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The Breakdown of Credit Relations Under Conditions of a Banking Crisis: A Switching Regime Approach

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The Breakdown of Credit Relations Under Conditions of a Banking Crisis: A Switching Regime Approach

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Abstract

This paper empirically analyzes the effects of a banking crisis on bank credit to the private sector for a panel of developing, developed, and transition economies for the period 1970-1998. The model illustrates how the behavior of the bank credit function changes during a banking crisis, reflecting a generalized disruption in the stability of behavioral parameters. Usual links such as interest rate signaling for lending, and synergy between deposits and loans, fall apart. Moreover, this study gives support to Third Generation Models in their ability to predict banking crises. Based on the empirical findings, the paper then provides policy implications for monetary policy.

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I. INTRODUCTION

Recent experience has shown how difficult it is to implement an appropriate monetary policy under conditions of banking crises. In particular, distress in the banking sector reduces the ability of the monetary authorities to forecast the demand for credit and liquidity and decisions have to be taken under conditions of imperfect information[2]. As a result, the authorities' ability to manage liquidity and ensure adequate credit growth could be significantly weakened. At the same time, by disrupting the flow of credit to households and enterprises, a banking crisis affects investment and consumption negatively, and could lead to increased levels of bankruptcy, which worsens further the condition of the banks.

In most countries affected by a banking crisis, bank credit to the private sector declined substantially. Even though the reduction of credit may have been partially related to the liquidity effects of bank runs that were not offset by monetary policy, in some countries the contraction of credit was much steeper than the decrease in deposits.[3] An alternative explanation for the decline of credit is related to a capital crunch in the banking sector resulting from a tightening of capital requirements which reduces bank resources available for credit. It is also possible that sound banks behave more conservatively during a crisis and thus limit the amount of credit that they are willing to extend, while unsound banks may be forced to reduce credit owing to the drying up of their funding sources.

In such a context, the scope for monetary policy actions is restricted and their effects through the interest rate channel are not very clear. The monetary authorities face various problems. First, monetary policy will need to be conducted in an environment where the main behavioral relations become highly unstable. The money multiplier becomes highly volatile, usually showing a rapid increase prior to or at the beginning of the crisis, and a sharp decline some time after.[4] An increase in the multiplier may reflect an initial reduction in banks' excess reserves as they try to cope with a drying up of liquidity, while its decline usually reflects an ensuing increase in the demand for cash as a result of lack of confidence in the viability of banks. In addition, income velocity also exhibits substantial volatility, increasing significantly during the crisis period and reflecting the instability of the money demand.[5]

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[2] This is important when a country defines a monetary aggregate as the intermediate objective. During the 1990s, some countries have been switching to a possible alternative to the monetary policy strategy, inflation targeting. However, inflation targeting is not a crucial issue here because it was only used by a small number of the countries considered at the end of the sample.

[3] See García-Herrero (1997).

[4] Spain, Uruguay and Philippines are good examples of volatility in the money multiplier.

[5] Although such volatility will lead to long-run instability of money demand, García-Herrero (1997) shows that changes in velocity did not disrupt the stability of the money demand for

(continued...)

Secondly, a banking crisis greatly diminishes the effectiveness of monetary policy and reduces the ability of the central bank to manage liquidity, since it has to work in an environment where both sound and unsound banks are present. These problems are further compounded the greater the reliance on direct monetary instruments, as they lower the flexibility of the monetary authorities to react to changes in liquidity conditions. In addition, the effectiveness of indirect monetary instruments suffers from the effects on bank soundness of the increasing deterioration in the quality of bank assets, and of the growing interbank market segmentation; which disrupt the responsiveness of credit aggregates to interest rates. Bank lending might become less sensitive to interest rates owing to capitalization of interest payments and massive roll-overs of loans, since borrowers' demand for credit becomes less elastic on account of their growing financial troubles. Monetary policy, however, may affect not only the general level of interest rates but also the loan supply through the lending channel. This situation highlights the independent role of the credit channel of the monetary transmission mechanism. Specifically, the impact of monetary policy may be amplified through the lending channel more than what could be expected in the case that policy were only transmitted through the interest rate channel. Since a banking crisis increases the variability of interest rates, their information content is lost to a large degree and banks may have to resort to credit rationing practices. The latter lead to distortions and may accelerate business bankruptcies, especially among small and medium-sized firms, therefore leading to a faster decrease of output. Thus, the credit channel might amplify the economic decline.[6]

Finally, the authorities' efforts to avoid illiquidity in the system during a banking crisis are also complicated by the need to preserve price stability. On the one hand, the relationship between monetary instruments and objectives becomes less predictable during a banking crisis. On the other hand, while the central bank is usually primarily responsible for ensuring price stability, it is also responsible for the stability of the banking system, which may require injecting liquidity into the banks.

Most of the papers that have been written on the issue of monetary policy during a banking crisis have focused on case studies but few have based their conclusion on the use of econometric analysis. The purpose of this paper is to estimate an econometric model that could help understand the factors leading to higher probability of a banking crisis and the behavior of credit to the private sector in a crisis environment, and to derive lessons for the conduct of monetary policy in an environment of banking crisis. The empirical study is based on limited dependent variable and switching models for a panel of developing, developed and transition economies, for the period 1970-1998. The basic model is divided into a discrete and a continuous part that will characterize bank credit supply to the private sector. We propose that the probability of a banking crisis is endogenous, that is, the fact that a banking

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the seven countries in her sample. However, her results are based on structural tests, and results could change if a more complete money demand equation were to be modeled.

[6] See Bernanke and Blinder (1988) model of bank lending channel for details.

crisis occurs or not and its duration vary over time. In addition, such probability is also likely to be endogenous with respect to bank credit.

The rest of the paper is organized as follows: Section II describes the evolution of bank credit to the private sector during a banking crisis and presents the monetary instruments available to manage liquidity during a banking crisis and their effectiveness. Section III describes the estimation procedure. Section IV presents the results of the endogenous switching model. Section V concludes. Variable definitions and constructions are discussed in the Appendix.

II. Bank Credit Supply to Private Sector Behavior and Monetary Policy During a Banking Crisis

The recent banking crises of the 1980s and 1990s have led to a number of studies investigating the factors that contribute to banking distress and eventually to systemic risk. The literature is divided into two groups: microanalyses focusing on banking data[7] and macro-analyses using macroeconomic variables that can contribute to a banking crisis. Among those in the second group, Kaminsky and Reinhart (1999) identify variables that can act as "early warning signals" for crises and find that high interest rates and declines in foreign exchange reserves, output growth or stock market prices are good predictors of banking crises. Demirguc-Kunt and Detragiache (1998) estimate a multivariate logit model according to which a banking crisis is more likely to happen in a weak macroeconomic environment and when real interest rates are high. They find strong evidence that deposit insurance schemes can create moral hazard if not well designed, and that the larger the share of credit to the private sector, the more vulnerable the banking sector is to a crisis. In addition, they find that the vulnerability of the system to sudden capital outflows also increases the probability of a banking crisis.

Gonzalez-Hermosillo (1999) provides an analysis of both macroeconomic and microeconomic factors associated with five banking crises: Southwest U.S. (1986-92), Northeast U.S. (1991-92), California (1992-93), Mexico (1994-95) and Colombia (1982-87) and finds that low capital equity and reserve coverage of problem loans is a leading indicator of bank distress and that proxies for credit risk and moral hazard produce ambiguous results.

A number of studies have previously explored the implications of a banking crisis. For example, Kaminsky and Reinhart (1999), García-Herrero (1997), and Lindgren, García and Saal (1996) provide some stylized facts regarding monetary variables such as bank credit supply to the private sector. As these authors show, in most of the countries affected by a banking crisis, bank credit to the private sector usually continues to grow until the crisis

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[7] Such analyses use the CAMEL rating based on a composite number of five criteria of robustness (capital, assets, management, earnings and liquidity considerations) (see section on micro-factors in Gónzalez-Hermosillo (1999)).

erupts and slows down and sometimes declines substantially some time after the onset of the crisis.

In the existing literature, most econometric studies have explored bank credit around the period of the banking crisis as opposed to during the crisis period itself. In addition, banking crisis events have been introduced as an exogenous factor when modeling the behavior of the variable under study. For instance, Laffont and García (1977) and Kim (1999) include the loan rate, the differential between the loan rate and the yield of corporate bonds, total deposits, an index of industrial production, and a banking-crisis-specific dummy, as determinants of bank credit.[8]

To fill this gap, the model that we develop in the next section—takes into account that the occurrence of a banking crisis is not an exogenous event—there are economic and institutional factors that determine such an event. In this sense, we include additional determinants of banking crises, suggested by Third Generation Models (TGMs) introduced by Chang and Velasco (1998) and Krugman (1999), which have been unexplored in the existing empirical literature.[9] Then, we endogenize them to be able to explain the equation for bank credit to the private sector both in crisis and non-crisis periods.

During a crisis, the usual relationships between loans, deposits and interest rates tend to break down, and as a result, increased lending may increase the risks faced by the banks. Under these circumstances, inefficiency may arise if the loan price does not depend on the amount lent, as firms would not be taking into account the marginal cost of their loans. Another relationship that can be jeopardized is the link between deposits and credit. In a non-crisis period, a symmetric link between them holds but might break down in a crisis period. In this context, banks experience difficulties in transmitting credible information to the market and increases in interest rates to compensate lenders for higher risk can give a signal of an unsound position, eventually leading to a higher contraction in credit.

In order to face this market failure, the authorities will need to take explicit policy action. The central bank has different ways of responding to a banking crisis and the associated drop in credit: Lender-of-Last Resort (LOLR) support, open market operations (OMOs), modifications in reserve requirements (RRs), and bailing out banks.

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[8] For Canada and Korea respectively.

[9] Theories explaining currency crises are divided into three groups: First Generation models for currency crisis are based on inconsistencies in macroeconomic policy mix as the leading cause of currency crisis; Second Generation models are based on the idea of self-fulfilling expectations, that is, policy objectives can become inconsistent once a currency comes under pressure; and Third Generation Models take into account the existence of a commercial banking sector.

There are two views regarding the role of LOLR support during a banking crisis. The first view maintains that the proper role of the central bank as the lender-of-last resort is to lend only to illiquid but solvent financial institutions. This is the so-called Bagehot's "lender of last resort" rule that proposes an elastic supply of currency at a fixed ceiling rate. The second view emphasizes the difficulties in making the distinction between insolvent and illiquid banks. On the one hand, it might happen that some illiquid banks in need of LOLR assistance actually are insolvent. On the other hand, risk-taking activities could get subsidized, and incentives to build adequate loan-loss provisions, reduced. In addition to the difficulty of distinguishing between illiquid and insolvent banks, moral hazard problems may arise and contagion may spread. Widespread LOLR support can also contribute to a more severe banking crisis, because it may place an undue burden on the supervision authorities, creates doubts about the size of bank rescue operations, and the policy can be abused for political reasons. Another negative effect of LOLR operations, which the authorities must deal with, such as excessive risk-taking by the banks, undermines the role of the inter-bank market in the provision of liquidity.

In contrast to LOLR operations, which are by definition directed towards specific banks, the authorities may opt to conduct system-wide OMOs that increase or decrease supply of high-powered money. OMOs help in facing a banking crisis because they provide liquidity to banks. Goodfriend and King (1988) distinguish between central bank monetary policy (OMOs) and banking policy actions (LOLR support), with monetary policy being the management of high-powered money and banking policy being regular and emergency lending to private banks and other financial institutions. They point out that monetary policy can be implemented without supporting financial regulations, and that it can be managed instead with OMOs in government bonds. The advantage of monetary policy during an episode of banking crisis is that it can provide resources to banks to meet depositors' demands at a low resource cost. However, banking policy involves a swap of government securities for claims on individual banks, and therefore gives rise to costs in terms of additional required supervision. In addition, sterilized discount window lending, that is, discount window lending accompanied by an open-market sale of equal value has no monetary policy implications due to the fact that it leaves high-powered money unaffected. It is a mere substitution of bank paper for government paper for the central bank. These operations are pure banking policy, offering lines of credit to individual banks as a private bank. Goodfriend and King (1988) conclude that it is monetary policy and not banking policy that is both necessary and sufficient for a central bank to protect the banking system from a crisis.

Reserve requirements (RRs) are in principle another indirect monetary instrument that can inject or withdraw liquidity on a system-wide basis. Banks have to buy temporary liquidity from the central bank when RRs are increased, which leads to a reduction of their lending activity. Conversely, a reduction in RR may lead to an expansion in lending. Unlike OMOs, RRs are a unilateral decision of the central bank that has a significant big effect on banks' portfolios and suffers from problems of implementation. In addition, frequent changes in RR will lead to higher holdings of excess reserves by the banks to be used as a buffer and to the use of substitutes for deposits, thus weakening the link between RRs and the money multiplier and eventually the monetary target. Therefore, OMOs are better suited for the

efficient execution of monetary policy; RRs can help to determine the amount of OMOs that the central bank would need to provide but do not help efficiently to determine the stock of money.

Finally, another form of reaction from the authorities has been to bail out insolvent banks with public resources. Even though this could lead to a temporary increase in liquidity, it could slow down the implementation of risk management systems due to the fact that banks could expect future bailouts. In addition, the fiscal burden can be very large.

III. An Endogenous Switching Model

This section develops an econometric model that aims to be an alternative to the previous literature. We investigate formally what are the main factors that could help assess the likelihood of a banking crisis and those that could help determine the behavior of bank credit to the private sector during a banking crisis. On the basis of these findings, we will then attempt to derive useful conclusions regarding the role that monetary policy can play in a financial crisis.

Consequently, the rationality behind the model below is that a banking crisis is endogenous with respect to bank credit to the private sector. In addition, the model also attempts to explain if the probability that a banking crisis occurs, i.e., if it is binding or not, and its duration vary over time. In order to capture these interactions, an endogenous switching model will be used, in which the continuos behavior of bank credit to the private sector is described by two regression equations –one for crisis periods (equation 1), and another one for tranquil or non-crisis periods (equation 2). The model also includes a discrete criterion function that determines which of these two equations is applicable in any given situation (equation 3).

Therefore, the switching model with endogenous switching is defined as follows:

$$c_{1i} = X_{1i}\beta_1 + u_{1i} \tag{1}$$

$$c_{2i} = X_{2i}\beta_2 + u_{2i} \tag{2}$$

$$B_i^* = Z_i\gamma - \varepsilon_i \,. \tag{3}$$

$$(u_1, u_2, \varepsilon)' \sim N(0, \Sigma)\,,$$

$$\text{with } \Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_{22} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{bmatrix}.$$

where c_{1i} and c_{2i} are bank credit to the private sector in a crisis and non-crisis period, respectively; X_{1i} and X_{2i} are the explanatory variables of the continuous equations—bank

credit equation—and Z_i are the explanatory variables of the discrete equation—banking crisis equation. We assume that the error term ε_i is correlated with the error terms u_{1i} and u_{2i}.

The selection variable B^*_i, that measures the intensity of the banking crisis, is not fully observable; we can only observe a sign for B_i. In other words, it is possible to determine whether there is a banking crisis or not, but not its magnitude.

The sample selection tells us that c_{1i} is observed only when B_i^* is greater than zero -that is, during a crisis - but cannot be observed when B_i^* is equal or lower than zero.

$$\begin{aligned} B_i &= 1 \quad iff \quad B_i^* > 0 \\ B_i &= 0 \quad iff \quad B_i^* \le 0 . \end{aligned} \tag{4}$$

The observed c_i is defined as

$$\begin{aligned} c_i &= c_{1i} \quad iff \quad B_i = 1 \\ c_i &= c_{2i} \quad iff \quad B_i = 0 . \end{aligned} \tag{5}$$

It is important to point out that estimation of equation 1 using only data during a banking crisis would produce inconsistent estimates of β because it neglects all information coming from the endogeneity of a banking crisis.

Then, following Maddala (1983), the likelihood function for this model is

$$L(\beta_1, \beta_2, \sigma_1^2, \sigma_2^2, \sigma_{1\varepsilon}, \sigma_{2\varepsilon}) = \prod \left[\int_{-\infty}^{\gamma' Z_i} g(c_i - \beta_1' X_{1i}, \varepsilon_i) d\varepsilon_i \right]^{B_i} \left[\int_{\gamma' Z_i}^{\infty} f(c_i - \beta_2' X_{2i}, \varepsilon_i) d\varepsilon_i \right]^{1-B_i},$$

where g and f are, respectively, the bivariate normal density functions of (u_{1i}, ε_i) and (u_{2i}, ε_i).

In order to avoid the above integrals, Lee (1976) proposes a two-step method.

The first step is to model the selection equation, namely, whether there is a banking crisis or not, as follows:

$$B_{it} = I(z_{it}'\gamma + \varepsilon_{it} \ge 0), \tag{6}$$

where the indicator function $I(.)$ is equal to 1 if the statement in the argument is true, and equal to 0 otherwise.

There are different approaches to estimating the binomial model. We will choose a probit ML estimation, which assumes normality in the residuals and can be expressed as follows:

$$\Pr ob(B_i = 1) = \Pr ob(\varepsilon_i \rangle - \gamma' z_i) = 1 - \Phi(-\gamma' z_i),$$

where $\Phi(.)$ is the cumulative distribution function (standard normal) for ε_i. ε_i is normalized to have var=1. The observed values of B_i are realizations of a binomial process with the probabilities above and variation from trial to trial.

Then, we need to obtain the expected values of the residuals u_{1i} and u_{2i} as follows:

$$E(u_{1i} / \varepsilon_i \le \gamma' Z_i) = \sigma_{1\varepsilon} \frac{\phi(\gamma' Z_i)}{\Phi(\gamma' Z_i)}$$

$$E(u_{2i} / \varepsilon_i \ge \gamma' Z_i) = \sigma_{2\varepsilon} \frac{\phi(\gamma' Z_i)}{1 - \Phi(\gamma' Z_i)}.$$

Let's define the following Mills ratios,

$$\hat{W}_{1i} = \phi(\gamma' Z_i) / \Phi(\gamma' Z_i) \qquad \textit{and} \qquad \hat{W}_{2i} = \phi(\gamma' Z_i) / [1 - \Phi(\gamma' Z_i)],$$

where $\phi(.)$ is the standard normal density function and $\Phi(.)$ the distribution function.

We obtain estimates for the Mills ratios by substituting the estimated $\hat{\gamma}$ for γ.

The second step consists of rewriting our original model as follows:

$$c_{1i} = \beta_1' X_{1i} + \sigma_{1\varepsilon} W_{1i} + v_{1i} \qquad \textit{for} \qquad B_i = 1 \tag{7}$$

$$c_{2i} = \beta_2' X_{2i} + \sigma_{2\varepsilon} W_{2i} + v_{2i} \qquad \textit{for} \qquad B_i = 0, \tag{8}$$

where

$$Ev_{1i} / x_{1i}, z_i = 0$$
$$Ev_{2i} / x_{2i}, z_i = 0.$$

In the second step, we substitute the $\hat{W}$ estimated from the first step in the equations above. This two-step procedure gives consistent estimates of β.

IV. Empirical Results

The results are derived from the two components of the model: (a) the discrete component, which analyzes the factors leading to a banking crisis and (b) the continuous component, which describes the changes in the behavior of bank credit to the private sector during a banking crisis.

A. Factors Leading to a Banking Crisis

This part of the model explores which macroeconomic and institutional factors are associated with the appearance of a banking crisis. The purpose is to endogenize the probability of the appearance of a crisis in our bank credit equations in the second part of the model.

Based on the econometric model developed in the preceding section, we present the first part of our results, namely the factors that help to explain the likelihood of banking crises. We can divide such factors between traditional fundamental variables and variables that can be identified when applying the new TGMs. These models allow for the interaction of banking crises and currency crises, the so-called twin crises. In our specification, we include variables coming from the traditional models such as changes in the terms of trade, exchange rate, fiscal surplus/deficit over GDP and real interest rate; and variables from the TGMs such as interest controls, currency crisis, stock market prices, private credit over GDP, the presence of a deposit insurance scheme, and M2 over reserves.

The parameters arising from the estimation of the equation on the probability of a banking crisis (equation 6) are reported in Table 1. Since the estimated coefficients are not easily interpretable, we also report the effects of an infinitesimal change in regressors on the probability of a banking crisis evaluated at the mean values of the data.

From Table 1, we can point out that the variables coming from the TGMs appear to be more significant than the other variables and that the effects of currency crisis, inflation and lag of credit to the private sector are very large. We discuss this below.

The sign and significance of the estimated coefficient for the variable on interest controls (IC) indicates that the removal of interest controls tends to increase the probability of a banking crisis. This result may reflect the fact that many countries have implemented financial liberalization without simultaneously strengthening bank regulation; the resulting bank mismanagement then tends to lead to a banking crisis.

The variable measuring the lag of credit to the private sector over GDP is significant and exhibits a positive sign. This implies that a lending boom can lead to a banking crisis, especially if banks do not have good credit and risk management systems in place. This result coincides with Gourinchas (1999), who shows with a sample of 91 countries during the period 1960-96 that the probability of having a banking crisis or a balance of payments crisis significantly increases after a lending boom, which could in turn be related to the effects if lifting of interest rate controls in a situation of imperfect supervision.

Table 1. Probability of a Banking Crisis

Variables	Estimate	T-Statistic	δF/δx
Constant	-1.90	-3.74	
Interest Controls	-.36	-2.40	-.115
Currency Crisis	.90	3.42	.338
GDP Growth	-2.24	-4.67	-.721
Terms of Trade Change	3.74_{e-03}	1.11	.001
Exchange Rate	-8.82_{e-06}	-.30	-2.77_{e-06}
Real Interest Rate	.01	2.05	.004
Inflation	-1.42	-2.94	-.457
Lag of Stock Market Prices	-.37	-2.00	-.121
Fiscal Surplus/Deficit over GDP	-.43	-.38	-.139
Lag of Credit to the private sector over GDP	.67	2.36	.218
Deposit Insurance Scheme	.36	2.33	.113
M2 over Reserves	1.71e-06	.001	5.51e-07
χ^2		87.13	
p-value		0.00	
No. of Observations		505	

It is also clear that the presence of a currency crisis is an important indicator of the likelihood of a banking crisis. In this regard, Kaminsky and Reinhart (1999) show that although banking and currency crises are not unidirectional, a banking crisis tends to predate a currency crisis and the subsequent collapse of the currency tends to deepen the banking crisis, giving rise to a vicious cycle. They claim that even when there is no apparent causal link between the two crises, they usually share common causes, such as an economic recession, a worsening of the terms of trade and an overvalued exchange rate. On the other hand, Obstfeld and Rogoff (1995) point out that countries with a pegged exchange rate and experiencing a banking crisis are more likely to suffer from a speculative attack against the currency. Depositors can change their domestic deposits to foreign currency abroad if they expect a devaluation, thus leaving domestic banks illiquid. The coefficient for a currency crisis shows a strong relation between both kinds of crises.[10]

The model also introduces moral hazard issues by considering the existence of deposit insurance schemes (DIS). There are different positions in the literature on the effects

[10] In this paper we have introduced currency crisis as an exogenous variable; however, in a companion paper we endogenize currency crisis, to take fully into account that liquidity support to fragile banks and defense of a currency peg can become inconsistent policies that lead to a currency crisis and devaluation, and that defense of a currency could lead to a banking crisis by hurting the balance sheets of banks.

of DIS. On the one hand, for example, Diamond and Dybvig (1983) point out that the implementation of an implicit or explicit DIS can help avoid self-fulfilling bank runs; as a result, a DIS would help to reduce the probability of a banking crisis. On the other hand, according to Kareken and Wallace (1978), DIS do not provide any social improvement and banks will hold as risky portfolios as regulations allow in a context of moral hazard. Our model results show a strong positive correlation between the presence of DIS and the probability of a banking crisis. These results, which are similar to those of Demirgüç-Kunt and Detragiache (1998), probably reflect the fact that a DIS can lead to moral hazard and encourage an excessive increase in bank credit as banks are willing to take on additional risk. In addition, underfunded DIS may give rise to a process of adverse selection, leading to deposit runs. However, variables used in the model might be contemporary with the introduction of DIS, since DIS are a sometimes adopted at the time of the crisis. Demirgüç-Kunt and Detragiache (2000) show that the probabilities of adopting DIS and the occurrence of a banking crisis are driven by different factors, and that correcting for the possible endogeneity of DIS does not change the results of the banking crisis equation.

The model results also show that real GDP growth is negatively related to the occurrence of a banking crisis, which highlights the importance of the state of the real economy in determining the health of the banks. As expected, declines in stock market indexes also are positively related with banking crises, confirming that stock market prices are a good early warning indicator of a forthcoming banking crisis[11]. The exposure of asset collapse generates a high degree of financial vulnerability that may trigger a pre-emptive attack by panicking creditors.[12]

High real interest rates in our model seem to point to an increase in the likelihood of a banking crisis. This may reflect either of the two explanations normally stated in the literature in this regard. Increases in short-term interest rates could lead to deterioration of the balance sheets of the banks because they force an increase in deposit rates while the rate of return on assets adjusts more slowly, which could lead to losses. Alternatively, if high interest rates reflect increasing lending rates, non-performing loans will tend to rise.

A puzzling result of the equation is that lower inflation seems to be consistent with a high probability of a banking crisis. On the one hand, one should expect that high rates of inflation would be associated with high and volatile interest rates,[13] which—as the model results show—are clearly associated with a higher probability of banking crisis. On the other hand, however, our result may be reflecting the fact that a substantial decline in inflation as a

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[11] By including stock market indexes a large number of observations is lost; therefore, we exclude this variable to estimate the second part of the model (equations 7 and 8). What we lose in significance, we gain in degrees of freedom for the second stage of the model.

[12] See Radelet and Sachs (1998).

[13] See Demirguc-Kunt and Detragiache (1997).

result of a successful stabilization program may lead to a deterioration of the balance sheet of the banks owing to the elimination of the float, leading to a banking crisis in the event that bank soundness is weak. Consequently, even though low inflation is desirable, stabilization programs in countries with weak banking systems could be associated with the appearance of a banking crisis.

Another peculiar result is that the level of exchange rates and terms of trade changes are not significant. These results are found as well by Demirguc-Kunt and Enrica Detragiache (1998). The likely explanation is that we have already controlled for the occurrence of a currency crisis. Less capitalized banks are usually more vulnerable to the crisis. Unfortunately, we could not use the market capitalization variable due to lack of observations.

The M2 to foreign exchange reserves variable is used as a proxy for sudden capital outflows. It allows to test the relationship between these outflows and banking sector problems in countries with fixed exchange rates. Chang and Velasco (1998) use M2 and short-term debt relative to reserves as measures of vulnerability under the notion of "international illiquidity." This variable does not play any role once a currency crisis is controlled for, possibly because both are predictors of a country's vulnerability to balance-of-payments crises.

Additional testing has been carried out, excluding insignificant variables in order to check for the robustness of the estimation. The results are unchanged and robust; however, we leave the insignificant variables for the sake of comparison with previous literature on the subject.[14]

B. Bank Credit to the Private Sector

The aim of this section is to show how the credit function clearly switches its behavior from being determined basically by bank business factors during non-crisis periods to a complete disruption of the stability of its behavioral parameters during periods of banking crisis.

The literature on credit supply has mainly focused on the portfolio management approach theory. Building on Laffont and García (1997), we explain the behavior of bank credit to the private sector during crisis and non-crisis periods in terms of the following variables: loan interest rate, total deposits, credit the public sector, central bank credit to the private sector, output, expected inflation, open market operations, reserve requirements, interest rate spread, expected investment and three time dummy variables (Table 2)[15].

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[14] Results are available from the author upon demand.

[15] Bank credit to private sector, total deposits, credit to the public sector, central bank credit to the private sector and output is in differences.

Table 2. Bank Credit to Private Sector Function

	Non-Crisis Period	Crisis Period
Constant	-.37	-.79
	(-.10)	(-1.47)
Lending Interest Rate		.005
	.33	(0.30)
	(5.51)	
Total Deposits	.50	-.04
	(2.11)	(-.32)
Credit to the Public Sector	-.02	-.0004
	(-3.44)	(-1.47)
Central Bank Credit to Banks	1.60	-.08
	(7.57)	(-1.80)
Output	.18	.10
	(2.39)	(5.50)
Expected Inflation	-4.74	-.006
	(-2.43)	(-.36)
Open Market Operations	1.48	.71
	(.59)	(2.34)
Reserve Requirements	3.45	-.20
	(1.46)	(-.612)
Spread	-.36	-.01
	(-3.06)	(-.26)
Expected Investment	-.42	.01
	(-1.24)	(.43)
Time Dummy 1976-81	-1.10	.57
	(-.87)	(1.42)
Time Dummy 1982-87	-1.85	.61
	(-1.57)	(1.76)
Time Dummy 1988-93	-1.98	-.10
	(-2.03)	(-.33)
F-Statistic	19.41	10.79
p-value	0.00	0.00

Note: Numbers in parenthesis are t-ratios

The table clearly shows that during a banking crisis the usual links between credit and variables that determine lender behavior fall apart. Different relationships break down: interest rate signaling on lending, synergy between deposits and lending, lending to public sector, inflation expectations and negative effect of agency costs. We analyze these relationships below.

The coefficient associated with the lending interest rate variable has the right positive sign according to the theory as lending rates are a good indicator of the profitability of banks' lending business, in both periods. However, while in the non-crisis period the coefficient for lending interest rates is highly significant, in a crisis period it loses all its significance. This is

a very important result because it implies that interest rates may not play their usual signaling role in the market during crisis periods.[16]

The availability of deposits is usually a key determinant of banks' willingness to provide credit to the private sector. During a non-crisis period, the coefficient associated to deposits is positive and significant. This result is similar to the synergy argument in the spirit of Kashyap, Rajan and Stein (1999) where an increase in the amount of demand deposits leads to an increase in loan commitments. They show that both activities, lending and deposit-taking provide bank customers the same service, that is, provision of liquidity on demand. In addition, both activities are in need of large amounts of liquid assets on their balance sheets to use as a buffer stock to accommodate liquidity shocks.[17] They find that if deposit withdrawals and loan commitment takedowns are not perfectly correlated, their synergy rises due to the fact that both activities share the deadweight costs of holding the liquid assets. However, during a banking crisis deposits fail to be an appropriate proxy of the supply of credit, as shown in Table 2. The coefficient loses significance and moreover changes its sign. An explanation for its limited impact during crisis periods is that credit and deposit growth slow down and sometimes decline substantially, although not always in a symmetric fashion. During a crisis, the behavior of deposit growth will in part depend on the share of foreign banks and state banks in the banking system and on how dollarized the economy is. Although flight to quality of deposits to foreign banks may help to moderate the overall decline in deposits, restrictions against holding dollar-denominated deposits may actually lead to offshore deposits and an even faster decline of deposits from the system.

A decline in the volume of credit may be the result of either a decrease in willingness to lend or a weak demand for loans. In order to control for the latter we include GDP growth as a credit demand factor in the specification. It has a positive sign and most interestingly it maintains its significance during a banking crisis.

Following Pazarbasioglu (1996), we proxy cyclical risk premium by the spread between the lending rate and the money market rate. The rationale behind this formulation is that an increase of the spread represents cyclical agency costs that lead to moral hazard and adverse selection behavior in an asymmetric information context. As expected, this coefficient is negatively significant in our specification but it becomes insignificant during a crisis.

We also consider the inclusion of expected inflation and expected investment to proxy for the state of the overall economic environment. The first one has the predicted

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[16] Lending rates are not the interest rate used for open market operations, so caution should be taken in interpreting the model results as reflecting ineffectiveness of interbank interest rates.

[17] Under the realistic assumption that raising external finance can be very costly in the short term.

negative sign in a non-crisis period, reflecting that uncertainty about the future—more inflationary environment—tends to make bankers more cautious about lending. The relation breaks down during the crisis. Expected investment is non-significant in any specification probably because it is not well measured.

We also include bank credit to the public sector in order to analyze possible crowding out of credit to the private sector. Our results show a strong crowding out during the non-crisis period and a loss of significance in a crisis period. This can be explained by the fact that during a crisis the authorities' priorities may shift, with assistance to banks in distress becoming a more important concern.

As we mentioned before, one shortcoming is that we could not include the market capitalization variable to represent the collateral available to banks and the net worth of the corporate sector, because of lack of observations.

C. The Efficiency of Monetary Instruments During Crisis and Non-Crisis Periods

The basic model can be expanded by including variables describing monetary instruments in order to show the role that different monetary instruments can play during a crisis as the authorities try to limit the ensuing decline in credit to the private sector. In particular, we consider the role of OMOs, RRs and central bank credit to banks. The results are reported in Table 2.

We are especially interested in the role of OMOs in the conduct of monetary policy during a banking crisis. Therefore, we include a variable measuring their presence in both periods. Ideally we would like to use a non-polychotomous variable but there is not a (long enough) series available. Therefore, we rather use a dummy variable, indicating whether OMOs[18] are in place as a monetary policy instrument in each year of the sample. OMOs are a very flexible indirect monetary instrument and their use helps to speed up the impact of monetary policy. It shortens the implementation lag of monetary policy because the authorities are able to react faster to liquidity shocks, due to the fact that prices adjust automatically to clear the securities market. In a non-crisis period, the coefficient associated to the availability of OMOs is not significantly different from zero probably because bank credit is mostly driven by banking business variables. However, during periods of banking crisis the coefficient becomes highly significant, showing that this flexible instrument of monetary policy seems of significant importance in helping to redress the negative effects of a banking crisis on the availability of credit to the private sector.

The presence of RRs,[19] does not appear to provide to the authorities a useful instrument that could help prevent a decline of bank credit to the private sector in crisis or

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[18] See Appendix for a description of the variable.

[19] See the Appendix for a description of the variable.

non-crisis periods, probably due to its rigidity as an instrument to manage liquidity, as discussed before. In general and as explained above, central banks avoid frequent changes of the RR ratio owing to the large costs that banks would experience.

LOLR support to banks is captured in the model by using central bank credit to banks as an independent variable. In a non-crisis situation, the coefficient for this variable is positive, which implies that the presence of LOLR facilities actually may help promote the growth of credit to the private sector. However, in a situation of banking crisis, the coefficient turns out to be significantly negative, which implies that during a banking crisis the expansion of central bank credit to banks is not enough to prevent a decline of bank credit to private sector. Some other interpretations that can be derived from this result are as follows: First, in a context of moral hazard and adverse selection, central bank credit to banks cannot distinguish between illiquid and insolvent banks, therefore central bank credit cannot prevent a decline of bank credit to private sector. According to Goodhart and Huang (1999), moral hazard is an insufficient reason to argue against LOLR policies if contagion is not taken into account. In case of contagion, LOLR becomes "necessary and justified," even though moral hazard exists. Second, this variable could be capturing large differences in bank portfolio quality. Third, injection of liquidity by central banks could be used by banks only to restructure their portfolios and not to extend new credits.

V. Conclusion

Using annual data for a panel of countries that have suffered at least one banking crisis during the period 1970–1998, we estimate a switching model with endogenous switching in the event of a banking crisis. The model involves discrete choice and continuous results for the bank credit to private sector function under conditions of a banking crisis. By accounting for the endogeneity of the probability of a banking crisis, we show how the link between bank credit to the private sector and lending rates falls apart during a crisis period. This breakdown occurs as well in the case of the relationship between deposits and credit. A banking crisis starts from the illiquidity or insolvency of a large fraction of the banking system leading to a collapse of the credit channel and of the synergy between lending and deposit-taking advocated in the literature. Other variables used to explain bank business in the literature lose their role. This is the case of inflation expectations, agency costs and the spread of interest rates. Possible crowding outs of credit to the private sector are inexisting during a banking crisis since authorities' priority is to assist banks in distress.

With respect to monetary policy implications, we discussed the role that monetary policy instruments can play in alleviating the severity of the crisis. We shed light on the argument of Goodfriend and King (1988) on whether it is better to lend to the market or to individual banks. Based on the empirical findings, our measures of LOLR support and OMOs seem to indicate that the existence of OMOs may have a positive effect during crisis periods; while LOLR support may not be enough to alleviate the depth of the banking crisis. More inflexible instruments like RRs do not play any role during a crisis. Consequently, this paper gives empirical evidence to the fact that OMOs seem an efficient monetary policy instrument during a banking crisis, mainly owing to their flexibility in timing and volume. A

logical line to extend the analysis will be to try to answer the question of what should be the target of monetary policy during a crisis. Our findings encourage the use of OMOs as instruments for monetary policy; therefore further research on the most suitable objective for monetary policy, during a banking crisis, could be quite valuable in helping us to understand the complete role of monetary policy in these episodes.

Finally, the discrete choice results show that traditional fundamental factors cannot explain by themselves a banking crisis; as a result, we need to include third generation fundamentals of the financial sector reflecting micro-prudential factors. In this sense, we find that stock market indexes are a good signal to predict a banking crisis, DIS could lead to moral hazard if schemes are not well funded, and stabilization programs could affect negatively banking activity if they produce sharp declines in inflation. Lending booms and liberalization without a strong banking regulation can lead to a banking crisis. Finally, the results give support to possible twin crises, where currency crises can trigger banking crises and worsen them.

DESCRIPTION OF THE DATA

The original sample of countries contains 107 economies[20] that had at least one banking crisis during the period 1970–1998. However, reflecting lack of data in some cases, our panel is unbalanced, the period covered for some countries is shorter than 28 years and some of the countries had to be dropped owing to missing values in some of the variables. We do not treat the missing values to avoid misleading results.

All quantitative variables are taken from IFS (International Financial Statistics) and WEO (World Economic Outlook) databases with the exception of the stock market indices that are taken from Datastream and Bloomberg.

The variable indicating the presence of a banking crisis is taken from Lindgren, García and Saal (1996) and Caprio and Klingebiel (1996). The currency crisis variable is taken from Andrew Rose web-site. The Deposit Insurance variables are constructed based on García (1999).

Open Market Operation and Reserve Requirement and Interest Control variables are constructed following Gulde and Zhu (1998) methodology:

- OMO will be 0 if central bank or government paper is not used for OMO, 1, if Treasury bill or central bank paper is issued at auction and used for monetary operations, 2, if secondary market is well developed and OMO is the primary instrument.

- RR is 1, if RR is less than 12 percent when there is no remuneration, or if the unremunerated part is less than 10 percent if reserve is partially remunerated, 0, if there is no reserve requirement or if the reserve ratio is higher due to the fact that in the latter case, RR will act as a tax.

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[20] Albania, Algeria, Argentina, Australia, Bangladesh, Benin, Bhutan, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Burundi, Cameroon, Canada, Cape Verde, Central African Republic, Chad, Chile, Colombia, Republic of Congo, Costa Rica, Cote d'Ivoire, Czech Republic, Denmark, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Germany, Ghana, Greece, Guinea, Guinea-Bissau, Guyana, Haiti, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakstan, Kenya, Korea, Kuwait, Latvia, Lebanon, Lesotho, Liberia, Lithuania, Macedonia, Madagascar, Malaysia, Mali, Mauritania, Mexico, Morocco, Myanmar, Nepal, New Zealand, Niger, Nigeria, Norway, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Sao Tome and Principe, Senegal, Sierra Leone, Singapore, Somalia, South Africa, Spain, Sri Lanka, St.Vincent, Swaziland, Sweden, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United States, Uruguay, Venezuela, Zambia, Zimbabwe.

- IC is 1, if directed credit is less than 25 percent and 0 otherwise.

Information on monetary instruments in place is taken from de Melo and Denizer (1997), Gulde and Zhu (1998), Baliño and Zamalloa (1997) and internal IMF reports.

A detailed description of the data is available from the author.

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