is given by the formula:

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

while the index of bank insolvency is given by

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

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 ($nbrun_t$; and $ninsolv_t$) as cases where the calculated indices (run_t; and $solv_t$, 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 de.ne 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 de.ned 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 de.ned, 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.

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

2.3. 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).

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.

2.4 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 over; 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.

2.5 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).

3. Results Analysis

3.1 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 1 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.

Table 1: Bank Runs and Deposit Insurance

	1	2	3	4	5	6	7
Variables	Bbrun	bbrun	bbrun	bbrun	bbrun	bbrun	bbrun

Gdpgr	-.0608***	-.0533***	-0.0604***	-0.0601***	-0.0609***	-0.0610***	-0.0601***
	-0.0124	-0.013	-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	-0.0041	-0.00526	-0.00401	-0.0041	-0.00407
Inflatn	-0.00022	-0.00021	-0.00021	-0.00028	-0.00025	-0.00021	-0.00021
	-0.00018	-0.00018	-0.00018	-0.0002	-0.0002	-0.00018	-0.00018
m2fxres	0.000106	0.000101	0.000108	0.000112	0.000114	0.000111	0.00011
	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012	-0.00012
Crgdp	0.00235	0.00206	0.00239	0.00287	0.0025	0.00176	0.000447
	-0.00224	-0.00225	-0.00225	-0.0023	-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		
					-0.00076		
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	-0.12
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 2 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.

Table 2: Bank Insolvency and Deposit Insurance

	1	2	3	4	5	6	7
Variables	Binsolv	Binsolv	Binsolv	binsolv	binsolv	binsolv	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	-0.0042	-0.00432	-0.00392	-0.00222	-0.00347	-0.00411	-0.0034
	-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
	-0.00015	-0.00015	-0.00015	-0.00015	-0.00016	-0.00015	-0.00015
m2fxres	-0.00078	-0.00079	-0.00081	-0.00079	-0.0008	-0.00081	-0.00079
	-0.00075	-0.00076	-0.00077	-0.00076	-0.00076	-0.00078	-0.00076
crgdp	0.00513	0.00529	0.00488	0.00517	0.0051	0.0051	0.00127
	-0.00339	-0.00337	-0.00339	-0.00336	-0.00335	-0.0034	-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

3.2 Design Features of Deposit Insurance

3.2.1. Generosity of Payouts

Estimation results presented in Table 3 and Table 4 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 incentivized 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.

Table 3: Bank Runs and the Generosity of Deposit Insurance

	1	2	3	4	5	6	7
Variables	bbrun	bbrun	bbrun	bbrun	bbrun	bbrun	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	0.0011	0.000811	0.0045	0.00143	0.00156	0.000945
	-0.00637	-0.00641	-0.00633	-0.00733	-0.00645	-0.00646	-0.00631
inflatn	-1.98E-04	-3.21E-04	-2.09E-04	-4.43E-04	-2.48E-04	-2.44E-04	-2.01E-04
	-0.00089	-0.0009	-0.00088	-0.00101	-0.0009	-0.0009	-0.00088
m2fxres	0.000283*	0.000291	0.000261	0.000308	0.000286	0.000302	0.000272
	-0.00017	-0.00018	-0.00017	-0.00019	-0.00018	-0.00018	-0.00017
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***
	-0.0092	-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 4: Bank Insolvency and Deposit Insurance

	1	2	3	4	5	6	7
Variables	bbrun	bbrun	bbrun	bbrun	Bbrun	bbrun	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	0.0011	0.000811	0.0045	0.00143	0.00156	0.000945
	-0.00637	-0.00641	-0.00633	-0.00733	-0.00645	-0.00646	-0.00631
inflatn	-1.98E-04	-3.21E-04	-2.09E-04	-4.43E-04	-2.48E-04	-2.44E-04	-2.01E-04
	-0.000886	-0.000897	-0.000879	-0.00101	-0.000898	-0.0009	-0.000877
m2fxres	0.000283*	0.000291	0.000261	0.000308	0.000286	0.000302	0.000272
	-0.000171	-0.000183	-0.000169	-0.00019	-0.000184	-0.000184	-0.00017
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***
	-0.0092	-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

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 (especially 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.

3.2.2. Coverage.

Table 5 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.

Table 5: 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	-0.015
crgdp	0.00432	0.00861**
	-0.00396	-0.00409
xrdepr	-0.0244**	-0.0272**
	-0.00977	-0.0128

fxcoverd	-0.523	0.26
	-0.437	-0.479
intbank	0.45	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

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 o¤ the foreign currency deposits in local currency at the prevailing exchange rate, the depositors may end up in a worse o¤ 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.

3.2.3. Legal Environment

Estimation results illustrating the importance of the legal environment in explaining banking instability are presented in Table 6. 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.

Table 6: Banking Instability and the Deposit Insurance Legal Environment

	1	2	3	4
Variables	bbrun	Bbrun	binsolv	binsolv
gdpgr	-0.0738	-0.066	-0.0893*	-0.0755
	-0.045	-0.0466	-0.0537	-0.0543
rir	0.00561	0.00484	-0.0429	-0.0369
	-0.00769	-0.00784	-0.028	-0.0275
inflatn	-0.000658	-0.000619	-0.0146	-0.0104
	-0.00109	-0.0011	-0.00985	-0.00778
m2fxres	0.024	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	-0.016
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*
	-0.72	-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

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.

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).

3.2.4. Administration.

Table 7 presents estimation results of the deposit insurance administration indicators. We find that the impact of coinsurance on the probability of bank runs is insignificant.

Table 7: Banking Instability and the Deposit Insurance Administration

	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	-0.00055
	-0.018	-0.0151
crgdp	0.00256	0.00607
	-0.0056	-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	-0.62
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	-0.63
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

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.

3.3. 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 nearly 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 behaviour, captured by an increase of the ratio of credit to the private sector (estimation results not included but available on request).

4. Conclusions

This paper set out to investigate the role moral hazard plays in the effectiveness 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.

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