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 with flexible regimes were able to lessen the impact of external shocks on the domestic economy. This in turn reduced the likelihood of banking crises.

JEL Classification: E42, E51, G21.

Keywords: banking crises, shocks, exchange rates.

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1. Introduction

The causes and consequences of banking crises have regained prominence after the recent wave of financial and banking crises in emerging economies. A number of internal and external factors, such as capital flows, terms of trade shocks, institutional strength and appreciations of exchange rates have been identified in the literature as contributory factors. While factors such as interest rates, stock market crashes and public confidence could seriously affect the performance of a banking system, the type of exchange rate regime could also be a major determining factor in the way external shocks are transmitted to the banking sector. This is particularly important in small open developing economies, which are heavily dependent on volatile primary product exports and foreign capital and where large negative shocks have the potential to create banking crises.

This paper empirically focuses on the link between external factors and the incidence of banking crises in developing small open economies, (SOEs). Major banking crises over the 1970 to 1992 period are identified from existing case studies. Using theoretical priors from the literature, principal factors that may lead to banking crises in these economies are modeled in a logistic framework. 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 II discusses the theoretical literature. Section III analyzes case studies from the literature and the

methodology used to define crisis episodes. Section IV explains the econometric model and Section V conducts the estimation. Section VI concludes the analysis.

II. Literature on Banking Crisis

We begin by defining a banking crisis, with some commonly cited examples:

> "..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]

These definitions imply that banking crises have both micro and macro economic origins. In fact, the interaction of microeconomic and macroeconomic factors could explain a large number of banking crises in SOEs. Macroeconomic factors such as negative terms of trade shocks, level and composition of foreign debt, changes in interest rates, recessions and sudden capital outflows have been suggested as major determinants of crises. Some of these factors are also conditioned by the nature of the policy environment in place, such as institutional strength, confidence in government and the type of the nominal exchange rate regime in operation prior to the occurrence of a crisis. On the microeconomic front,

institutional factors relating to bank supervision and regulation, adequate legal and judicial framework with regard to bankruptcy, law enforcement as well as internationally recognized accounting standards could also have a bearing on the performance and soundness of a banking system. In fact, the combination of several of these factors have the potential to trigger a banking crises.

The theoretical literature for analyzing banking crises is reflective of these numerous contributory factors, with different models and theories explaining various aspects of banking crises. While it is impossible to discuss all models pertinent to banking crises, a brief overview of the main explanations will be conducted. These will be discussed under the monetary approach to financial crises, asymmetric information and micro theories and the business cycle view of banking crises. We start with the monetary view and the role played by exchange rates.

1. Monetary approach and exchange rates

The monetary approach emphasizes the role of money growth and its variability as the principal determinant of a crisis, Friedman and Schwartz [1963]. A financial crisis need not occur at any particular stage of the business cycle, but could result from a change in the monetary base, such as a sudden and erratic tightening of reserve money, or a foreign inflow which may force financial enterprises to sell assets to meet reserve obligations. This may reduce asset prices, raise interest rates and threaten solvency. The exchange rate regime is one of the factors which may affect the way external shocks impact on monetary base and banking sector. This arises works through the demand for money and the supply of supply.

The demand for money is affected through two elements. First there is the conventional change in the transactions demand component. Second, agents also hold money as a store of value. The process by which the supply of money is altered depends on the type of exchange rate regime, i.e. if it is fixed or flexible. If the currency is freely floating, then the supply of money is determined by the central bank. When the exchange rate is fixed, the supply of base money is determined by the balance of payments. The Neary [1985] model analyzes the adjustment process under fixed and floating exchange rates.

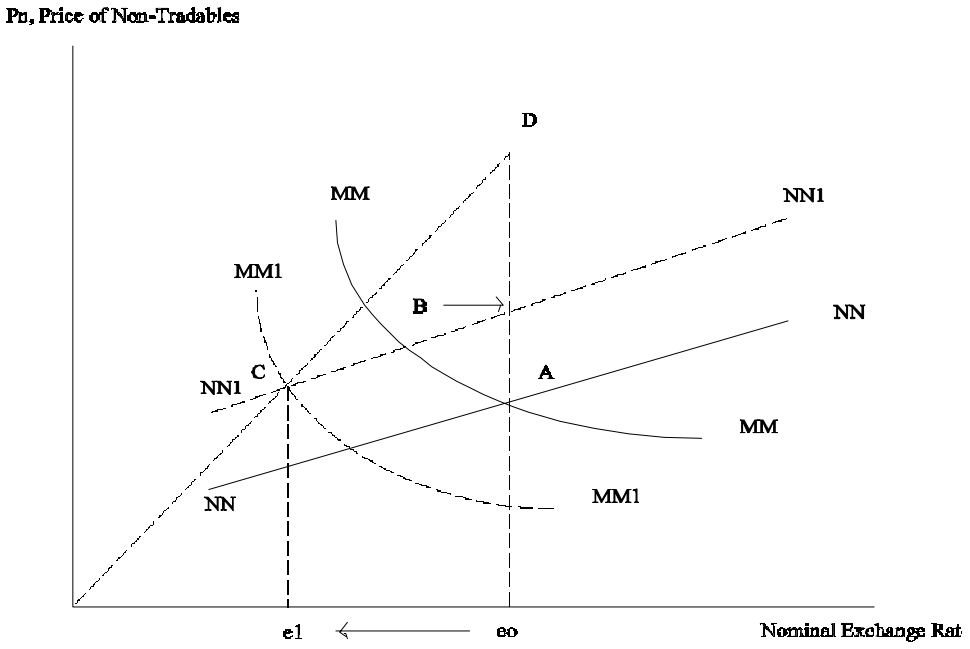
The level of real money balances is determined by a conventional money demand function:

$$m - P = \alpha y - \delta i \tag{1}$$

where i is the domestic interest rate and m, P and y are the logarithms of nominal money demand, the price level and the level of income. This equation is related to the nominal exchange rate in two ways. First, the domestic price level P is a weighted average of the prices of trade and non-traded goods:

$$P = \beta_n P_n + (1 - \beta_n)e. \tag{2}$$

Secondly, the expected changes in the exchange rate influence the link between the domestic interest rate i and the world interest rate i^* (which the home country is too small to



affect). For simplicity, Neary initially ignores expected exchange-rate changes, so domestic and foreign rates are identical. The money market is obtained by substituting the domestic money supply into the money demand function and is depicted in Figure 1. The vertical axis shows the price level of non-tradables. The horizontal axis shows the nominal exchange rate, (i.e. domestic currency per unit of foreign currency). The *NN* locus depicts the non-tradable market equilibrium and *MM* the money market equilibrium. Any ray through the origin corresponds to the relative price of non-traded to traded goods and gives a real exchange rate. The economy's initial equilibrium is at *A*, where the *NN* and *MM* loci intersect.

If the economy operated a flexible exchange rate, the domestic money market is always in equilibrium and the economy must lie along this locus. Under a fixed exchange

rate on the other hand, the economy could be, for example, at a point above the *MM* locus, reflecting a shortfall of actual holdings of real money balances below desired holdings. This disequilibrium must be offset by a buildup of foreign exchange reserves to augment domestic money supply. Therefore, all points above the *MM* locus depict situations of balance of payments surplus and all points below reflect deficits.

The model can be used to analyze the effects of a boom. With a pre-boom equilibrium *A*, the increased demand for non-tradables shifts the *NN* locus upwards to NN_1. The increase in real income also raises demand and if domestic money supply is unchanged, the price level must fall to restore money market equilibrium. The liquidity effect shifts the *MM* locus to MM_1. The nominal exchange rate appreciates from e_0 to e_1, and a new equilibrium *C* is reached. The greater slope of *OC* relative to *OA* implies a fall in the real exchange rate. This combined with the nominal appreciation means that the price of domestic tradable goods unambiguously falls while the price of non-tradables may rise or fall.

Now consider the case when the exchange rate is fixed at e_0. The price of non-tradables moves the economy to B, and since desired money balances are greater than actual, the equilibrium at this point cannot be maintained indefinitely. Instead the trade surplus leads to a build-up of foreign reserves and in the absence of sterilization, money supply gradually rises. This causes both the MM_1 and NN_1 curves to shift upwards. This process can only end when the post-boom equilibrium real exchange rate is attained at point *D* where the surplus is eliminated and the economy reaches its new long run equilibrium. In this Neary framework, a fixed exchange rate increases the real and monetary effects of a boom and gives rise to

inflationary pressures as the rise in the price of non-traded goods is brought about by a rise in the nominal price rather than a fall in the price of tradables. If a large part of this monetary expansion is transmitted through the banking system in the form of bank credit, a large debt overhang may result. A slowdown in growth or a recession in subsequent years, may deteriorate the loan portfolio. A negative shock, such as sudden capital outflows would also adversely affect the banking sector. Lower foreign reserves and bank liquidity would result in higher interest rates and subsequently a decline in output and employment. These factors would increase debt servicing burden of borrowers and increase the potential for default. If this is systematic across the financial sector, a banking crisis may result.

The situation may be less acute under a floating regime, if most of the debt is domestic, as capital outflows and reduced demand for real money balances would depreciate the currency and raise domestic prices. This in turn would reduce the real value of assets of the banking system (including loans given to the private sector). Furthermore, the real value of bank liabilities would also fall, lessening the impact of the negative outflow on banks. Floating exchange rates would also accommodate downward wage rigidity through a nominal depreciation, after a negative shock or economic slowdown, easing competitive pressures. The key difference between the fixed and flexible exchange rate scenarios is that the adjustment in the fixed case mainly affects the supply side and the price level while under flexible regimes, the adjustment largely takes place through cahnges in the nominal exchange rate and relative prices.

While the transmission of external shocks through different exchange rate regimes could play a leading role in causing crises, the interaction of various other internal disturbances and institutional factors could also important in determining banking crises. These relate to institutional strength with regard to supervision, prudential regulation relating to connected lending, accounting standards affecting the disclosure of financial information and an adequate legal environment. Some of these micro theoretic factors are discussed below.

2. Micro theoretic explanations

The micro view comes from asymmetric information and credit market analysis. The most commonly discussed approach is the credit rationing situation resulting from various market failures, Stiglitz and Weiss [1981]. Due to asymmetric information and adverse selection, banks may ration credit, creating problems for non-financial firms. According to Mishkin [1996], the problems of moral hazard and adverse selection rise after stock market crashes. As the value of net worth declines, the moral hazard problem increases as borrowers have less to lose by making a more risky investment. Demirguc-Kunt and Detragiache, 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, Diaz-Alexandro [1985]. DKD [1997] address this issue using cross country data and shows that countries which liberalized with weak institutional and regulatory frameworks were more susceptible to financial crises in subsequent years.

3. 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 may develop due to systematic forces near the peak of the cycle as interest rates rise. 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. Studies 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.

External conditions could also affect assets of the banking sector. Terms of trade shocks could profoundly affect the profitability of firms and households in primary product exporting economies. Unanticipated changes in the terms of trade could make debtors unable to discharge their debts, deteriorating bank balance sheets. Sachs, Tornell and Velasco [1996] 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 an exchange rate depreciation may severely increase the debt service requirement.

III: Evidence of Banking Crises

The literature has mainly focused on developed economies, particularly the United States, to analyze numerous episodes of bank runs and crises, with the most notable during the Great Depression, Benanke [1983], Hubbard [1991]. There have been severe banking crises in other developed countries, Honohan [1997]. Developing countries have also been subject to major crises over the last 20 years, with considerable costs attached, Caprio and Klingebiel [1996], (Table 1). Due to the small and concentrated nature of banking systems in developing countries, even a single bank failure can have tremendous effects.

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	50% 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 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]. They used one of the following four main thresholds to define a

banking crisis; (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.

Table 3
Definition of Banking Crises

Country	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

The second group of studies analyzed banking crisis years implicitly, with qualitative information relating to financial fragility, non-performing loans and the cost of restructuring. Although the information was not comprehensive, these studies gave an indication of the

severity of crises. For the purposes of this paper, common crisis periods were identified from all six studies. When the crisis periods differed, information from the studies discussing the crises implicitly were used as they had more detailed in-depth information.

IV: Empirical Estimation

1. Econometric model

The econometric model estimates the probability of a country experiencing a crisis using a logit model. A logit model estimates whether or not an event occurs, or in this case whether a country experienced a crisis or not. Following Baltagi [1995], the dependent variable is 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:

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

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. 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.

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

(5) $$y_{it} = 0, \quad \text{if} \quad y^*_{it} \leq 0,$$

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

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

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

2. Fixed effects estimation

Moving from the pooled estimation, a useful extension of the analysis is the fixed effects estimation with 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:

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

This implies that the likelihood for each set of *T* observations is conditioned on the number of *1*s 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

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

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

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

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

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

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

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

and

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

The latter can be calculated as

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

with

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

since the latter two events are mutually exclusive. Therefore,

(15) $$\Pr[y_{i1} = 1] = \frac{e^{u_i + x'_{it}\beta}}{1 + e^{u_i + x'_{it}\beta}}.$$

This means that,

(16) $$\Pr[y_{i1} = 1, y_{i2} = 1] y_{i1} + y_{i2} = 1] = \frac{e^{x'_{it}\beta}}{e^{x'_{it}\beta} + e^{x'_{i2}\beta}}.$$

Similarly,

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

and neither probability involves u. By conditioning on $y_{i1} + y_{i2}$, the u_i have been swept away. We now move to the estimation.

3. The variables

Definition of variables and the corresponding descriptive statistics are shown in Tables 4 and 5.

Table 4

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 5
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

3.11. 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 expressed as 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 excluding official aid.

Table 6
Identifying Shock Periods

Country	Terms of trade shock		Exchange rate regime at onset of	
	Positive	negative	positive shock	negative shock
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	

3.12. 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, (M2reserves). The composition of debt, in terms of maturity and creditor has received much attention, Sachs et al [1996]. This may be important for countries with a high proportion of short term foreign commercial debt with variable interest rates.

3.13. Macroeconomic variables

Inflation was introduced as it is normally associated with mismanagement of the economy. Other macroeconomic variables 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 used to investigate the impact of banking crises on real income . In order to establish the causality between real income growth and crises, lagged values of the real GDP variable were used in the predictive model. Finally, to test for sensitivity of crisis year definitions, different years of banking crises were introduced.

V. Econometric Results

1. Baseline model

Table 7 shows the results from the baseline case, using Stata (5).

Table 7
Logit regressions

	Baseline model		External shocks		Institutions	
Dep. var: Crises	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	$\|z\|$
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

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 in the literature, for example Eichengreen and Rose [1998]. Of the macro variables, the contemporaneous growth rate is highly significant, implying that negative real income shocks could lead to a banking crisis. However, as causality may run from the banking sector to the real economy, a predictive model with lagged values is tested in the next section.

Coming to the other macro variables, the inflation term was not significant, 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 interest rate faced by a country on its foreign debt (Avindebtgdp), was also significant. Sudden increases in debt service requirements strongly 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, as changes in this variable are a more appropriate indicator of a crisis than a general interest rate. The trade shock variable was positive, but insignificant, 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. 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.

2. Shocks and choice of exchange regime

The relationships between nominal exchange rate regimes and shocks was analyzed to investigate the nature of the monetary transmission channel. Nominal regimes were broadly classified into fixed pegs, intermediate regimes and floating rates. 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, investigating how different regimes interact with external shocks.

The results in the second regression in Table 7 also support the priors on the effects 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 both 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. 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.

3. 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 across countries. 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.

These variables consist of indices specifying infrastructure quality, on a 0 to 4 scale. Higher values imply low infrastructure quality. 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 to yield (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 infrastructure development could affect the probability of banking crises through bank lending, i.e. lending booms associated with low quality institutions increased 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, i.e. measures of effective legal and judiciary systems, (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.

4. Predictive model

When lagged values of the explanatory variables were used, they more or less confirmed the results of 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

Table 8
Predictive models

	Baseline		External shocks	
Dep. var: Crises	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	$\|z\|$
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	χ^2 (10)= 56.93	0.00	χ^2 (14)=73.61	0.00
HO: Macro effects 0	χ^2 (3)=8.31	0.04	χ^2 (3) = 9.17	0.03
HO: Financial effects 0	χ^2 (4)= 25.91	0.00	χ^2 (4)= 26.03	0.00
HO: Shock effects = 0	χ^2 (3)=19.79	0.00	χ^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

[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 transmitted 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.

5. Robustness

Regional dummy variables were introduced to test for robustness. The results more or less remain unchanged as shown by the Table 9. 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, from the goodness-of-fit tables, high levels of predicted outcomes were obtained.

The coefficient on the real income term remained 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.

Table 9
Robustness

	Baseline model		External shocks		Institutions	
Dep. var: Crises	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	I z I	$\delta F(x)/x$	$\|z\|$
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	χ^2 (12)= 66.48	0.00	χ^2 (14)=77.42	0.00	χ^2 (14)=35.01	0.00
HO: Macro effects 0	χ^2 (3) = 13.2	0.00	χ^2 (3)= 13.34	0.00	χ^2 (3)=10.56	0.01
HO: Financial effects 0	χ^2 (4) = 24.81	0.00	χ^2 (4)= 37.14	0.00	χ^2 (4)=13.31	0.01
HO: Shock effects = 0	χ^2 (3) = 19.92	0.00	χ^2 (7)= 34.29	0.00	χ^2 (3) =6.02	0.11
HO: Institu. effects = 0					χ^2 (2) =6.73	0.03

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

6. Sensitivity analysis - different treatment of crisis years

Two variations of crisis years were used in the sensitivity analysis to separate the feedback effects when a crisis was on-going crisis from those factors that influenced the build-up to the crisis. From Table 10, in the first model, all years after the first year of the crisis are deleted. In the second model, all years after the occurrence of the entire crisis are deleted. The results again lend weight to the argument that countries with flexible exchange rates were less likely to face banking crises from external shocks.

Table 10
Definitions of crises

	All years after 1st crisis year deleted		All years after entire crises episode deleted	
Dep. var: Crises	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	$\|z\|$
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	0.001	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		618	
		Prob		Prob
HO: Slopes = 0	χ^2 (14)=24.78	0.04	χ^2 (14) =77.75	0.00
HO: Macro effects 0	χ^2 (3) = 5.49	0.13	χ^2 (3)=15.42	0.00
HO: Financial effects 0	χ^2 (4) = 9.45	0.05	χ^2 (4) =35.89	0.00
HO: Shock effects = 0	χ^2 (7)= 11.44	0.12	χ^2 (3)=37.21	0.00

Goodness of fit models (cut-off probability = 0.5)	Crisis	No Crisis	Total
Shocks			
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

7. Foreign Debt composition

Using the Frankel and Rose [1996] database, the aggregate debt variable was decomposed into long term debt to GDP (Longdebtgdp), commercial debt to GDP, (Comdebtgdp), concessional debt to GDP, (Condebtgdp), 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 main 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, led to problems in the banking sector, while concessional debt was unlikely to have induced crises. These results again corroborate results from the literature, for example by Sachs et al. [1996] and Eichengreen and Rose. The signs on the interacted terms of trade shock variables exhibited 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.

Table 11
Debt decomposition

	Main model		All years after Ist crisis year deleted		All years after entire crises episode deleted	
Dep. var: Crises	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	I z I	$\delta F(x)/x$	$\|z\|$
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	χ^2 (19)= 93.06	0.00	χ^2 (19)=32.16	0.03	χ^2 (19)=91.29	0.00
HO: Macro effects 0	χ^2 (3) =7.49	0.06	χ^2 (3)=3.37	0.03	χ^2 (3) =8.33	0.04
HO: Financial effects 0	χ^2 (3)= 11.06	0.01	χ^2 (9)=20.20	0.02	χ^2 (9)=52.95	0.00
HO: Shock effects = 0	χ^2 (7)=25.35	0.00	χ^2 (7) = 10. 80	0.15	χ^2 (3) =6.02	0.11
HO: Debt. effects = 0	χ^2 (6) =46.36	0.00	χ^2 (7) = 16.78	0.01	χ^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

8. Fixed effects specification

In the fixed effects version, only those countries which experienced crises were included. The first equation interacted the shocks model with exchange rate regimes. Sensitivity analysis of the crisis variable was carried out following the definitions used previously. The fixed effects results are reported in Table 12 and corroborate some of the findings from the pooled results. The interactive shock terms survives 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. 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.

Table 12
Fixed effects models

	Shocks model		All years after Ist crisis year deleted		All years after entire crises episode deleted	
Dep. var: Crises	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	$\|z\|$	$\delta F(x)/x$	$\|z\|$
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	χ^2 (14)= 51.67	0.00	χ^2 (14)=10.72	0.70	χ^2 (14)=33.19	0.03
HO: Macro effects 0	χ^2 (3)=3.47	0.32	χ^2 (3)=2.68	0.44	χ^2 (3)=5.37	0.14
HO: Financial effects 0	χ^2 (3) = 36.92	0.00	χ^2 (4)=7.78	0.09	χ^2 (9)=29.13	0.00
HO: Shock effects = 0	χ^2 (7)=15.05	0.04	χ^2 (7) = 6.14	0.52	χ^2 (3)=16.37	0.02

V1: 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. 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 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. Again the problem was more acute under rigid exchange rate regimes.

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