Power of a Deposit Insurance Scheme's Authority and a Banking Crisis

Anichul Hoque Khan
University of Regina, Canada
E-mail: anichul.khan@gmail.com

Kazi Nazrul Islam
Carleton University, Canada
E-mail: kazi_islam@carleton.ca

Received: November 2, 2012 Accepted: November 25, 2012 Online Published: November 27, 2012
doi:10.5430/jbar.v1n2p88 URL: http://dx.doi.org/10.5430/jbar.v1n2p88

Abstract

Using a large panel data set, this study analyzes effects of empowering the authority of an explicit deposit insurance scheme (EDIS) on banking crises. Findings suggest that the use of an EDIS increases the probability of a banking crisis. Moreover, this probability is greater if the EDIS is not empowered for the direct intervention in banks' operations—e.g., the power to cancel or revoke banks' deposit insurance contracts, or situations in which deposits are not explicitly covered before a bank failure but are to be covered after the failure. The probability is even greater if the EDIS is used in a less developed country while the scheme is not empowered for the direct intervention in bank operations or uncovered deposits are to be covered ex post to a bank failure.

Keywords: Deposit insurance scheme, Banking crises, Logit model

JEL Classification: E52, G22, G32

1. Introduction

This paper examines the relationship between a country's use of a deposit insurance scheme (DIS) and the probability of a banking crisis (Note 1) while the scheme takes into account its different legal obligations. A country's deposit insurance scheme can be explicit, called explicit deposit insurance scheme (EDIS), or it can be implicit, called implicit deposit insurance scheme (IDIS). It is explicit in the sense that the rules and regulations are defined in advance to secure the funds deposited in banks up to a certain limit; and it is implicit because there is nothing explicit but the government usually steps in after any bank failure to rescue the depositors and the banking sector on an ad hoc basis. (Note 2)

There are two main views regarding the impact of an EDIS on banking crisis. A number of studies consider that the use of an EDIS is an optimal policy to protect a banking sector when its stability is threatened by depositor runs (Diamond and Dybvig 1983; Bhattacharya et al. 1998) (Note 3) The depositor runs are usually triggered by asymmetric information in the financial markets (Hwang et al. 2009). Allen and Gale (1998) postulate that even if the depositors are capable of gathering necessary information, there could still be depositor runs because of actual deterioration in the quality of assets in banks.

González-Hermosillo (1996) points out that the depositors' decisions to withdraw their deposits depend on several factors: the coverage limit of their deposits (the lower the coverage, the higher the chance of self-fulfilling runs); the effective endowments which are and will be available in the deposit insurance fund; and on the expected probability of simultaneous failures of a significant number of other banks. Thus, establishing an EDIS does not always ensure the cessation of depositor runs.

Moreover, the EDIS is often responsible for moral hazard problems. The depositors often become less careful in choosing the better performing banks knowing that their deposited funds are insured. Banks, on the other hand, could grant loans to high risk projects, as well as engage in fraudulent activities such as making loans to themselves or to their close associates at a price lower than the market price or at weak terms and conditions. The supervisory authority can have insufficient incentive to monitor banks, resulting in a weak enforcement of prudential regulations as well (Demirguc-Kunt and Kane (2002). Hence, the benefits of EDIS remain debatable.

There have been attempts by Demirguc-Kunt and Detragiache (2002; DKD henceforth) and by Khan and Dewan (2010) to resolve the contentious issue of the impact of an EDIS. (Note 4) A study by DKD (2002) finds that the use of an EDIS in general increases the probability of a banking crisis and this probability is greater when the EDIS is designed inefficiently—namely the scheme with voluntary bank membership, the government-administered scheme, the scheme having funds *ex ante*, the scheme with government-provided funds, and the scheme with a provision of high coverage. Their study also shows that the probability of a banking crisis is even greater if the EDIS's use interacts with the utilizing country's weak institutional environment.

On the other hand, Khan and Dewan (2010) show that only if the interaction between a country's overall economic development and its use of an EDIS is not controlled for, the country's use of the EDIS increases the probability of a banking crisis, and this increase is correspondingly greater the more inefficiently designed the EDIS is. However, once the interaction between the overall economic development and the use of the EDIS is controlled for, the EDIS itself is not a significant factor of a banking crisis. In that case, the less developed the country is that is using the EDIS, the higher the probability of the banking crisis.

None of the studies, however, has addressed the effect on banking crises by an EDIS while taking into account its legal power—such as, the power of the authority to intervene in bank operations, the power to cancel or revoke bank deposit insurance contracts, the power to take legal action against bank officials, and the power to not provide any coverage to the uncovered deposits *ex post* to a bank failure (Barth et al. 2004). Hence we examine the role of an EDIS on banking crises by taking into account the designs of the legal empowerments of the EDIS's authority. Especially we investigate the following hypotheses: a) *ceteris paribus*, whether a banking crisis is more likely to occur in a country with an EDIS than with an IDIS; b) whether the likelihood of a crisis is more when the regulatory authority of the EDIS is less empowered; and c) whether the probability of a crisis is correlated with the state of development of the country.

The rest of the paper is structured as follows: Section 2 presents the model; Section 3 discusses the data; Section 4 provides empirical findings; and Section 5 provides concluding remarks.

2. The model

We use the following logit model for estimating the probability of a banking crisis:

$$\text{Prob}(y = 1|\mathbf{x}) = \frac{e^{\beta'\mathbf{x}}}{1 + e^{\beta'\mathbf{x}}} \equiv F(\boldsymbol{\beta}'\mathbf{x})$$

The dependent variable is banking crisis dummy y, where y = 1 for a country in a year if the country experiences a banking crisis in that year, and where otherwise y = 0. Vector **x** is a set of explanatory variables discussed in next section. The parameter vector $\boldsymbol{\beta}$ reflects the impacts of changes in **x** on the probability. The notation F(.) is the cumulative logistic distribution.

The log-likelihood function for the logit model can be written as follows:

$$\ln L = \sum_{j \in S} \ln F(X_j b) + \sum_{j \notin S} \ln\{1 - F(X_j b)\}$$

where *S* is the set of all country-years *j* such that $y_j = 1$, i.e., country-years with banking crises. Thus the set of "j not belonging to S" implies the set of all country-years not experiencing banking crises. We take the robust standard errors (see Huber 1967; White 1980), according to which the standard errors are adjusted for countries' clustering.

Yearly fixed effects by taking yearly dummies in the regression models to allow the possibility that the probability of a banking crisis may change cross-year independently of the explanatory variables. Country fixed effects could also be included, but the inclusion of country fixed effects in the logit estimation model would require omitting all the countries from the panel that did not experience banking crises. Since many of the countries in our dataset did not experience any banking crisis during the study period and thus would be omitted from the panel, we do not estimate the country-fixed effects.

When interpreting the regression results, one needs to keep in mind that an estimated coefficient does not indicate the direct increase in the probability of a banking crisis given a one-unit increase in the corresponding explanatory variable. Instead, the coefficient reflects the effect of the change in the explanatory variable on the probability function as given in the above expression. However, the sign of the coefficient does indicate the direction of the change.

3. The data

3.1 Deposit Insurance Scheme (DIS)

We use Demirguc-Kunt et al. (2005) as the data source for DIS. They built their database from the earlier studies by Demirguc-Kunt and Sobaci (2001), Garcia (1999), Kyei (1995) and Talley and Mas (1990). Our database is further complemented and improved with the data from various countries' and online sources, as well as based on the survey by Barth et al. (2004).

Since 1980, the EDIS-adopting countries have been rising. According to the International Association of Deposit Insurers (IADI), as of January 2010, 106 countries have instituted some form of EDIS. (Note 5) We assume that a country uses an IDIS, if it has not instituted an EDIS, because the country establishes a *de facto* insurance system for the depositors and the banks *ex post* to any significant bank failure (see Kyei 1995; DKD 1999, 2002; Demirguc-Kunt et al. 2005).

A simple dummy variable called *"IDIS-EDIS"* is used in our regression models to examine the effect of an EDIS on banking crises. The variable takes the value '0' for the country-period with IDIS and '1' for that with EDIS. We hypothesize this variable to be positively associated with the probability of a banking crisis. An EDIS can be formed (or designed) in many different ways (see Kyei 1995; DKD 2002; Demirguc-Kunt et al. 2005). However, this paper is concerned only with the forms of an EDIS regarding its authority's legal empowerment to take actions against banks.

3.2 Sample selection and other control variables

The period covered in our sample is 1980-2003. To select the sample countries, we begin by taking all the countries enlisted in the IMF's data series. Then we drop countries and/or periods out of the sample because either they are centrally planned or socialist states,(Note 6) subservient states,(Note 7) states affected by civil war,(Note 8) or because the data is missing on the necessary control variables.(Note 9) Furthermore, parts of the study period for some countries are dropped because of their transitional state(Note 10) and because of non-systemic banking crises. (Note 11)

To be robust, we use the data of an EDIS, including its designs, from the date it was first enacted where it was not revised, or otherwise from the date of its latest revision. For instance, the EDIS of Finland was most recently revised in 1998, and thus we use the data of Finland since 1998. Note that about one-third of the countries in our study revised the designs of their EDISs after they were first instituted; unfortunately, the data do not offer much information on the revisions undertaken.

The data on banking crises come from Caprio and Klingebiel (2003). (Note 12) A banking crisis is said to occur in a country when a sufficient number of banks fail within a given period and threatens the rest of the banks in the country. (Note 13) A number of studies (Note 14) find that a banking crisis is difficult to identify because of limited information. For instance, many banking crises are accompanied by depositor runs, but the potential for depositor runs cannot be observed directly. On the other hand, banking crises in recent years are associated not only with depositor runs, but also with the deterioration in asset quality and by the subsequent government intervention. However, the availability of such information is also limited.

Owing to data and conceptual limitations, most studies have employed a combination of events to identify and date the occurrences of banking crises. Following Caprio and Klingebiel (2003), we find that at least one of the following conditions exists in a systemic banking crisis: a) the ratio of non-performing loans to total assets in the banking system is at least 10 percent; b) the amount of assets of insolvent banks is at least 10 percent of the amount of total assets of all banks; c) the cost of rescue operation was at least 2.5 percent of the GDP; and d) banking sector problems resulted in government intervention with measures such as large-scale nationalization of banks, or prolonged bank holidays, or bank closures, or mergers of a large number of banks. The variable called "Bank crisis" takes the value '0' when an economy is in a tranquil state and '1' when it experiences a systemic banking crisis. The years during which the systemic crises occurred are excluded from the sample, because the crises themselves may affect the behaviour of the explanatory variables in our model.

3.2 Other control variables

When testing the effect of an EDIS on banking crises, we use a set of control variables which are similar to that of DKD (2002). (Note 15) Expected signs of the variables' impacts on banking crises and their sources are reported in Table 1.

4. Empirical Findings

4.1 Estimates

In our regressions, the sample size is largest when we use the simple IDIS-EDIS dummy to estimate the effects of EDIS. The sample sizes are smaller and unbalanced when the EDIS-design variables are used, because of the variables' missing values. Therefore, we also estimate the effects of EDIS by using the IDIS-EDIS dummy with the same samples that are used to estimate the effects of different EDIS-designs. The reason for this estimation is to determine whether the estimated coefficient of an EDIS's design is more precise than the coefficient of the simple EDIS. The estimation results of the simple IDIS-EDIS dummy used in different regression models with different sample sizes are reported in the corresponding columns at the bottom of the result-tables. These results are distinguished with **bold** and *italic* style (due to the space limitation, the coefficients of the control variables are not reported).

4.2 EDIS and banking crises

The effects of an EDIS controlling the other necessary variables, including the yearly dummies, are reported in Table 2. The parameter of the IDIS-EDIS dummy is highly significant with a positive sign. That is, the probability of a banking crisis is higher in a country with an EDIS than the country with an IDIS.

In order to infer that the probability of a banking crisis is higher for any inefficient design of the EDIS, its coefficient should be estimated more precisely than the coefficient of the IDIS-EDIS dummy. The coefficient in comparison with that of the simple IDIS-EDIS dummy is considered to be more precisely estimated if the following conditions are fulfilled: the level of significance of its estimation is stronger; the log-likelihood value of the model is higher; and the model's goodness of fit is better (higher pseudo-R-squared value). Accordingly, the more precisely estimated coefficients of EDIS-designs and their interpretations are as follows:

EDIS's power to intervene bank: Once a country implements an EDIS, it should empower the EDIS's authority to intervene in bank operations directly. This viewpoint is established as this study evidences that the banking crisis probability is higher if an EDIS's authority has no decision-power to intervene in bank operations than that if the EDIS's authority has the power. The estimated probabilities of the crises for Sri Lanka (1989) and Japan (1991) would have decreased from 6.53% and 3.76% to 3.7% and 2.18% respectively if the EDIS authorities of the countries had been empowered for direct intervention in the bank operations. Perhaps the reason is the incentive problem, as the theory suggests. The problem ensues in the following way. The scheme provides insurance to the deposited funds in the banks, while it has no power to directly intervene the bank activities, even if the banks have done any deceitful acts with the deposited funds. In this case, if any other authority is assigned the power to directly intervene in the bank activities to ensure the effective use of the deposited funds, the authority will have less incentive for the timely intervention in bank activities. Lack of efficient and timely intervention by the authority in the bank's activities will widen the opportunity for the bank's managements to misuse the deposited funds, i.e., an adverse selection problem.

EDIS's power to cancel insurance: This study finds evidence that the probability of a banking crisis increases if an EDIS lacks the authority to cancel the deposit insurance contract of a participating bank. Like the EDIS design of the above one and as the theory suggests, the incentive and consequently the moral hazard problem may cause this increase of the crisis's probability. That is, the EDIS guarantees payment of the dues of the bank depositors as it sells the insurance of their deposited funds. However, it has no power to cancel the deposit insurance contract of the banks for any of their defaults. Logically, the first problem is that any other authority assigned with the power to cancel the insurance contract will have less incentive for the timely action against any bank concerning the deposit insurance contract. Secondly, the bank managers may take this opportunity to misuse the deposited funds. The predicted probabilities of the crises for Argentina (2001) and Korea (1997) would decrease from 7.45% and 8.57% to 3.88% and 4.32% respectively for the countries with switching of their EDIS without the power to cancel the deposit insurance contract to EDIS with that power.

Compensation of uncovered deposits: The results suggest that a banking crisis's probability is higher if the authority of an EDIS cannot intervene but still provides coverage to the deposited funds of a bank which were not covered before the bank's failure. This kind of handling by an EDIS reveals the liberalized policy of the scheme. This liberalized policy can increase the scope of moral hazard problem on the part of banks' managements, because the implicit coverage of the deposited funds increases. The predicted probabilities of the crises for Argentina (2001) and Turkey (2000) would reduce from 14.27% and 3.87% to 5.65% and 1.29%

respectively for the countries with switching of their EDIS with coverage of the uncovered deposits to EDIS without that coverage.

The above-mentioned findings remain the same when the regression models are tested either by using only the control variables those are statistically significant, or the control variables that are significant with the least number of missing values. In the first case, the control variables are GDP growth, Depreciation, and Less development; and in the second case, the control variables are Depreciation and Less development. The findings remain the same when we add 'corruption', a measure of institutional environment, as a separate control variable in the models. (Note 16)

4.3 An EDIS with economic development and banking crisis

Now we focus on the effect of a country's use of an EDIS on banking crises when the interaction of the EDIS's use with the country's level of economic development is controlled for. We consider only those EDIS-design variables, the parameters for which were found to be more precisely estimated than the estimated parameter of the simple IDIS-EDIS dummy.

The results show that most of the interaction parameters are significant and have the expected positive signs. That is, the less developed the country interacting with an EDIS is, the higher is the probability of a banking crisis, as suggested by Khan and Dewan (2010). What additional effect the inefficient design of EDIS concerning the legal empowerment of its authority has on a banking crisis when that EDIS interacts with the country's level of economic development? It can be assessed by examining whether the coefficient of the EDIS-design's interaction is more precisely estimated than the coefficient of the simple IDIS-EDIS dummy's interaction. Following are such more precisely estimated parameters based on the levels of significance, the log-likelihood values and the values of goodness of fit:

EDIS's power to intervene bank x Less development: Findings (table 3) implies that the probability of a banking crisis magnifies further if an EDIS is handled by a less developed economy. For example, the predicted probabilities of the crises in Nigeria (1990) and Kenya (1992) would decrease from 12.48% and 10.19% to 5.73% and 4.60% respectively if the EDIS of these countries, which lack the power to directly intervene in bank's activities, were handled by an institutional framework like that of a developed country. The possible reason is, as the theory suggests, that the weaker institutional framework in a less developed economy inflates the said incentive and moral hazard problems.

Compensation of uncovered deposits x Less development: The probability of a banking crisis arising from an EDIS, the authority of which cannot intervene but still provides coverage to a bank's uncovered deposits *ex post* the bank's failure, is even greater if the scheme is handled by a less developed economy. For instance, the predicted probability of the 2001 crisis in Argentina would have decreased from 11.83% to 6.33% if the above-mentioned kind of EDIS in the country had been handled by an institutional framework like that of a developed country rather than the existing one. This is so because of the weaker institutional framework of the less developed economy, and it causes the probability of the crisis to increase even more.

4.4 Robustness

The adoption of the EDIS and the banking crisis may be simultaneously determined, i.e., the decision to adopt an EDIS may be influenced by a banking crisis itself. If this is the case, then treating the EDIS as an exogenous variable would lead to the simultaneity bias. To assess whether such a bias exists, a two-stage logit estimation method is used. In the first stage, adoption of an EDIS is estimated from a set of explanatory variables where there is at least one variable that is not correlated with banking crises. In the second stage, the IDIS-EDIS dummy is replaced by a variable called "EDIS-predict" in estimating the probability of banking crises. The variable EDIS-predict takes the predicted values of adopting an EDIS.

The robustness check is reported in Table 4 by taking a fewer control variables, the parameters for which were found to be significant in the earlier regression models. The first regression model of the table reports the results with "Bank crisis*"* as the dependent variable and "IDIS-EDIS*"* as an explanatory variable along with the other control variables. The result with the IDIS-EDIS dummy remains the same as that in Table 2. That is, a country's use of an EDIS significantly increases the probability of a banking crisis.

In the first stage of the two-stage estimation method (column 3 of Table 4), the dependent variable called "Adopting EDIS" takes the value of '0' for a country with an IDIS and '1' for a country that adopts an EDIS. Once a country adopts an EDIS, we drop the subsequent period of the country during which the EDIS remains in effect. The key explanatory variable in this regression model is the "EDIS-contagion", which takes the value of annual proportion of the sample countries that use an EDIS. The higher the proportion of the countries that use an EDIS, the more likely it is that a country with an IDIS replaces its IDIS with the EDIS. This is the variable likely to be related to the

application of an EDIS but not to a banking crisis (see DKD 2002). The other control variables are the same as those of the first regression model (column 2 of Table 4).

The logit model used in the first stage of the two-stage estimation method disregards the yearly fixed effects, because the annual proportions of the sample countries that use an EDIS are different between years but the same for all the countries within a year. Therefore, if we use the yearly dummies to include their fixed effects, the variable EDIS-contagion gets dropped from the estimation. However, we use the logit model with the yearly dummies in the second stage of the two-stage estimation method.

The results (Table 4, columns 2 and 3 respectively) show that the probability of adopting an EDIS and the probability of a banking crisis are driven by different factors. The parameters of the variable "Less development" are strongly significant in both of the columns but with different signs. Explicitly, the less developed a country is, the lower the likelihood of adopting an EDIS, but the higher the probability of a banking crisis. The levels of significance of the parameters for the other control variables influencing "Bank crisis" and "adopting EDIS" are also much different. "EDIS-contagion" is positively related with the probability of adopting an EDIS, as expected. This implies that the higher the number of countries around the globe that are adopting an EDIS, the higher the probability that a country will replace its IDIS with an EDIS.

In the second stage of the two-stage regression method, the variable "EDIS-predict" is a significant (at the 5% level) factor for a banking crisis. Thus, we conclude that our finding with an EDIS is not muddled because of the simultaneity bias.

5. Conclusion

Deposit insurance schemes (DIS)—implicit or explicit—are needed to protect depositors and to prevent bank runs on. These schemes however could be a source of moral hazard problems, and can trigger banking crises. The problem could be acute especially in case of LDCs, as they usually adopt EDISs even though they are weakly structured in regards to the preventing of the EDISs' possible adverse effects. In order to uncover the impacts of DIS on banking crisis, this paper has tested several hypotheses regarding alternative forms of DISs and their impacts on banking crises.

The panel data used in this study include all the possible countries with the information of an EDIS's use for the period of 1980 to 2003. (Note 17) Using a logit model with yearly fixed affects, the study finds that the probability of a banking crisis is significantly increases if the EDIS is not empowered for the direct intervention in bank's operations.

The result also reconfirms that that the less developed an EDIS-adopting country is, the higher the chance of a banking crisis as suggested by Khan and Dewan (2010). Furthermore, the probability of a banking crisis increases in a LDC, where the EDIS lacks the legal power to directly intervene in bank's operations, or if the EDIS is to cover a bank's uncovered deposits *ex post* to the bank's failure.

The findings can be improved by updating the banking crises data—this study is based on a secondary source (Caprio and Klingebiel, 2003). The data do not provide a single decisive factor to define a banking crisis. The findings have powerful policy implications especially for LDCs. In order to mitigate banking crisis through DIS, a country must adequately empower the DIS authority. Moreover, the institutional frameworks (legal structures, enforcement capability) should be in place before instituting an EDIS. Otherwise, the EDIS will be counterproductive. Therefore, without ensuring these preconditions, a country should not adopt an EDIS.

Acknowledgement

The preliminary work for this paper was accomplished when Anichul Khan was at the Economics Department of Helsinki University. We are grateful to Prof. Pertti Haaparanta and other participants for their helpful comments at the Helsinki Centre of Economic Research workshop on Macroeconomics and Development. Graduate school fellowship offered by Finnish Doctoral Program in Economics and the financial supports from Yrjö Jahnsson Foundation to carry out the research work for this paper are gratefully acknowledged. The authors wish to thank the Editor and two anonymous referees for their kind comments to the first version of this paper.Of course, we are responsible for any errors in the paper.

References

Allen, F., and Gale, D. (1998). Optimal Banking Crises, *Journal of Finance*, 53 (4), pp. 1245-1284. http://dx.doi.org/10.1111/0022-1082.00052

Berth, J.R., Caprio, G. and Levine, R. (2004). The Regulation and Supervision of Banks around the World: A New Database, 2003 Version and Update, Washington DC, World Bank.

Bhattacharya, S., Boot, A.W.A., Thakor, A.V. (1998). The economics of bank regulation, *Journal of Money*, Credit, and Banking 30 (4), 745-770. http://dx.doi.org/10.2307/2601127

Calvo, G. A. (1998). Varieties of capital-market crises. In: Calvo, G., King, M. (Eds.), The debt burden and its consequences for monetary policy. Published for the International Economic Association by Macmillan Press.

Caprio, G. and Klingebiel, D. (2003). *Episodes of Systemic and Borderline Financial Crises*. World Bank.

Demirgúc-Kunt, A. and Detragiache, E. (1999). The Determinants of Banking Crises: Evidence from Industrial and Developing Countries, The World Bank, Policy Research Working Paper Series: 1828.

Demirgúc-Kunt, A., and Detragiache E. (2002). Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation. *Journal of Monetary Economics*, Vol. 49, Issue 7.

Demirgúc-Kunt A, Detragiache E. (2005). Cross-Country Empirical Studies of Systemic Bank Distress: A Survey. Policy Research Working Paper Series No. 3719, World Bank

Demirgúc-Kunt A., Karacaovali B. and Laeven L. (2005). Deposit Insurance around the World: A Comprehensive Database, mimeo, World Bank.

Demirguc-Kunt, A. and Sobaci, T. (2001). A New Development Database: Deposit Insurance Around the World, *World Bank Economic Review*, 15, 481-490. http://dx.doi.org/10.1093/wber/15.3.481

Diamond, D., and P. Dybvig. (1983). Bank Runs, Deposit Insurance and Liquidity, *Journal of Political Economy.* 91.

Garcia, Gillian. (1996). Deposit Insurance: Obtaining the Benefits and Avoiding the Pitfalls. IMF, WP/96/83.

Garcia, Gillian (1999). Deposit Insurance: A Survey of Actual and Best Practices. IMF, WP/99/54.

Glick, R. and Hutchison, M. (1999). Banking and Currency Crises: How common Are Twins? Federal Reserve Bank of San Francisco, Pacific Basin Working Paper Series: 99-07

Golembe, C.H. (1960). The Deposit Insurance Legislation of 1933: An Examination of Its Antecedents and Its Purposes, *Political Science Quarterly*, 75 (2), 181-200.

González-Hermosillo, Brenda. (1996). Banking Sector Fragility and Systemic Sources of Fragility. IMF Working Paper No. 12.

Gorton, G. (1988). Banking panics and business cycles, Oxford Economic Papers, No. 40.

Huber PJ. (1967). The Behavior of Maximum Likelihood Estimates Under Non-Standard Conditions. In: Proceedings of the Fifth Annual Berkley Symposium on Mathematical Statistics and Probability.

University of California Press, Berkeley, 221–233.

Hwang D, Shie F, Wang K, Lin J. (2009). The pricing of deposit insurance considering bankruptcy costs and closure policies. J Bank Finance 33:1909–1919. http://dx.doi.org/10.1016/j.jbankfin.2009.04.013

Kaminsky, G. L., and Reinhart, C. M. (1999). The Twin Crises: The Causes of Banking and Balance of Payments Problems, *American Economic Review*, Vol. 89, p.473-500. http://dx.doi.org/10.1257/aer.89.3.473

Khan, A. and Dewan, H. (2010). Deposit insurance scheme and banking crises: a special focus on less-developed countries. *Journal of Empirical Economics*. http://dx.doi.org/10.1007/s00181-010-0438-8

Komulainen, T. and Lukkarila, J. (2003). What Drives Financial Crises in Emerging Markets? *Emerging Market Review*. 4, p. 248-272. http://dx.doi.org/10.1016/S1566-0141(03)00039-6

Kyei, Alexander (1995). Deposit Protection Arrangements: A Survey, IMF, WP/95/134.

Obstfeld, M., (1986). Rational and self-fulfilling balance-of-payment crises, *American Economic Review*, 76 (1).

Talley, Samuel H., and Ignacio Mas. (1990). Deposit Insurance in Developing countries, The World Bank, WPS 548.

White H. (1980). A Heteroskedasticity – Consistent Covariance Matrix and a Direct Test of Hetersoskedasticity. *Econometrica*. 48(4): 817–38. http://dx.doi.org/10.2307/1912934

Notes

Note 1. A banking crisis occurs when a sufficient number of banks fail within a given period and threaten the rest of the banks; and a bank failure occurs when a bank is unable to meet its obligations to its depositors or other creditors because it has become insolvent or illiquid to meet its liabilities (González-Hermosillo 1996).

Note 2. See Kyei (1995), Garcia (1996), DKD (1999, 2002) and Demirguc-Kunt et al. (2005).

Note 3. Golembe (1960) finds that the goal of DIS is more focused on restoring confidence in the liquidity of bank deposits than on protecting small depositors.

Note 4. Demirgúc-Kunt and Kane (2002) also focus in resolving the ambiguities of the EDIS's impact on banking crises.

Note 5. The list of countries was rretrieved from the following site <http://www.iadi.org/di.aspx, accessed on August 8, 2010.

Note 6. China, Cuba, Laos, and Vietnam are dropped because of their centrally planned economies.

Note 7. Hong Kong, Micronesia, and Taiwan are not completely sovereign states yet.

Note 8. Afghanistan, Somalia, and Sudan have been affected by civil conflicts throughout most of our study period.

Note 9. Albania, Azerbaijan, Belarus, Brunei Darussalam, Isle of Man, Kiribati, Liechtenstein, Marshal Islands, and Serbia Montenegro are dropped due to lack of data on the specified control variables.

Note 10. We exclude only the first two years for transitional economies when they transitioned from the centrally planned economy to the market economy.

Note 11. Periods of non-systemic banking crises are dropped because: 1) a non-systemic crisis may affect the systemic crisis and the explanatory variables in our regressions; 2) we are interested in estimating the probability of a systemic banking crisis given that the economy is otherwise in tranquil period.

Note 12. There could be small scale (or non-systemic) banking crises and systemic banking crises. The banking crises, discussed in this paper, are systemic banking crises unless otherwise specified.

Note 13. See Gonzalez-Hermosillo (1996) for details.

Note 14. See Glick and Hutchison (1999).

Note 15. The data for the control variables are taken from various issues of the International Financial Statistics (IFS).

Note 16. The results of these additional tests, however, are not reported in this paper but can be obtained upon request from the authors.

Note 17. We were unable to extend the study period due to unavailability of data on key variables; however, the study covered several banking crises; therefore, the findings are applicable to recent banking crises (e.g. financial crisis of 2008) as well.

Table 1. Expected signs of the control variables on banking crises

Explanatory variables	Expected signs	References and short explanations
GDP growth	-	Kaminsky and Reinhart (1999) and Gorton (1988): cyclical output downturns increase banking sector problems; DKD (1999, 2002, 2005): -ve relation with occurrences and costs of BC
Terms-of-trade change	-	Kaminsky and Reinhart (1999) and Gorton (1988): terms of trade deteriorations increase banking sector problems; DKD (1999): -ve relation with occurrences and costs of BC
Inflation	+	Obstfeld (1986): 2nd generation theory; Komulainen and Lukkarila (2003): +ve relation with CC; DKD (1999, 2005): +ve relation with occurrences and costs of BC.
Depreciation	+	DKD (1999, 2002): +ve relation with occurrences and costs of BC.
Real interest	+	DKD (1999, 2002, and 2005): +ve relation with occurrences and costs of BC.
M2/reserves	+	Calvo (1998): high ratio causes vulnerability; DKD (1999, 2002, 2005): +ve relation with occurrences and costs of BC; Komulainen and Lukkarila (2003): + ve relation with CC
Credit $growth_{t-2}$	+	DKD (2002, 2005): +ve relation with occurrences of BC
GDP/Capita	-	DKD (1999, 2005): -ve relation with occurrences of BC

NB: GDP = gross domestic product; BC refers to "banking crises" and CC to "currency crises"; -ve = negative, +ve = positive.

Table 2. Effects of EDIS on banking crisis probability

Dependent variable = Bank crisis	(1)	(2)	(3)	(4)	(5)
GDP growth	-0.146*** (0.047)	-0.136*** (0.049)	-0.135*** (0.048)	-0.131*** (0.048)	-0.125*** (0.047)
Inflation	-0.0125* (0.0068)	-0.0101 (0.0065)	-0.0102 (0.0063)	-0.0093 (0.0067)	-0.0105 (0.0068)
Terms of trade change	0.0076 (0.0071)	0.0070 (0.0069)	0.0070 (0.0068)	0.0072 (0.0068)	0.0062 (0.0069)
Depreciation	0.0134** (0.0064)	0.0115* (0.0062)	0.0116* (0.0061)	0.0107* (0.0064)	0.0118* (0.0069)
Real interest	0.0016 (0.0010)	0.0011 (0.0009)	0.0011 (0.0009)	0.0010 (0.0009)	0.0011 (0.0012)
M2/reserves	-0.0024 (0.0032)	-0.0023 (0.0029)	-0.0022 (0.0030)	-0.0021 (0.0028)	-0.0020 (0.0027)
Credit growth$_{t-2}$	0.0025 (0.0078)	0.0033 (0.0081)	0.0040 (0.0085)	0.0039 (0.0081)	0.0073 (0.0132)
Less development	0.4077*** (0.1353)	0.4253*** (0.1372)	0.4511*** (0.1375)	0.3931*** (0.1308)	0.4116*** (0.1468)
IDIS-EDIS	1.004**[2%] (0.4094)				
EDIS's power to intervene bank		0.5828*** (0.2108)			
EDIS's power to cancel insurance			0.7463*** (0.2472)		
EDIS's power to take action against bankers				0.3613 (0.2262)	
Ex post covering of uncovered deposits					1.1131*** (0.3018)
Constant	-4.533*** (1.1205)	-4.645*** (1.1041)	-4.655*** (1.1285)	-4.429*** (1.0780)	-5.202*** (1.1031)
Observation	1134	1065	1065	1065	939
Log likelihood	-149.73	-145.98	-145.88	-148.48	-138.10
Wald chi2	98.95	99.22	97.59	90.82	101.66
Prob > chi2	0	0	0	0	0
Pseudo R2	0.1665	0.1598	0.1604	0.1454	0.1649
AIC	359.46	349.96	349.76	354.96	332.2
No. of crises	42	41	41	41	40
% overall correct	73.54	72.86	71.74	70.52	72.63
% crises correct	73.81	73.17	75.61	73.17	72.50
IDIS-EDIS		***1.025**[2%] (.417)***	***1.025**[2%] (.417)***	***1.025**[2%] (.417)***	***1.230*** (.392)***
Log likelihood		***-146.65***	***-146.65***	***-146.65***	***-139.17***
Pseudo R2		***0.1559***	***0.1559***	***0.1559***	***0.1584***

Numbers in the parentheses are standard errors; ***, **, and * refer to 1%, 5%, and 10% level of significance respectively.

Table 3. Effects of EDIS interacted with economic development on banking crisis

Dependent variable = Bank crisis	(1)	(2)	(3)	(4)
GDP growth	-0.146*** (0.047)	-0.136*** (0.049)	-0.133*** (0.048)	-0.128*** (0.048)
Inflation	-0.0144** (0.0072)	-0.0122* (0.0070)	-0.0124* (0.0067)	-0.0129* (0.0073)
Tot change	0.0075 (0.0078)	0.0070 (0.0077)	0.0072 (0.0077)	0.0060 (0.0077)
Depreciation	0.0153** (0.0067)	0.0135** (0.0067)	0.0137** (0.0065)	0.0142** (0.0073)
Real interest	0.0018* (0.0010)	0.0013 (0.0009)	0.0013 (0.0009)	0.0013 (0.0011)
M2/reserves	-0.0014 (0.0025)	-0.0015 (0.0026)	-0.0013 (0.0022)	-0.0012 (0.0022)
Credit growth$_{t-2}$	0.0018 (0.0086)	0.0028 (0.0087)	0.0035 (0.0092)	0.0065 (0.0143)
IDIS-EDIS x Less development	0.5868** (0.2887)			
IDIS-EDIS	-0.6125 (0.8237)			
EDIS's power to intervene bank x Less development		0.2971* (0.1683)		
EDIS's power to intervene bank		-0.2498 (0.4988)		
EDIS's power to cancel insurance x Less development			0.4008 (0.2577)	
EDIS's power to cancel insurance			-0.2995 (0.7075)	
Compensation of uncovered deposits x Less development				0.5644** (0.2601)
Compensation of uncovered deposits				-0.2479 (0.6194)
Constant	-3.38*** (1.03)	-3.45*** (1.01)	-3.36*** (1.02)	-2.83*** (0.82)
Observation	1134	1065	1065	939
Log likelihood	-151.24	-148.00	-148.40	-139.14
Wald chi2	105.84	100.7	101	105.6
Prob > chi2	0	0	0	0
Pseudo R2	0.1581	0.1481	0.1459	0.1586
AIC	362.48	354.0	354.8	334.28
No. of crises	42	41	41	40
% overall correct	73.02	72.21	71.74	72.31
% crises correct	76.19	75.61	78.05	77.50
IDIS-EDIS x Less development		***.680** (.315)***	***.680** (.315)***	***.454 (.329)***
IDIS-EDIS		***-.836 (.900)***	***-.836 (.900)***	***-.025 (.913)***
Log likelihood		***-148.10***	***-148.10***	***-141.01***
Pseudo R2		***0.1476***	***0.1476***	***0.1473***

Numbers in the parentheses are standard errors; ***, **, and * refer to 1%, 5%, and 10% level of significance respectively.

Table 4. DIS and banking crises: two-stage estimation

	Banking crisis	Adopting EDIS	Banking crisis
GDP growth	-0.140*** (0.040)	-0.050* (0.026)	-0.067 (0.052)
Depreciation	0.0023*** (0.0006)	0.0002 (0.0004)	0.0020*** (0.0006)
Less development	0.4220*** (0.1459)	-0.4803*** (0.1132)	0.9201*** (0.3269)
IDIS-EDIS	1.0720*** (0.3993)		
EDIS-contagion		9.7518*** (2.8705)	
EDIS-predict			36.61** (17.14)
Constant	-5.00*** (1.09)	-3.6212*** (0.5331)	-7.36*** (1.89)
Observation	1321	1470	1321
Log likelihood	-164.09	-203.25	-165.27
Wald chi2	99.16	29.37	98.35
Prob > chi2	0	0	0
Pseudo R2	0.1495	0.0539	0.1435