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## External Shocks and Banking Crises in Developing Countries: Does the Exchange Rate Regime Matter?

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# External Shocks and Banking Crises in Developing Countries: Does the Exchange Rate Regime Matter?

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**Abstract:**
This paper examines some determinants of banking crises in developing economies. Specifically, the effects of terms of trade shocks and capital flows are analyzed. The choice of the nominal exchange rate regime is found to be a crucial factor in the way various shocks are transmitted through the monetary sector. A logit model is used on panel data and preliminary results indicate that countries that had more flexible regimes were able to lessen the impact of external shocks on the domestic economy. This in turn reduced the likelihood of banking crises.

1 This research was conducted at the Univeristy of Oxford. The findings of this paper do not represent the views of the IMF, or its Executive Directors.

## Section 1. Introduction

The causes and consequences of banking crises has regained prominence after the recent wave of financial and banking crises in emerging economies. This is particularly so where banks and bank lending played a significant role in the crises that engulfed much of Asia, Russia and Brazil in the late 1990s. The resulting monetary and real effects were profound, with substantial social and economic dislocation. The subsequent academic and policy debate has focused on the major contributory factors which may have led to such crises in the context of existing theory and historical evidence. Various explanations ranging from business cycle to monetarist explanations of banking crises have been sugested[1]. A number of internal and external factors such as capital flows, terms of trade shocks and exchange rates have been identified in the literature as contributory factors.

While most internal factors are within the control of banks, those relating to the external macro-economic and policy environments are beyond their control. These external influences could have a significant impact on banks' profitability. Changes in external factors such as the exchange rate, trade and capital flows, the rate of change of inflation and confidence in the government could seriously affect the performance and viability of a banking system.

This paper empirically focuses on the link between some of these internal and external factors that may have contributed to some of the crises in small open economies, (SOEs). Using information from existing studies, major banking crises over the last 20 years are

[1] Each of these major theories will be discussed briefly.

identified. Common macroeconomic factors that may have led to some of these crises are then use in a logistic modeling framework to ascertain the major determinants of banking crises. Particular emphasis is placed on the occurrence of terms of trade shocks, capital flows, bank lending and how they affect economies under different nominal exchange rate regimes.

The remainder of the paper is organized as follows. Section 2 discusses the theoretical literature on banking crises. Section 3 analyses case studies from the literature. The methodology used to define various banking crises is discussed in Section 4. Section 5 conducts the econometric estimation, and Section 6 concludes the analysis.

**Section 2. Theory of Banking Crisis**

We begin by discussing how a crisis is defined before conducting a brief review of the existing theory and empirical literature. Some commonly cited definitions include:

> "..liquidation of credits that have been built up in a boom. " Veblen (1904)
>
> `".. a sharp reduction in the value of banks' assets, resulting in the apparent or real insolvency of many banks and accompanied by some bank collapse and possibly some runs." Federal Reserve Bank of San Francisco (1985)
>
> "... situation in which a significant group of financial institutions have liabilities exceeding the market value of their assets, leading to runs and other portfolio shifts, collapse of some financial firms, and government intervention." Sundararajan and Balino (1991)
>
> ".. a non-linear disruption to financial markets in which adverse selection and moral hazard problems become much worse, so that financial markets are unable to efficiently channel funds to those who have the most productive investment opportunities. " Frederic Mishkin (1996)

Looking at these definitions, it can be ascertained that banking crises are both micro and macro economic in nature. In fact, the interaction of microeconomic and macroeconomic factors may explain a large number of banking crises in SOEs. The main theories used to analyze banking crises are the monetary approach to financial crises, the business cycle view and micro theoretic explanations of banking crises. We start with the monetary view and the role played by exchange rates.

**Monetary approach to financial crises**

The monetary approach emphasizes the role of money growth and its variability as the principal determinant of a crisis, Friedman and Schwartz (1963). According to this view, a financial crisis need not occur at any particular stage of the cycle, but could result from a change in the monetary base, such as a sudden and erratic tightening of reserve money, which may force financial enterprises to sell assets to meet reserve obligations. This may reduce asset prices, raise interest rates and threaten solvency. The key feature of the monetary approach is that a crisis is treated as an endogenous event precipitated by economic policy and the structure of the financial system.

**Role of policy - the exchange rate regime**

Since determinants of banking crises are analyzed as endogenous events caused by economic policy at the time of the crises, the choice of the exchange rate regime (fixed and flexible) could be a significant factor in the transmission process. Although the effects of exogenous shocks such as declines in asset prices, crises and stock market crashes are known to

“trigger'” financial crises, according to the monetary doctrine, these events are not assumed to influence financial crises independently of the effects of policies already in place.

By looking at the lending process of a bank from the view of a bank's balance sheet, the importance of the exchange rate regime can be illustrated. Under a fixed exchange rate regime, a foreign inflow raises international reserves and the money supply. Assuming part of this increase in foreign currency is not fully sterilized, bank deposits rise. As the nominal exchange rate is fixed, the price level rises to match this increase in money demand. Increased liquidity in the banking sector may lead to an expansion in credit. With the subsequent impact of a negative shock, such as a terms of trade or foreign interest rate shock on the economy, net foreign assets, the level of foreign reserves and a contraction of money supply and credit. The resultant higher interest rates would make it more difficult for borrowers to service their debts with the banking system leaving banks with a large amount of bad debt. If this is systematic across the financial sector, a banking crisis may result.

Under a flexible exchange rate, the money supply is exogenous. Any fall in net foreign assets would instead lead to a contraction in the demand for money. This would depreciate the currency and raise domestic prices, thus reducing the demand for real money balances. This in turn would reduce the real value of assets of the banking system (including loans given to the private sector), facilitating their repayment. However, on the other hand the real value of bank liabilities would also fall, lessening the impact of the negative outflow on banks. The key difference between the fixed and flexible exchange rate scenarios is that the adjustment in the fixed case comes via the money supply and the price level while under flexible

regimes, the adjustment comes via the exchange rate. This stresses the importance of the interaction of the exchange rate regime and banking sector when the transmission of external shocks and capital flows are analyzed in SOEs.

**Business cycle explanations of banking crises**

The business cycle approach looks at the vulnerability of a financial sector over the business cycle. The financial sector responds endogenously to movements in the business cycle, see Minsky (1977), Taylor and O'Connell (1985). A crisis develops due to systematic forces near the peak of the cycle as interest rates rises. Reduced lending by banks and high interest payments may adversely affect non-financial firms, increasing the likelihood of default. The entire financial sector may suffer after a surprise shock, such as news of a major bankruptcy.

Other external conditions could also affect assets of the banking sector. Terms of trade shocks could profoundly affect the profitability of firms and households in SOEs. This is particularly so in economies which rely on primary product exports. Unanticipated changes in the terms of trade could make exporters unable to discharge their debts, thereby leading to a deterioration in the balance sheets of the banking sector.

Sachs, Tornell and Velasco (1996) also argue that countries with a high proportion of short term debt may end up with a maturity mismatch due to sudden changes in interest rates and debt service requirements. Eichengreen and Rose (1998) make the point that this maturity mismatch is attenuated in developing countries where the average length of maturity is much shorter than in developed countries. Aligned to this is the problem of currency mismatch,

where a large proportion of loans is denominated in foreign currency, as exchange rate depreciation may severely increase the debt service requirement.

**Micro theoretic explanations**

The micro view comes from asymmetric information and credit market analysis. The most commonly discussed approach has been a credit rationing situation resulting from various market failures, Stiglitz and Weiss (1981). Due to asymmetric information and the adverse selection, banks may ration credit, creating problems for non-financial firms. Studies done by Calomiris and Garton (1991), Greenwald and Stiglitz (1988) and Bernanke and Gertler (1988) show that unanticipated shocks such as stock market crashes could lead to financial crises through the impact on the balance sheets of financial institutions. According to Mishkin (1996), the problems of moral hazard and adverse selection rise under such conditions. This comes about because banks normally require collateral before issuing loans. Collateral takes the form of assets or even the net worth of a firm. The higher the net worth, the lower the moral hazard and adverse selection problem as the lender has more to lose by defaulting on the loan. However, when the value of net worth declines, for example during a stock market crash, the moral hazard problem increases as lenders have less to lose by making a more risky investment.

Demirguc-Kunt and Detragiache (1997) (hereafter DKD (1997)) have argued that these problems of moral hazard and adverse selection are attenuated after financial liberalization in developing countries. While the benefits of financial liberalization have been well documented in theoretical and empirical work, hasty liberalization of often weak financial

sectors have known to create financial crises in subsequent years.[2] Deposit insurance schemes could also lead to reckless lending due to the implicit assurance of a bail out (Diamond and Dybvig, 1984).

**Section 3: Evidence of Banking Crises**

Banking crises have been common in both developed and developing countries. The main focus of the literature has been on developed economies, particularly the US. The US has had a considerable sequence of "bank runs" and crises over the last century, with the most notable being the banking crisis in 1931 during the Great Depression. The analysis of such crises have been well documented, see for example Benanke (1983), Hubbard (1991). There have been severe banking crises in other parts of the world in the post-war period. Spain experienced a severe crisis between 1977 and 1985, Finland (1991), Sweden (1991) and Norway (1988).

A large number of developing countries have also been subject to major crises over the last 20 years, with considerable costs attached. Studies by Caprio and Klingebiel (1996) and Honohan (1997) show that most Latin American countries experienced major problems in the 1980s. The main crises are listed in Table 1.

[2] See for example Diaz-Alexandro, on the pitfalls of speedy financial liberalization in Latin America. DKD (97) address this issue using cross country data and show that countries that liberalized with weak institutional and regulation frameworks were more susceptible to financial crises in subsequent years.

Chile had a major banking crisis between 1981 and 1983. Capital account liberalization attracted major capital inflows in the late 1970s. As bank liquidity rose, a lending boom ensued. However, since the exchange rate was pegged to the dollar, the real exchange rate also appreciated, making exports uncompetitive. A subsequent economic downturn led to a devaluation, followed by capital outflows. The debt servicing requirements for companies and banks which had borrowed in foreign currency rose in local currency terms, leading to several bank failures. As seen from Table 2, the resultant bailout amounted to 41% of GDP.

Similar events occurred in Venezuela, Brazil, Argentina and Mexico. Colombia managed to avoid a huge expansion in credit by choosing a crawling peg system, which basically allowed the real exchange rate to appreciate in response to capital inflows. In the 1990s, several East Asian countries kept faith in their fixed exchange rate pegs, up to the recent crisis, after which they had to be abandoned in Thailand, Indonesia and Korea. In Kenya, financial deregulation facilitated the entry of new banks, often with inadequate capital. This led to risky lending and deterioration in the balance sheet of the banking sector. The inability by a number of small banks to recover their loans resulted in a liquidity crisis and subsequent deposit run in the late 1980s. In Cote d'Ivoire, between 60-70% of assets in the banking system were affected after the four main state banks become insolvent. In Zambia, in contrast, although only one bank was affected, the resulting cost to the economy amounted to 1.4% of GDP and 13% of bank assets. Due to the small and concentrated nature of banking systems in developing countries, even a single bank failure can have tremendous effects on the economy.

**Section 4: Methodology used for crises**

Table 3 describes how crisis years for each country were assigned. The first category consists of studies where crisis years were explicitly stated, namely by Caprio and Klingebeil (1996) and DKD (1997). The second category list papers where banking crisis years were implicitly ascertained. Hausmann and Rojaz-Suarez , and Morriss *et a*l focused on Latin America. The study by Alexander *et al* was a global survey. These studies consisted of detailed analysis of banking crises and provided information relating to measures such as non-performing loans and the cost of restructuring. Although the data were not comprehensive, they provided an indication of the problems experienced in various countries and were useful in pinpointing crisis periods. When the crisis periods differed between the two categories of data, information from the studies discussing the crises implicitly were used. The rationale for this was that the second category of case studies had more detailed in-depth analysis of problems in the banking sector and therefore provided more accurate information relating to the exact occurrence of crises. As mentioned earlier, identification of crisis periods involves a large degree of subjective judgment and this study attempts to be consistent with this literature.

For example, Demiriguc-Kunt and Detragiache (1997) use one of the following four main thresholds to define a banking crisis. They are:

(i) that the ratio of non-performing loans to GDP must exceed 10% or

(ii) the cost of the rescue operation must be at least 2% of GDP or

(iii) there must be a large scale reorganization and nationalization of banks or

(iv) the enactment of various emergency measures, such as deposit freezes, prolonged bank holidays, deposit guarantees, etc.

While the first two thresholds involve quantitative measures, the use of qualitative measures implies a detailed knowledge of the history and dynamics of the financial sector concerned. It also involves a large subjective component. The methodology used in this paper is similar to the above mentioned study. Information from this and other studies will be used to define whether a crisis occurred or not. A crisis variable will be constructed using this information, which will be used in the econometric analysis to find the main determinants of such crises from a menu of explanatory variables.

**Section 5: Empirical Estimation**

**Econometric model**

The econometric model estimates the probability of a country experiencing a crisis using a logit model. A logit estimates whether or not an event occurs, or in this case whether a country experienced a crisis or not. We use the exposition by Baltagi (1995). The dependent variable is represented by a binary choice variable $y_{it} = 1.$ if the event happens and 0 if it does not happen for country *i* at time *t.* If $p_{it}$ is the probability that a crisis occurs, then $E(y_{it}) = 1.p_{it} + 0.(1-p_{it}) = p_{it}$. This is usually modeled as a function of some explanatory variables:

$$p_{it} = \Pr[y_{it} = 1] = E(y_{it} \mid x_{it}) = F'(x'_{it}\, b)$$

For the linear probability model, $F(x'_{it}\beta) = x'_{it}\beta$, the usual panel data methods apply except that $\hat{y}_{it}$ is not guaranteed to lie in the unit interval. According to Baltagi (1995) the standard solution has been to use the logistic or normal cumulative distribution functions that

constrain $F(x'_{it}\beta)$ to lie between 0 and 1. In this case, a country experiences a crisis if the explanatory variable(s) exceeds some unobserved threshold, i.e.

$$y_{it} = 1, \quad \text{if} \quad y^*_{it} > 0$$

$$y_{it} = 0, \quad \text{if} \quad y^*_{it} \# 0$$

where $y^*_{it} = x'_{it}\beta + u_{it,}$ so that

$$\Pr[y_{it} = 1] = \Pr[y^*_{it} > 0] = \Pr[u_{it} > -x_{it}'\beta] = F(x'_t\beta)$$

The last equality holds as long as the density function describing $F$ is symmetric around zero.

**Fixed effects estimation**

Moving from the pooled estimation, a useful extension of the analysis is the fixed effects estimation in order to take into account country characteristics. Chamberlin (1980) suggests a way of wiping out deviations from group means in a logit framework. Consider a large sample with $n$ observations, and $T$ time periods. Chamberlin (1980) suggests using the following conditional likelihood function to get a computationally convenient estimator:

$$L = \prod_{i=1}^{N} \Pr(y_{i1}, \ldots\ldots, y_{iT} \mid \sum_{t=1} y_{it}$$

This implies that the likelihood for each set of $T$ observations is conditioned on the number of 1s in the panel. By conditioning on the sum of observations, heterogeneity effects can be removed and a conditional likelihood function created from the product of those terms for which the sum is not zero or $T$. For example, let us consider the case where $T=2$; the unconditional likelihood is

$$L = \prod_{i=1}^{N} \Pr(y_{i1}) \Pr(y_{i2})$$

The sum $(y_{i1} + y_{i2})$ can be 0, 1 or 2. If it is 0, both $y_{i1}$ and $y_{i2}$ are 0 and

$$\Pr[y_{i1} = 0, y_{i2} = 0 \mid y_{i1} + y_{i2} = 0] = 1$$

Similarly, if the sum of both $y_{i1}$ and $y_{i2}$ are 1 and

$$\Pr[y_{i1} = 1, y_{i2} = 1 \mid y_{i1} + y_{i2} = 2 = 1]$$

Since log 1 =0, these terms add nothing to the conditional likelihood. Only observations for which $y_{i1} + y_{i2} = 1$ matter in log L are given by

$$\Pr[y_{i1} = 0, y_{i2} = 1 \mid y_{i1} + y_{i2} = 1]$$

and

$$\Pr[y_{i1} = 1, y_{i2} = 0 \mid y_{i1} + y_{i2} = 1]$$

The latter can be calculated as

$$\Pr[y_{i1} = 1, y_{i2} = 0 \mid \Pr[y_{i1} + y_{i2} = 1]$$

with

$$\Pr[y_{i1} + y_{i2} = 1] = \Pr[y_{i1} = 0, y_{i2} = 1] + \Pr[y_{i1} = 1, y_{i2} = 0]$$

since the latter two events are mutually exclusive. Therefore,

$$\Pr[y_{i1} = 1] = \frac{e^{u_i + x'_{it} b}}{1 + e^{u_i + x'_{it} b}}$$

This means that,

$$\Pr[y_{i1} = 1, y_{i2} = 1] y_{i1} + y_{i2} = 1] = \frac{e^{x'_{it} b}}{e^{x'_{it} b} + e^{x'_{i2} b}}$$

Similarly,

$$\Pr[y_{i1} = 0, y_{i2} = 1 \mid y_{i1} + y_{i2} = 1] = \frac{e^{x'_{i2}b}}{e^{x'_{it}b} + e^{x'_{i2}b}}$$

and neither probability involves $u$. By conditioning on $y_{i1} + y_{i2}$, the $u_i$ have been swept away. The product of the terms such as $y_{i1} + y_{i2} = 1$ gives the conditional likelihood function which can be maximized with respect to $b$. This can be generalized for any $T$. We now move to the estimation.

**The variables**

The dependent variable is the crises variable, which was constructed using data from various case studies (this was discussed in Table 3). The choice of explanatory variables depended on both theoretical assertions as well as data availability. The time period covered was from 1970 to 1992. The explanatory variables are described in Table A1 in the appendix. Table A2 shows the exchange rate regimes in operation at the time of substantial terms of trade shocks. The corresponding descriptive statistics are shown in Table A3.

**Measuring external shocks**

The impact of shocks is captured by the terms of trade and capital inflows. Unanticipated terms of trade shocks are measured by the deviation of the terms of trade from its long run trend and is a percentage term. This variable is further disaggregated into positive and negative shocks in subsequent sensitivity analysis. The "size" of these shocks is therefore regressed against the crisis variable. The impact of capital inflows is captured by the capflow

variable, the ratio of capital flows to GDP. Capital flows consist of net long term debt flows (commercial and public), net foreign direct investment flows and portfolio flows without aid flows.

**Financial variables**

With the lifting of controls on interest rates and directed credit, evidence from case studies points to lending booms with the proliferation of new banks. A corollary of this may be a worsening of financial fragility, especially if undertaken without adequate institutional development, DKD (1997). The literature uses a number of variables to proxy for financial liberalization. An obvious choice is lending itself (LEND), which is private sector credit from the banking sector expressed as a percentage of GDP. To test whether sudden capital outflows lead to liquidity crises, the ratio of M2 money to foreign reserves is introduced, (M2RESRVES). This is argued to be a good measure of a country's vulnerability to a balance of payments crisis.

**Debt composition**

The composition of debt stocks has received much attention lately. The portfolio composition of capital, the maturity structure has become one of the most closely studied indicators, see for example Sachs et al (1996). This has become particularly significant for countries with a heavy concentration of short term debt, where sudden changes in foreign interest rates could increase the debt service burden almost immediately. It is worth investigating if the particular composition of debt could affect the likelihood of a crisis.

**Policy variables**

Inflation is introduced as it is normally associated with mismanagement of the economy. Other policy variables that were used include the fiscal deficit and various measures of nominal exchange rate in the sensitivity analysis. The real exchange rate (REER) was used to test for overvaluation. Real GDP growth was regressed to investigate whether fluctuations in growth led to banking crises or if banking crises affected growth. In order to distinguish between the causes and consequences, lagged values of the real GDP variable were used in the predictive model, as well as different definitions of banking crises.

**Results**

Various models using different definitions of variables, such as interactive dummy variable terms and crisis definitions were estimated. It must be emphasized that interpretation of the coefficients on logit regressions are not straightforward, as their values depend not only on the slope but also on their initial conditions. The baseline case is discussed first.

**Baseline model**

Table 4 shows the results from the baseline case[3]. The coefficients and associated z-statistics are shown in the first two columns. Diagnostic tests are shown at the bottom of the table together with joint hypothesis tests for the shock, macro and financial effects. Finally, tabulations of actual and predicted values are reported for each regression. Overall, the pooled results have a low explanatory power. However, the levels are similar to those found

[3] The models were estimated using Stata, (version 5).

in the literature, for example Eichengreen and Rose (1998). Of the macro variables, the contemporaneous growth rate is highly significant. A fall in real income could be one of the factors that may lead to a crisis. However, this is not as conclusive, as causality may run in the other direction. As will be shown in the next table, lagged values of variables are used in a predictive model to investigate this possibility.

Coming to the other macro variables, the inflation term was insignificant, while the real exchange rate (Reer) term was significant and negatively associated with crises. This implies that real exchange rate appreciations increases the probability of banking crises. The ratio of foreign debt to GDP was highly significant. Furthermore, the average rate of interest faced by a country on its foreign debt (Avindebtgdp), was also significant. Sudden increases in debt service requirements severely increased the probability of banking crises, supporting Sachs et al.(1996), that debt maturity mismatches could generate banking crises. Although DKD (1997) also find real interest rates to be significant, the interest rate used in this study applies to the debt stock outstanding for that particular country, and changes in this variable are more appropriate as an indicator of a crisis than a general interest rate. Coming to the shock variables, the term on the trade shock variable was positive, but not significant, though the trend term was significant. Capital inflows were also not significant. The other significant variable is the ratio of M2 money to international reserves. The results suggest that the probability of a crisis is significantly enhanced with a low level of reserves, i.e. a sudden capital outflow could seriously undermine the banking system. This again confirms previous work done with similar measures, see for example Calvo and Leiderman (1993). Looking at the diagnostic statistics, the test for joint significance for the aggregate effects was jointly

significant in the baseline model. From the table of actual and predicted outcomes, at a cut-off probability of 0.5%, 12 out of 22 cases were correctly predicted as having crises and 573 out of 652 cases were correctly predicted as not having crises in the baseline model, i.e. in total 86% of the cases were correctly classified.

**Shocks and choice of exchange regime**

The relationships between nominal exchange rate regimes and shocks was conducted to investigate the nature of the monetary transmission channel. Using the IMF definition, three broad categories of nominal regimes were identified. They were broadly classified into fixed pegs, intermediate regimes and floating systems. Dummy variables were created for each year for the three types of regime. These in turn were interacted with the shock variables. For example, if Kenya experienced a positive external shock in 1979, and the exchange rate regime in operation was a fixed peg, then the interactive dummy for the fixed exchange rate and the external trade shock, (Fixshock), took a value of one multiplied by the shock variables, and zero for other years. This differs from the Eichengreen and Rose study, which employs [1,0] dummy variables for each regime. The question posed in this study is more specific, as the aim is to investigate how different regimes interacted with external inflows.

The results in the second regression in Table 4 also support the priors on the effects of volatility of trade shocks on the macro economy. Terms of trade shocks that enter through floating exchange rate regimes decrease the probability of banking crises. For intermediate and pegged regimes, the results are diametrically opposite, where shocks significantly increase the probability of crises. The results are less conclusive for capital inflows, though

the interactive variable on the floating exchange rate term is negative and significant. An interpretation could be that capital flows entering through floating exchange rate regimes are less likely to cause crises. These results again support the assertions made in the theory regarding the transmission of external inflows and their monetary consequences. It was suggested that under fixed exchange rate regimes, external inflows would have a greater effect on monetary growth, particularly on the supply side. These real and monetary effects were supposed to be greater under fixed exchange rate regimes than under more flexible ones. For example, a large amount of lending could lead to potential non-performing loans, making fixed exchange rate regimes more fragile and vulnerable to future problems in the banking sector. This is what the signs in the interacted shocks and capital flows terms seem to be suggesting, i.e. shocks and capital inflows going though floating regimes had a lower probability of creating a crisis in subsequent years (with a negative sign), than shocks that went through more rigid regimes which had a positive sign on the coefficients. Coming to the diagnostics, the combined macro, shock and financial effects were jointly significant. In the goodness-of-fit table, 576 out of the 645 cases were correctly predicted as not having a crisis, and 16 out of the 29 cases were predicted as having crises, i.e. (87%) of the case were correctly classified. However, as will be shown, the choice of exchange rate regime is not the sole determinant of banking crises. The conjunctural effects of fiscal management, institutional strength and bank supervision also have a significant impact on banks.

**Role of institutions**

Since theoretical foundations concerning asymmetric information and moral hazard are linked to institutional structure, the level of “financial institutional development'” could

significantly affect banking crises. Unfortunately, data on institutional development, such as connected lending, corruption, bureaucracy, prudential regulations and supervision, are non-existent for such panel purposes. The closest proxies available were the Bureaucratic Delay Index from the Business Environmental Risk Intelligence (BERI) organization, and the International Country Risk Guide (ICRG) measures on infrastructure.

The variables consisted of indices specifying different levels of infrastructure, ranging from 0 to 4. Higher values imply deterioration in the quality of the index. However, complete data for all the countries were not available, with data missing for most of the 1970s and for the entire period for some countries. This reduced the sample size to 222 observations. The infrastructure index was interacted with the lending variable (LENINFRA) to proxy how poor levels of institutions such as prudential regulation and banking supervision might have led to excessive lending. The signs on the coefficient imply that the level of infrastructural development could affect the probability of banking crises through bank lending, i.e. low levels of institutions increase lending booms and the likelihood of crises. Interacting the bureaucratic variable with lending (LENBUR) did not yield significant results. The signs on the other key variables such as real income, and shock variables were significant for the institutions equation. The other significant variable is the lagged ratio of M2 money to international reserves. DKD (1997) also use an institutional variable in their study, where a law and order variable measuring the quality of law enforcement (proxying corruption) was highly significant, i.e. a higher value in the index implies a higher level of law and order which decreases the probability of crises.

From the table of predictions, 14 out of the 21 cases were correctly predicted as having a crisis, while 169 out of the 200 cases were correctly predicted as not having crises, implying in total that 83% of all the cases were correctly called. However, these results must be treated with caution due to the small sample size. The models were then subjected to a range of robustness and sensitivity tests.

**Predictive model**

Lagged values of the explanatory variables were used as proxies to test if they correctly predicted the crises. Although lagging the variables can be viewed as overly simplistic, this method is the most cited in the literature, see for example Frankel and Rose (1996). Results more or less confirm the evidence from the baseline model. The average rate of interest variable, debt to GDP ratio and M2 to GDP were all correctly signed and significant. Eichengreen and Rose (1998) also find high debt to GDP ratios and high foreign interest rates to be significant predictors of crises. The lagged value of capital flows is a significant predictor of impending problems. In the disaggregated shocks model, the effects of shocks going through floating exchange rate regimes reduced the likelihood of a crisis. While the lagged floatcap term became insignificant, the value of the intermediate interactive term became highly significant. Coming to the test of joint significance, only the macro effects were rejected at the 3% and 4% levels. Furthermore, 11 out of 23 outcomes were correctly predicted as having crises and 533 out of 611 were predicted as not having crises, yielding a combined 84% percentage of correctly predicted outcomes for the baseline variant. By the same token, 88% of cases were correctly predicted in the disaggregated model.

**Robustness**

Various tests for robustness of the models were conducted. Regional dummy variables were introduced to validate the results obtained in previous regressions. The results more or less remain unchanged as shown by the Table 6. Both regional dummies were insignificant. The tests for joint significance also suggest robust results except for the institutions regressions, where the joint test for shock effects is rejected at the 5 and 10 per cent levels. Finally, looking at the goodness-of-fit tables, high levels of predicted outcomes were obtained. The coefficient on the real income term remains significant. However, the real exchange rate becomes significant in the second equation, suggesting that the causality in adjustment runs from the crisis to the real exchange rate in this version of the analysis. Both the ratio of M2 to reserves and debt to GDP become significant "during'" the crisis. The average interest rate faced by countries on the other hand loses significance. Looking at the specification of the model, the joint significance tests are rejected at the 5% level suggesting that the second model gives a better fit.

**Sensitivity analysis - different treatment of crisis years**

Two variations of crisis years were used in the sensitivity analysis to distinguish the feedback effects from an on-going crisis and those factors that influenced the build-up to the crisis. From Table 7, in the first equation, all years after the first year of the crisis are deleted. In the second equation, all years after the occurrence of the entire crisis are deleted. Although both methods resulted in a significant loss in observations, some interesting results emerge.

**Foreign Debt composition**

In order to test if different types of debt had varying implications, various debt classifications were used to decompose the total debt variable. The data was derived from the Frankel and Rose (1996) work. Five definitions of debt were used to decompose (Debtgdp), namely the ratio of long term debt to GDP (Longdebtgdp); ratio of commercial debt to GDP, (Comdebtgdp); ratio of concessional debt to GDP, (Condebtgdp); ratio of variable interest debt to GDP (Vardebt); public debt to GDP, (Pubdebtgdp); and the ratio of short term debt to GDP, (Shodebtgdp). Results are shown in Table 8, starting with the baseline model.

As seen, only the long term and short term debt definitions were important. They had the expected sign and support the view that excessive levels of debt, especially short term debt, could led to problems in the banking sector, while concessional debt is unlikely to induce crises. These results again are in line with those found in the literature, for example by Sachs et al. (1996) and by the Eichengreen and Rose. While Eichengreen and Rose they find short-term debt to be a significant indicator of a crisis, they find that concessional debt also leads to crises. One would normally expect the opposite, i.e. commercial debt to be more detrimental due to higher interest payments and a shorter grace period. The signs on the interacted terms of trade shock variables again had the expected signs in the first equation, where more flexible regimes lessened the likelihood of a crisis. The other two equations use different definitions of the crisis periods. Again the results support the underlying story looking at the first and last equation. When all the post-crisis years were deleted in the last equation, the signs on the interacted shock variables remained unchanged. Only the interaction between capital flows and fixed regimes had a sign contrary to what was expected.

**Fixed effects specification**

Fixed effects model of the logit were also modeled following Chamberlin (1980). Only those countries which experienced crises were included. This was done to see if country characteristics mattered and if the results held through the fixed effects estimation. The first model estimated was the shocks model with exchange rate interactions. Then sensitivity analysis of the crisis variable was carried out following the definitions used previously. The fixed effects results are reported in Table 9 and corroborate some of the findings from the pooled results. The interactive shock terms survive the fixed effects estimation. The capital flow variable is significant but negative in sign. The effects on the financial variables all have robust effects on the fixed effects estimation. However, the significance of the real income growth term diminishes. Of the test for joint significance, only the effects of the macro variables were rejected in the shocks model. However coming to the other two models, all the tests of joint significance are rejected when the first definition of crisis was used, while only the financial effects mattered in the second definition.

**Section 5: Conclusion**

This paper examined various determinants of banking crises. The results point to a strong association between the incidence of external shocks and the occurrence of banking crises in SOEs. Key macroeconomic factors such as negative income shocks, level of debt and the real exchange rate were decisive determinants of crises. In particular, countries with high levels of external debt, particularly short term debt were more likely to have banking crises than countries which relied on concessional borrowing. Both terms of trade shocks and capital

flows were significant predictors of crises. Some of these factors were also conditioned by the nature of the policy environment in place, in particular the exchange rate regime. This was more profound in cases that where external inflows were channeled through fixed or rigid exchange rate regimes. In particular, negative trade shocks, were responsible for a large number of banking crises in the sample. Shocks that were transmitted through more flexible exchange rate regimes caused less problems to the banking sector.

While externally driven factors played a leading role in this process, various other internal disturbances and institutional factors also led to banking crises in SOEs. When low levels of infrastructure and bureaucratic delay were interacted with bank lending, the likelihood of banking crises increased. The problem was more acute under rigid exchange rate regimes. These results imply that the choice of the exchange rate regime is not the sole determinant of banking crises. In fact, policies underlying a particular regime have an interactive and significant effect on bank performance, especially with respect to fiscal management, institutional strength and bank supervision.

Table 1: Developing Country Banking Crises - Post 1970

| Country | Extent of banks affected |
|---|---|
| Cameroon | High proportion of loans written off |
| Chile | 7 commercial banks, 1 finance company affected |
| Colombia | 6 banks affected |
| Cote D'Ivoire | 4 big banks insolvent |
| Ecuador | one bank liquidated, one take over |
| Egypt | 5 banks affected |
| Gabon | state banks affected |
| Ghana | 7 banks insolvent |
| Honduras | 12 banks affected |
| Jordan | large number of banks affected |
| Kenya | 4 banks, 24 non-bank firms in distress |
| Malawi | Lending to agricultural parastatsals |
| Malaysia | 4 banks insolvent, 24 others affected |
| Mauritania | S major banks |
| Mexico | 29 banks closed or merged |
| Nigeria | half banks in distress |
| Philippines | 8 banks, 32 thrifts, 128 small banks |
| Senegal | 6 commercial banks and 1 development bank |
| Sri Lanka | 4 state owned banks |
| Tanzania | most of banking system insolvent |
| Thailand | 24 finance companies closed, 3 commercial banks affected |
| Uganda | SO% of banks in distress |
| Uruguay | numerous banks affected |
| Venezuela | many banks were affected, including US branches |
| Zambia | Meridian Bank became insolvent |

Source: Caprio and Klingebiel (1996), Sundararajen and Balino (1991)

Table 2: Nature of Developing Country Banking Crises

| Country | Cause(s) | Costs of restructuring |
|---|---|---|
| Cameroon | oil shock | |
| Chile | high RER & interest rates, tot shock, | 41.2%% of GDP |
| | asset bubble, wage rigidity | 45% of financial assets |
| Colombia | bad lending & management, low growth | 25% of assets, 5% of GDP |
| | high debt, poor regulations k institutions | |
| Cote d'Ivoire | tot shock, inadequate | 60-70% of banking assets |
| | supervision, high RER | 25% of GDP |
| Ecuador | recession, high debt levels and interest rates | na |
| Egypt | oil shock | 4.9% of GDP |
| Gabon | oil shock | 5.6% of GDP |
| Ghana | poor regulations, supervision, devaluation | 6% of GDP |
| Honduras | inadequate monitoring | na |
| Jordan | fall in private capital inflows | na |
| Kenya | tot shocks, drought, connected lending, | 15% of liabilities |
| | insufficient capitalized banks, rules | |
| Malawi | poor regulations and lending | na |
| Malaysia | tot shocks, fall in asset prices | 7.7% of deposits, 4.7% of GDP |
| Mauritania | tot shock | na |
| Mexico | excessive borrowing, high interest rates | 2.3% of GDP |
| Nigeria | poor regulations, debt overhand | 20% of bank assets |
| Philippines | tot shocks, bad lending | 5.2% of deposits, 3% of GDP |
| Senegal | tot shock, drought, | 20-30% of financial assets |
| | poor supervision | 17% of GDP |
| Sri Lanka | tot shocks, poor lending and regulation | 35% of loan portfolio, 5% of GDP |
| Tanzania | excessive parastatal lending | 10% of GDP |
| Thailand | poor management & regulations | 25% of assets |
| | oil shock, | 0.7% of GDP |
| Uganda | bad lending | na |
| Uruguay | fall in beef prices, high interest rates, | na |
| Venezuela | financial liberalization, poor loans, | 13% of GDP, 30% of deposits |
| Zambia | poor management and regulations | 13% of commercial bank assets |
| | | cost - 1.4% of GDP |

Sources: Caprio and Klingebiel (1996)
na- data not given in case studies

Table 3: Definition of Banking Crises

| Country | Sources of Crisis Years | | | | | | |
|---|---|---|---|---|---|---|---|
| | Crisis Years Explicitly Stated | | Crisis years implicitly ascertained from case studies | | | | |
| | Caprio & Klingebeil | Demirgu-Kunt & Detragiache | Sundararajan & Balino | Hausmann & Rojas-Suarez | Morris et al$_1$ | Alexander et al$_2$ | Crisis years used |
| Cameroon | 1987-90 | | | | | 1986-90 | 1986-90 |
| Chile | 1981-83 | | 1981-84 | | | | 1981-84 |
| Colombia | 1982-87 | | | 1982-85 | | | 1982-85 |
| Cote D'Ivoire | 1988-91 | | | | | 1987-92 | 1987-92 |
| Ecuador | early 1980s | | | | 1984-88 | | 1984-88 |
| Egypt | 1987-92 | | | | | 1987-92 | 1987-92 |
| Gabon | | | | | | 1986-90 | 1986-90 |
| Ghana | 1982-89 | | | | | 1982-90 | 1983-90 |
| Honduras | | | | | 1983-92 | | 1983-92 |
| Jordan | | | | | | 1989-90 | 1989-90 |
| Kenya | 1985-89 | | | | | | 1986-89 |
| Malawi | | | | | | 1981-85 | 1981-85 |
| Malaysia | 1985-88 | 1985-88 | | | | 1986-88 | 1985-88 |
| Mauritania | 1984-93 | | | | | | 1988-92 |
| Mexico | 1981-82 | 1982 | | | | | 1982 |
| Nigeria | 1990s | 1991-94 | | | | | 1990-92 |
| Philippines | 1981-87 | 1981-87 | 1981-87 | | | | 1981-87 |
| Senegal | 1988-91 | 1983-88 | | | | | 1984-88 |
| Sri Lanka | 1989-93 | 1990-93 | | | | | 1990-92 |
| Tanzania | 1987 | 1988-94 | | | | | 1988-92 |
| Thailand | 1983-87 | | 1983-87 | | | 1983-87 | 1983-87 |
| Uganda | 1994 | 1990-94 | | | | | 1990-92 |
| Uruguay | 1981-84 | 1981-85 | 1981-86 | | | | 1981-86 |
| Venezuela | 1980 | 1993-94 | | | | | 1980-81 |
| Zambia | 1991-95 | | | | | | 1991-92 |

Table 4: Logit regressions

| | Baseline model | | External shocks | | Institutions | |
|---|---|---|---|---|---|---|
| Dep. var: Crises | *dF(x)/x* | \|z\| | *dF(x)/x* | \|z\| | *dF(x)/x* | \|z\| |
| Constant | 6.527 | 2.737 | 8.315 | 3.418 | -4.928 | 1.092 |
| **Macro variables** | | | | | | |
| Rgdpgr | -4.732 | 2.290 | -5.055 | 2.372 | -12.544 | 2.608 |
| Inflation | -0.076 | 0.153 | -0.113 | 0.219 | -3.419 | 2.228 |
| Reer | -0.005 | 2.240 | -0.005 | 2.272 | 0.008 | 0.547 |
| **Financial variables** | | | | | | |
| Lend | 0.608 | 0.809 | 0.848 | 1.103 | 2.753 | 0.557 |
| M2res | 0.028 | 2.54 | 0.025 | 2.294 | -0.912 | 0.428 |
| Debtgdp | 0.492 | 3.496 | 0.699 | 5.091 | 2.167 | 2.937 |
| Avintdebt | 0.113 | 2.234 | 0.100 | 1.985 | 0.076 | 0.846 |
| **Shock variables** | | | | | | |
| Tot trend | -1.974 | 3.785 | -2.368 | 4.324 | 0.343 | 0.356 |
| Trade shock | 0.089 | 1.096 | | | -0.035 | 2.042 |
| Capflow | 2.080 | 1.357 | | | 0.241 | 0.051 |
| Floatshock | | | -0.088 | 3.838 | | |
| Intershock | | | 0.036 | 2.372 | | |
| Fixedshock | | | 0.018 | 2.020 | | |
| Floatcap | | | -19.976 | 1.941 | | |
| Intercap | | | 8.456 | 1.289 | | |
| Fixedcap | | | -2.991 | 0.945 | | |
| Lenbure | | | | | -7.065 | 2.481 |
| Leninfra | | | | | 5.604 | 1.790 |
| Pseudo R squared | 0.147 | | 0.1934 | | 0.227 | |
| No of observations | 674 | | 674 | | 222 | |
| | | Prob | | Prob | | Prob |
| H0: Slopes =0 | $\chi^2(10)= 78.59$ | 0.00 | $\chi^2(14)=76.84$ | 0.00 | $\chi^2(12)=50.1$ | 0.00 |
| H0: Macro effects=0 | $\chi^2(3)110$ | 0.01 | $\chi^2(3)= 11.82$ | 0.01 | $\chi^2(3)=10.82$ | 0.01 |
| H0: Financial effects=0 | $\chi^2(4)= 26.51$ | 0.00 | $\chi^2(4)= 35.94$ | 0.00 | $\chi^2(5)=7.65$ | 0.17 |
| H0: Shock effects =0 | $\chi^2(3)=18.55$ | 0.00 | $\chi^2(7)= 38.41$ | 0.00 | $\chi^2(3)=5.92$ | 0.12 |

| Goodness of fit models | | (Cut off probability 0.5) | | |
|---|---|---|---|---|
| | | Crisis | No Crisis | Total |
| Baseline model | Predicted Crisis | 12 | 10 | 22 |
| | Predicted no Crisis | 79 | 573 | 652 |
| | Total | 91 | 583 | 674 |
| Shocks model | Predicted crisis | 16 | 13 | 29 |
| | Predicted no crisis | 75 | 576 | 645 |
| | Total | 91 | 583 | 674 |
| Institutions model | Predicted crisis | 14 | 7 | 21 |
| | Predicted no crisis | 31 | 169 | 200 |
| | Total | 45 | 176 | 221 |

Table 5: Predictive models

| | Baseline | | External shocks | |
|---|---|---|---|---|
| Dep. var: Crises | *dF(x)/x* | \|z\| | *dF(x)/x* | \|z\| |
| Constant | 5.201 | 2.148 | 6.147 | 2.324 |
| **Macro variables** | | | | |
| Lagdpgr | -4.689 | 2.227 | -5.453 | 2.441 |
| Lainflation | -0.143 | 0.292 | -0.529 | 0.855 |
| Lareer | -0.003 | 1.681 | -0.003 | 1.524 |
| **Financial variables** | | | | |
| Lalend | 0.139 | 0.175 | 0.137 | 0.157 |
| LaM2res | 0.027 | 2.423 | 0.030 | 2.567 |
| Ladebtgdp | 0.423 | 2.959 | 0.504 | 3.045 |
| Lavintdebt | 0.158 | 3.098 | 0.161 | 2.920 |
| **Shock variables** | | | | |
| Latot trend | -1.777 | 3.367 | -2.01 | 3.496 |
| Latrade shock | 0.003 | 0.357 | | |
| Lacapflow | 3.560 | 2.192 | | |
| Lafloatshock | | | -0.134 | 4.093 |
| Laintershock | | | 0.014 | 0.749 |
| Lafixedshock | | | 0.014 | 1.522 |
| Lafloatcap | | | -6.645 | 1.070 |
| Laintercap | | | 14.945 | 4.135 |
| Lafixedcap | | | 2.796 | 1,379 |
| Pseudo R squared | 0.1363 | | 0.2276 | |
| No of observations | 634 | | 634 | |
| | | Prob | | Prob |
| HO: Slopes = 0 | $\chi^2$ (10)= 56.93 | 0.00 | $\chi^2$ (14)=73.61 | 0.00 |
| HO: Macro effects 0 | $\chi^2$ (3)=8.31 | 0.04 | $\chi^2$ (3) = 9.17 | 0.03 |
| HO: Financial effects 0 | $\chi^2$ (4)= 25.91 | 0.00 | $\chi^2$ (4)= 26.03 | 0.00 |
| HO: Shock effects = 0 | $\chi^2$ (3)=19.79 | 0.00 | $\chi^2$ (7)= 45.81 | 0.00 |

| Goodness of fit models | | (Cut off probability 0.5) | | |
|---|---|---|---|---|
| | | Crisis | No Crisis | Total |
| Predictive model | Predicted Crisis | 11 | 12 | 23 |
| | Predicted no Crisis | 78 | 533 | 611 |
| | Total | 89 | 545 | 634 |
| Shocks model | Predicted crisis | 23 | 12 | 35 |
| | Predicted no crisis | 66 | 533 | 599 |
| | Total | 89 | 545 | 634 |

Table 6: Robustness

| | Baseline model | | External shocks | | Institutions | |
|---|---|---|---|---|---|---|
| Dep. var: Crises | *dF(x)/x* | \|z\| | *dF(x)/x* | I z I | *dF(x)/x* | \|z\| |
| Constant | 7.523 | 3.069 | 9.307 | 3.662 | -5.62 | 1.201 |
| **Macro variables** | | | | | | |
| Rgdpgr | -5.371 | 2.515 | -5.496 | 2.519 | -12.964 | 2.620 |
| Inflation | -0.116 | 0.225 | -0.133 | 0.255 | -3.377 | 2.134 |
| Reer | -0.006 | 2.508 | -0.006 | 2.479 | 2 | 0.676 |
| **Financial variables** | | | | | | |
| Lend | 0.203 | 0.252 | 0.625 | 0.768 | 4.189 | 0.785 |
| M2res | 0.034 | 2.894 | 0.029 | 2.507 | -0.037 | 0.114 |
| Debtgdp | 0.465 | 3.180 | 0.684 | 4.935 | 2.182 | 2.859 |
| Avintdebt | 0.110 | 2.508 | 0.089 | 1.634 | 0.079 | 0.740 |
| **Shock variables** | | | | | | |
| Tot trend | -2.03 | 3.840 | -2.44 | 4.422 | 0.543 | 0.536 |
| Trade shock | 0.009 | 1.111 | | | -0.369 | 2.164 |
| Capflow | 2.763 | 1.716 | | | 1.372 | 0.247 |
| Floatshock | | | -0.084 | 3.606 | | |
| Intershock | | | 0.035 | 2.364 | | |
| Fixedshock | | | 0.019 | 2.046 | | |
| Floatcap | | | -19.993 | 1.930 | | |
| Intercap | | | 8.03 | 0.214 | | |
| Fixedcap | | | -2.928 | 0.902 | | |
| Lenbure | | | | | -7.616 | 2.591 |
| Leninfra | | | | | 5.039 | 1.564 |
| Africa | -0.807 | 1.267 | -0.561 | 1.500 | | |
| Latin America | -0.373 | 0.960 | -0.193 | 0.463 | | |
| Pseudo R squared | 0.157 | | 0.1984 | | 0.225 | |
| No of observations | 674 | | 674 | | 221 | |
| | | Prob | | Prob | | Prob |
| HO: Slopes = 0 | $\chi^2$ (12)= 66.48 | 0.00 | $\chi^2$ (14)=77.42 | 0.00 | $\chi^2$ (14)=35.01 | 0.00 |
| HO: Macro effects 0 | $\chi^2$ (3) = 13.2 | 0.00 | $\chi^2$ (3)= 13.34 | 0.00 | $\chi^2$ (3)=10.56 | 0.01 |
| HO: Financial effects 0 | $\chi^2$ (4) = 24.81 | 0.00 | $\chi^2$ (4)= 37.14 | 0.00 | $\chi^2$ (4)=13.31 | 0.01 |
| HO: Shock effects = 0 | $\chi^2$ (3) = 19.92 | 0.00 | $\chi^2$ (7)= 34.29 | 0.00 | $\chi^2$ (3) =6.02 | 0.11 |
| HO: Institu. effects = 0 | | | | | $\chi^2$ (2) =6.73 | 0.03 |

| Goodness-of-fit: (cut-off probability 0.5) | Crisis | No Crisis | Total |
|---|---|---|---|
| Baseline Crisis | | | |
| Predicted crisis | 12 | 8 | 20 |
| Predicted no crisis | 79 | 575 | 674 |
| Total | 91 | 583 | 674 |

Table 7: Definitions of crises

| | All years after 1st crisis year deleted | | All years after entire crises episode deleted | |
|---|---|---|---|---|
| Dep. var: Crises | *dF(x)/x* | \|z\| | *dF(x)/x* | \|z\| |
| Constant | 3.72 | 0.83 | 8.70 | 3.48 |
| **Macro variables** | | | | |
| Rgdpgr | -7.92 | 2.18 | -5.69 | 2.66 |
| Inflation | 0.22 | 0.37 | 0.15 | 0.33 |
| Reer | 0.00 | 0.48 | -0.01 | 2.70 |
| Financial variables | | | | |
| Lend | -0.09 | 0.06 | 1.00 | 1.26 |
| Nl2res | 0.02 | 1.01 | 0.02 | 2.10 |
| Debtgdp | 0.38 | 1.46 | 0.71 | 5.18 |
| Avintdebt | 0.22 | 2.46 | 0.09 | 1.76 |
| **Shock variables** | | | | |
| Tot trend | | | -2.38 | 4.31 |
| Floatshock | -0.07 | 2.03 | -0.09 | 3.66 |
| Intershock | -0.03 | 0.66 | 0.03 | 1.96 |
| Fixedshock | 0.02 | 1.44 | 0.02 | 2.08 |
| Floatcap | -1.92 | 0.14 | -20.02 | 2.03 |
| Intercap | 3.43 | 0.44 | 6.25 | 0.94 |
| Fixedcap | 4.24 | 0.77 | -3.50 | 1.07 |
| Psedo R squared | 0.15 | | 0.09 | |
| No of observations | 540.00 | | 618.00 | |
| | | Prob | | Prob |
| HO: Slopes = 0 | $\chi^2$ (14)=24.78 | 0.04 | $\chi^2$ (14) =77.75 | 0.00 |
| HO: Macro effects 0 | $\chi^2$ (3) = 5.49 | 0.13 | $\chi^2$ (3)=15.42 | 0.00 |
| HO: Financial effects 0 | $\chi^2$ (4) = 9.45 | 0.05 | $\chi^2$ (4) =35.89 | 0.00 |
| HO: Shock effects = 0 | $\chi^2$ (7)= 11.44 | 0.12 | $\chi^2$ (3)=37.21 | 0.00 |

Goodness of fit models (cut-off probability = 0.5)

| **Shocks** | Crisis | No Crisis | Total |
|---|---|---|---|
| Predicted crisis | 19 | 14 | 22 |
| Predicted no crisis | 72 | 569 | 641 |
| **Total** | 91 | 583 | 674 |
| **Institutions Crisis** | | | |
| Predicted crisis | 17 | 7 | 24 |
| Predicted no crisis | 28 | 169 | 197 |
| **Total** | 45 | 176 | 221 |
| **Sensitivity analysis** | | | |
| Predicted crisis Eq 1 | 1 | 0 | 1 |
| Predicted -no crisis | 21 | 518 | 539 |
| **Total** | 22 | 518 | 540 |
| **Predicted crisis Eq 2** | | | |
| Predicted crisis | 22 | 16 | 38 |
| Predicted no crisis | 69 | 511 | 580 |
| **Total** | 91 | 527 | 618 |

Table 8: Debt decomposition

| | Main model | | All years after Ist crisis year deleted | | All years after entire crises episode deleted | |
|---|---|---|---|---|---|---|
| Dep. var: Crises | *dF(x)/x* | \|z\| | *dF(x)/x* | I z I | *dF(x)/x* | \|z\| |
| Constant | 5.88 | 2.14 | 3.19 | 0.60 | 6.42 | 2.28 |
| **Macro variables** | | | | | | |
| Rgdpgr | -4.58 | 1.99 | -7.89 | 1.83 | -5.30 | 2.24 |
| Inflation | -1.11 | 1.43 | 0.06 | 0.07 | -0.99 | 1.19 |
| Reer | 0.00 | 1.06 | 0.00 | 0.06 | 0.00 | 1.23 |
| **Financial variables** | | | | | | |
| Lend | -0.40 | 0.46 | -0.58 | 0.36 | -0.39 | 1.43 |
| M2res | 0.02 | 1.21 | 0.01 | 0.55 | 0.01 | 0.75 |
| Londebtgdp | 5.79 | 2.18 | 1.31 | 0.26 | 3.94 | 1.43 |
| Comdebtgdp | -3.74 | 1.31 | -8.24 | 1.27 | -5.02 | 1.53 |
| Condebtgdp | -0.72 | -0.50 | 4.92 | 1.60 | 0.21 | 0.14 |
| Vardebtgdp | 0.47 | 0.16 | 7.83 | 1.23 | 3.34 | 0.97 |
| Pubdebtgdp | -2.78 | 1.19 | -1.47 | 0.32 | -1.67 | 0.70 |
| Shodebtgdp | 0.03 | 1.95 | 0.02 | 0.91 | 0.03 | 1.95 |
| Avintdebt | 0.22 | 3.18 | 0.49 | 3.48 | 0.21 | 2.94 |
| **Shock variables** | | | | | | |
| Tot trend | -2.22 | 3.66 | -2.37 | 1.98 | -2.28 | 3.68 |
| Floatshock | -0.07 | 2.69 | -0.07 | 1.82 | -0.06 | 2.38 |
| Intershock | 0.03 | 1.69 | -0.02 | 0.33 | 0.03 | 1.35 |
| Fixedshock | 0.02 | 1.85 | 0.03 | 1.93 | 0.02 | 2.11 |
| Floatcap | -17.36 | 1.71 | -10.12 | -0.70 | -15.83 | 1.64 |
| Intercap | -2.48 | 0.31 | -18.51 | 1.67 | -6.42 | 2.28 |
| Fixedcap | -5.06 | 1.55 | -1.82 | 0.33 | -6.33 | 0.73 |
| R squared | 0.27 | | 0.23 | | 0.28 | |
| No of observations | 674 | | 540 | | 618 | |
| | | Prob | | Prob | | Prob |
| HO: Slopes = 0 | $\chi^2$ (19)= 93.06 | 0.00 | $\chi^2$ (19)=32.16 | 0.03 | $\chi^2$ (19)=91.29 | 0.00 |
| HO: Macro effects 0 | $\chi^2$ (3) =7.49 | 0.06 | $\chi^2$ (3)=3.37 | 0.03 | $\chi^2$ (3) =8.33 | 0.04 |
| HO: Financial effects 0 | $\chi^2$ (3)= 11.06 | 0.01 | $\chi^2$ (9)=20.20 | 0.02 | $\chi^2$ (9)=52.95 | 0.00 |
| HO: Shock effects = 0 | $\chi^2$ (7)=25.35 | 0.00 | $\chi^2$ (7) = 10. 80 | 0.15 | $\chi^2$ (3) =6.02 | 0.11 |
| HO: Debt. effects = 0 | $\chi^2$ (6) =46.36 | 0.00 | $\chi^2$ (7) = 16.78 | 0.01 | $\chi^2$ (6)=43.58 | 0.03 |

| Goodness of fit models -(Cut off probability 0.5) | | Crisis | No Crisis | Total |
|---|---|---|---|---|
| Baseline model | Predicted Crisis | 30 | 14 | 44 |
| | Predicted no Crisis | 61 | 569 | 630 |
| | Total | 91 | 583 | 674 |
| Shocks model | Predicted crisis | 2 | 0 | 2 |
| | Predicted no crisis | 20 | 518 | 538 |
| | Total | 22 | 518 | 540 |
| Institutions model | Predicted crisis | 29 | 14 | 43 |
| | Predicted no crisis | 62 | 513 | 575 |
| | Total | 91 | 527 | 618 |

Table 9: Fixed effects models

| | Shocks model | | All years after Ist crisis year deleted | | All years after entire crises episode deleted | |
|---|---|---|---|---|---|---|
| Dep. var: Crises | *dF(x)/x* | \|z\| | *dF(x)/x* | \|z\| | *dF(x)/x* | \|z\| |
| **Macro variables** | | | | | | |
| Rgdpgr | -1.96 | 0.613 | -2.445 | 0.144 | 2.330 | 0.570 |
| Inflation | -2.5 | 1.809 | -9.65 | 1.080 | -1.098 | 0.698 |
| Reer | -0.001 | 0.340 | -0.037 | 1.517 | -0.021 | 1.975 |
| **Financial variables** | | | | | | |
| Lend | 8.215 | 2.692 | 74.247 | 1.930 | 22.074 | 3.169 |
| M2res | 0.056 | 2.911 | 0.299 | 2.088 | 0.164 | 4.214 |
| Debtgdp | 4.905 | 5.275 | 18.433 | 2.529 | 11.657 | 5.038 |
| Avintdebt | 0.374 | 3.547 | 0.597 | 1.686 | 0.321 | 2.107 |
| **Shock variables** | | | | | | |
| Tot trend | -1.678 | 1.466 | -12.107 | 1.618 | -6.932 | 3.468 |
| Floatshock | -0.051 | 1.702 | 0.093 | 0.803 | 0.024 | 0.497 |
| Intershock | 0.053 | 2.876 | 0.233 | 1.457 | 0.090 | 2.917 |
| Fixedshock | 0.026 | 1.648 | 0.209 | 1.999 | 0.088 | 2.831 |
| Floatcap | -19.118 | 0.901 | -78.849 | 1.065 | -66.122 | 1.763 |
| Intercap | -6.783 | 0.638 | 100.422 | 1.319 | -50.742 | 2.758 |
| Fixedcap | -6.783 | 1.558 | -53.227 | 2.324 | -15.101 | 2.758 |
| R squared | 0.443 | | 0.759 | | 0.71 | |
| No of observations | 387 | | 254 | | 328 | |
| | | Prob | | Prob | | Prob |
| HO: Slopes = 0 | $\chi^2$ (14)= 51.67 | 0.00 | $\chi^2$ (14)=10.72 | 0.70 | $\chi^2$ (14)=33.19 | 0.03 |
| HO: Macro effects 0 | $\chi^2$ (3)=3.47 | 0.32 | $\chi^2$ (3)=2.68 | 0.44 | $\chi^2$ (3)=5.37 | 0.14 |
| HO: Financial effects 0 | $\chi^2$ (3) = 36.92 | 0.00 | $\chi^2$ (4)=7.78 | 0.09 | $\chi^2$ (9)=29.13 | 0.00 |
| HO: Shock effects = 0 | $\chi^2$ (7)=15.05 | 0.04 | $\chi^2$ (7) = 6.14 | 0.52 | $\chi^2$ (3)=16.37 | 0.02 |

Appendix : Al: Description of variables

| Varaible Name | Description | Source |
|---|---|---|
| GDPGR | Real GDP growth in logs | IFS: line 99b |
| Trade Shock | Percentage shock measure | World Tables, UNTACD |
| TOT Trend | Terms of trade trend | World Tables, UNTACD |
| RMOGR | Real growth in MO | IFS: line 14 |
| RM1GR | Real growth in MI | IFS: line 34 |
| RM2GR | Real growth in M2 | IFS: line 35 |
| DEFGR | Growth in GDP deflator | IFS: line 99bip |
| FISGDP | Ratio of fiscal deficit to GDP | IFS: line 80 |
| RESGDP | Ratio of foreign reserves to GDP | IFS: line 79dad |
| INFLATION | Inflation rate proxied by the annual CPI | IFS: line 64 |
| CAPFLOW | Ratio of foreign capital inflows [aggregate] to GDP | World Debt Tables |
| M2RES | Ratio of M2 money to international reserves | IFS: lines 35179dad |
| LEND | Ratio of private sector credit to GDP | IFS: lines 99b122d |
| DEBTGDP | Ratio of external total debt to GDP | Frankel and Rose (1997) |
| AVINTDEBT | Average of interest rates faced by country on foreign debt | Frankel and Rose (1997) |
| LONGDEBT | Ratio of foreign long term debt to total debt | Frankel and Rose (1997) |
| COMDEBT | Ratio of foreign commercial bank debt to total debt | Frankel and Rose (1997) |
| CONDEBT | Ratio of concessional debt to total debt | Frankel and Rose (1997) |
| VARDEBT | Ratio of foreign variable debt to total debt | Frankel and Rose (1997) |
| LENINFRA | Interactive term between infrastructure Index and lending | BERI |
| LENBUR | Interactive term between bureaucratic delay index and lending | ICRG |
| CRISES | [1,01 dummy variables for banking crises | Various case studies |

Table A2 : Identifying Shock Periods

| country | Terms of trade shock | | Exchange rate regime at onset of | |
|---|---|---|---|---|
| | positive | negative | positive shock | negative shock |
| | Year | Year | | |
| Botswana | 1977-1982 | | | Flexible |
| Cameroon | 1978-1982 | 1986-1992 | Fixed | Fixed |
| Chile | 1968-1974 | 1975-1988 | Fixed | Fixed |
| Colombia | 1976-79 | | Flexible | |
| Congo | 1972-1975 | 1986-1990 | Fixed | Fixed |
| | 1979-1985 | | Fixed | |
| Costa Rica | 1976-1979 | | Fixed | |
| Cote D'Ivoire | 1976-1980 | | Fixed | |
| Dominican Rep | 1974-76 | | Fixed | |
| Ecuador | 1977-80 | 1986-90 | Fixed | Fixed |
| | 1982-86 | | | |
| Egypt | 1972-74 | | Fixed | |
| | 1979-85 | 1986-90 | Fixed | Fixed |
| El Salvador | 1977-80 | | Fixed | |
| Ethiopia | 1976-80 | | Fixed | |
| Gabon | 1979-84 | 1986-92 | Fixed | Fixed |
| Ghana | 1976-79 | | Fixed | |
| Guatemala | 1976-1980 | | Fixed | |
| Indon | 1979-85 | 1986-90 | Flexible | Flexible |
| Korea | | | | |
| Kenya | 1976-1980 | | Fixed | |
| Malawi | 1976-1980 | 1981-83 | Fixed | Fixed |
| Malaysia | 1977-1985 | 1986-90 | Fixed | Fixed |
| Mauritius | 1974-1977 | | Fixed | |
| Mexico | 1979-85 | 1986-90 | Flexible | |
| Morocco | 1974-78 | | Fixed | |
| Niger | 1970-74 | | Fixed | |
| Nigeria | 1972-75 | | Flexible | |
| | 1979-85 | 1986-90 | Flexible | Flexible |
| Paraguay | | | Fixed | |
| Philippines | 1973-75 | 1979-85 | Flexible | |
| Senegal | 1974-1979 | 1979-84 | Fixed | Fixed |
| Sri Lanka | 1976-79 | | Flexible | |
| Syria | | | Fixed | |
| Tanzania | 1976-80 | | Fixed | |
| Thailand | 1974-76 | 1980-85 | Fixed | |
| Tunisia | 1974-78 | 1981-85 | Fixed | |
| Uganda | 1976-79 | | Fixed | |
| Uruguay | 1973-75 | 1980-85 | Flexible | |
| Venezuela | 1973-1977 | | Fixed | |
| | 1979-85 | 1986-90 | Fixed | |
| Zambia | 1969-72 | | Fixed | |
| | 1974-76 | 1977-85 | Fixed | |

Table A3: Descriptive Statistics

| Variable | Obs. | Mean | St. Dev. | Max. | Min |
|---|---|---|---|---|---|
| GDPGR | 899 | 0.01 | 0.06 | 20 | 19.98 |
| SHOCK | 895 | 2.62 | 20.85 | -60.2 | 33.3 |
| RM0GR | 1035 | 0.06 | 0.26 | 3.77 | -1.96 |
| RM1GR | 1059 | 0.01 | 0.3 | 5.98 | -1.89 |
| RM2GR | 1058 | 0.1 | 0.3 | 5.37 | -1.3 |
| FISGDP | 975 | -0.01 | 0.07 | 0.62 | -0.25 |
| RESGDP | 807 | 0.01 | 0.04 | 0.26 | -0.5 |
| DEFGR | 1105 | 0.11 | 0.23 | 4.73 | -1.94 |
| INFLATION | 1055 | 0.19 | 0.36 | 5 | -0.13 |
| CAPFLOW | 880 | 0.08 | 0.09 | 0.6 | -0.061 |
| M2RES | 1024 | 4.71 | 26.46 | 812.7 | 0.04 |
| LEND | 917 | 0.24 | 0.18 | 0.9 | 0.002 |
| DEBTGDP | 886 | 0.83 | 1.52 | 13.9 | 0.01 |
| AVINTDEBT | 1006 | 6.07 | 2.82 | 16.5 | 0.12 |
| LONGDEBT | 858 | 0.49 | 0.46 | 4.2 | 0.02 |
| COMDEBT | 858 | 0.11 | 0.15 | 0.94 | 0.01 |
| VARDEBT | 858 | 0.13 | 0.18 | 1.1 | 0.01 |
| CONDEBT | 858 | 0.19 | 0.28 | 2.08 | 0.02 |
| LENINFRA | 285 | 0.61 | 0.56 | 2.94 | 0.003 |
| LENBUR | 285 | 0.7 | 0.58 | 2.94 | 0.001 |

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