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Abstract

This paper examines the determinants of currency crises in Latin America, Asia and Africa. It asks two basic questions: (a) Are currency crises linked to economic fundamentals? and; (b) Is there any evidence of a contagion effect after controlling for the potential effects of economic fundamentals? Using pooled annual data for 19 developing countries spanning the period 1977-1993, we argue that among the macroeconomic variables considered as causes of currency crises, a measure of lending booms, real exchange rate misalignment and the ratio of M2 to international reserves are the only variables that can be consistently linked to currency crises. Economic fundamentals such as the growth rate of domestic credit and high fiscal and current account deficits are generally not significant. In cases where a significant relationship is found, the result is not robust in the sense that the relationship becomes insignificant when there is either a change in the sample size or the definition of the crisis index. Our paper also provides empirical evidence in support of the idea that currency crises could be contagious. The results from our study suggest that currency crises cannot be explained solely by looking at economic fundamentals and that regional contagion effects as well as the speculative behaviour of investors may be important determinants.

Résumé

L'étude examine les déterminants des crises monétaires survenues en Amérique latine, en Asie et en Afrique. Les auteurs abordent la question sous deux angles. Ils cherchent à établir a) si les crises monétaires sont liées aux facteurs économiques fondamentaux; b) si l'on peut déceler un effet de contagion une fois l'incidence possible de ces facteurs neutralisés. Sur la foi des résultats qu'ils obtiennent à l'aide de données annuelles regroupées portant sur 19 pays en développement et couvrant la période 1977-1993, les auteurs soutiennent que, parmi les variables macroéconomiques invoquées pour expliquer les crises monétaires, seules les suivantes présentent un lien systématique avec l'apparition de crises : le désalignement des taux de change réels, le ratio de M2 aux réserves de liquidités internationales et une variable représentant les hausses excessives des prêts accordés. Les variables économiques fondamentales comme le taux de croissance du crédit intérieur et les importants déficits enregistrés au chapitre des finances publiques et de la balance courante ne sont généralement pas significatives. Lorsque la relation s'avère significative, elle cesse de l'être dès que l'on modifie la taille de l'échantillon ou la définition de l'indice servant à reconnaître les crises. Les auteurs obtiennent également des résultats empiriques qui corroborent le caractère contagieux des crises monétaires. D'après les résultats présentés dans l'étude, celles-ci ne peuvent tenir exclusivement à des facteurs fondamentaux, et les effets de contagion au sein d'une région ainsi que le comportement spéculatif des investisseurs sont des déterminants importants.

CONTENTS

1. Introduction

The 1990s will be remembered in economic history as a decade of currency crises. In September 1992 the exchange rate mechanism of the European Monetary System came under attack. This was followed by the Mexican currency crisis of December 1994 and, more recently, the Asian crises. Concern about the possibility of these crises spreading to other countries and the implication this may have for the conduct of monetary policy rekindled interest amongst economists and policymakers in the determinants of currency crises. There is no consensus in the theoretical literature regarding the causes of currency crises. Traditional models suggest that currency crises are caused by deteriorating economic fundamentals, while more recent models link crises to self-fulfilling prophecies and contagion effects.[1] Since these models identify different factors as causes of currency crises, it is necessary to examine empirically the determinants of currency crises.

This paper examines the determinants of currency crises in developing countries. It asks two basic questions: (a) Are currency crises linked to economic fundamentals? and; (b) Is there any evidence of a contagion effect after controlling for the potential effects of economic fundamentals? Using a panel of annual data for 19 developing countries spanning the period 1977-1993, we demonstrate that among the macroeconomic variables considered as causes of currency crises, a measure of lending booms, real exchange rate misalignment and the ratio of M2 to international reserves, are the only variables that can be consistently linked to currency crises. Economic fundamentals such as the growth rate of domestic credit and high fiscal and current account deficits are generally not significant. In cases where a significant relationship is found, the result is not robust in the sense that

1. Some analysts argue that the Mexican currency crisis was contagious. However, because the effect of the crisis was not uniform across countries in the region, it is difficult to arrive at a general conclusion. While the fact that the crisis had a significant negative effect on Argentina and Brazil provides support for the contagion hypothesis, the minor effect it had on Chile and Colombia weakens the validity of the hypothesis.

the relationship becomes insignificant when there is either a change in the sample size or the definition of the crisis index. Our paper also provides empirical support for the idea that currency crises could be contagious. The results from our study suggest that currency crises cannot be explained solely by looking at economic fundamentals and that regional contagion effects as well as the speculative behaviour of investors may be important determinants.

The rest of the paper is organised as follows. Section 2 presents a brief summary of the theoretical literature on currency crises, while section 3 contains a survey of the empirical literature. Section 4 presents our definition of currency crises and contagion. The data, variables of interest, and the methodology used in our research are discussed in section 5. In section 6 we present and analyse our results, and conclude the paper.

2: The Theoretical Literature

The theoretical literature on currency crises can be classified into three categories. The first category, known in the literature as first-generation models, views currency crises as the inevitable consequence of macroeconomic policies that are inconsistent with the maintenance of a fixed exchange rate. Although there are different versions of first-generation models, the seminal paper by Krugman (1979) provides the basic intuition behind these models.[2] Krugman argues that currency crises are caused by high budget deficits that are financed through the expansion of domestic credit. In his model, attempts by the monetary authority to finance fiscal deficits through an expansion of domestic credit lead to reserve

2. For a more comprehensive review of the theoretical literature see Agenor, Bhandari and Flood (1992) or Blackburn and Sola (1993).

losses that ultimately make it impossible for the authorities to maintain the peg. Because these models rely on the premise that currency crises are caused by changes in economic fundamentals, the policy implication is that authorities can avert currency crises by implementing policies that are consistent with the maintenance of a peg.

The second category, labelled second-generation models, questions the idea that monetary authorities abandon their pegs due to the depletion of international reserves. It argues that a monetary authority might abandon a peg if it were concerned that economic policies necessary to maintain the peg might have adverse effects on other macroeconomic variables. For instance, Ozkan and Sutherland (1993) show that if the unemployment rate in an economy is high, the monetary authority will be less willing to defend it's currency against speculative attacks by raising interest rates because it might aggravate the unemployment problem. Obstfeld (1994), and Bensaid and Jeanne (1994) also argue that an increase in unemployment or the public debt increases the cost to the government of defending the peg, thereby increasing the probability of a speculative attack on the currency. The government might also be reluctant to defend the peg by raising interest rates due to concern about the effect of this policy on the probability of a banking crisis and the associated fiscal costs of a bail-out (Obstfeld 1996). These models also suggest that the contingent nature of the macroeconomic policy rule may give rise to multiple equilibria in which speculative attacks on currencies are self-fulfilling. The main implication of these models is that it is difficult to explain currency crises as entirely due to changes in economic fundamentals.[3]

The third category, labelled contagion models, differs from the other two in the sense that it links currency crises in a domestic economy to crises in other countries. Gerlach and

3. Although these models give a pride of place to arbitrary shifts in expectations as causes of currency crises, they do not suggest that economic fundamentals are not important in explaining currency crises. Rather, they emphasize the idea that changes in economic fundamentals are necessary but not sufficient for currency crises.

Smets (1994) present a two-country model of contagious currency crises.[4] They show that speculative attacks on one country could spill over to another country if the international reserves available to defend the peg in the second country are small. In their model, a currency crisis in one country that results in a devaluation affects the competitiveness of that country's trading partners thereby forcing these countries to devalue in order to avoid a loss of competitiveness. In this framework, the collapse of one currency conveys information that another currency might collapse. Contagious currency crises can be warranted or unwarranted depending on whether or not it can be justified by economic fundamentals. For instance, if a currency crisis in a domestic economy spreads to a foreign country with similar macroeconomic structure and policies, this would be described as warranted contagion. However, when a currency crisis in one country spreads to another country that otherwise would not have had a speculative attack, this would be described as unwarranted contagion.[5]

3: The Empirical Literature

Empirical models of currency crises adopt either a structural or non-structural methodology.[6] Meese and Rose (1996) and Melick (1996) are examples of papers that employ a structural estimation approach. Meese and Rose (1996) calibrate two structural models of speculative currency attacks, using quarterly data for eight European countries, in order to predict the exchange rate regime that will prevail in the next quarter. Their models perform

4. Note that in the literature contagion models are classified as second-generation models. We did not use this classification because we want to emphasize the fact that they link currency crises to external factors.

5. Unwarranted contagion is often attributed to herd-like behaviour.

6. An excellent and comprehensive review of the empirical literature on currency crises can be found in Kaminsky, Lizondo and Reinhart (1997).

very well in-sample, but do not yield reliable forecasts of currency crises one quarter ahead. Melick (1996) estimates a speculative attack model of exchange rate crises using Mexican data. Empirical results from his research are disappointing in the sense that the collapse probabilities generated from his model are inconsistent with observed collapses.[7]

Non-structural models of currency crises fall into two broad categories: those based on non-parametric tests and those based on probit regressions. The nonparametric approach was popularised by Eichengreen, Rose and Wyplosz (1995). Using quarterly data for members of the exchange rate mechanism (ERM) of the European Monetary Union, and non-ERM developing countries, they compare the behaviour of macroeconomic variables during periods of speculative pressure to the behaviour of the same variables during periods of tranquility. They argue that a finding that the behaviour of macroeconomic variables differs between both periods will provide some support to the view that currency crises are caused by inconsistent macroeconomic policies.[8] However, a finding that there is no significant difference in the behaviour of these variables in both periods will suggest that currency crises may be due to arbitrary shifts in expectations. For the ERM subsample they find that the key macroeconomic variables (money growth and inflation) do not behave as predicted by first-generation crises models. They argue that this result is consistent with the predictions of second-generation crises models emphasizing multiple equilibria. For the non-ERM subsample the behaviour of budget deficits, inflation, domestic credit growth, export/import ratios and international reserves differs between crisis and non-crisis periods. This is consistent with the predictions of first-generation models. Because their evidence is mixed, they conclude that it is difficult to determine whether their findings are more in sup-

7. Blanco and Garber (1986) present more promising results using Mexican data. They calculate collapse probabilities for the period 1973-82 and show that the probabilities of devaluation attain relatively high values prior to actual devaluations.

8. For instance, if theory suggests that currency crises are caused by high budget deficits, then we would expect the ratio of fiscal deficit to GDP to be significantly higher during periods of crises compared to periods of tranquility. A finding that this is not the case provides evidence against the theory.

port of the first or second-generation currency crises models.

Moreno (1995) applies the same technique to Pacific Basin economies. He finds that episodes of depreciation tend to be associated with larger budget deficits and growth in domestic credit. Using a methodology similar to the one described above, but labelled a "signals" approach, Kaminsky, Lizondo and Reinhart (1997) try to identify variables that have the best track record in anticipating currency crises. They find that output, exports, deviations of the real exchange rate from trend, equity prices and the ratio of broad money to gross international reserves are reliable indicators of currency crises.

Probit regressions have also been used in empirical studies of the determinants of currency crises. Eichengreen, Rose and Wyplosz (1996) apply this methodology using data for 20 industrial countries for the period 1959-1993. They show that speculative attacks on foreign currencies increase the probability of an attack on the domestic currency by 8 percentage points. Using a panel of annual data for developing countries, Frankel and Rose (1996) examine the determinants of currency crashes (a subset of currency crises).[9] They find that currency crashes are associated with high foreign interest rates, low output growth, high domestic credit growth and a low ratio of foreign direct investment to debt. An interesting finding is that neither the current account nor government budget deficits are related to currency crashes, yet these are variables that first-generation models suggest should be important.

Our paper is related to the paper by Frankel and Rose (1996) in the sense that it focuses on developing countries and adopts the probit regression approach. However, it differs from their study in two significant respects. First, unlike Frankel and Rose (1996), we focus

9. The difference between the two concepts is that currency crashes deal with successful speculative attacks alone while currency crises incorporate both successful and unsuccessful speculative attacks.

on currency crises rather than currency crashes. Second, we use a different sample and our analysis takes into consideration the possibility of contagion effects. Eichengreen, Rose and Wyplosz (1996) also incorporate contagion effects into their analysis. However, they focus on industrial countries and adopt a definition of contagion that is general rather than regional.[10]

4.1 Definition of Crises

Following Sachs, Tornell and Velasco (1996), and Kaminsky and Reinhart (1996) we identify crises by looking at an index of exchange market pressure defined as a weighted average of percentage changes in the nominal exchange rate and (the negative of) percentage changes in international reserves. Since the volatility of reserves and exchange rates is different, the weights are chosen so as to prevent any one of the series from dominating the index. We define crises as periods in which the index is 1.5 standard deviations above the mean.[11] The intuition behind the construction of the index is that when a currency is under a speculative attack, the monetary authority can respond to the attack by devaluing the currency, running down international reserves or raising interest rates. Because most developing countries do not have market-determined interest rates, the index is usually defined excluding interest rates.[12] The advantage of the weighted index is that it associates crises with both successful and unsuccessful speculative attacks.

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10. Note that the distinction between regional and general contagion is not important if all the countries in the sample are in the same geographical region.

11. The choice of a 1.5 standard deviation threshold follows Eichengreen, Rose and Wyplosz (1996). Using this definition of crises we obtained 23 crises in the sample. A bar chart showing the number of crises per year is presented in figure 1.

12. For a paper that includes the interest rate in the definition of the crisis index see Eichengreen, Rose and Wyplosz (1996). This paper, however, focuses on currency crises in industrial countries.

4.2 Definition of Contagion

Eichengreen, Rose and Wyplosz (1996) use the crisis index to construct a measure of contagion. The contagion variable for country *j* in any given period takes the value 1 if there is a crisis in the same period in any country other than country *j*. If this condition is not satisfied the contagion variable takes a value of 0 for that period. We believe that this measure of contagion is too general and would be difficult to justify in the case of developing countries. For instance, it would be difficult to argue that a currency crisis in a country such as Senegal would have a significant effect on Mexico. Instead of using this general measure of contagion, we adopt a regional definition of contagion. In order words, we assume that the contagion variable for country *j* takes the value 1 if and only if there is a crisis in at least one country other than country *j* and this country is in the same geographical region as country *j*. If this condition is not satisfied the contagion variable takes a value of 0 for that period. More formally, the regional contagion variable $R(Crisis_{j,t})$ is defined as:

$$R(Crisis_{j,t}) = 1 \text{ if } (Crisis_{i,t}) = 1 \text{ for any i} \neq \text{j, and j and i} \in \text{(Same Region)} \quad (1)$$
$$= 0 \text{ otherwise}$$

5. Data and Methodology

The choice of variables used in the estimations was based on theoretical considerations and data availability. The variables used in the analysis were: (a) the ratio of external debt to GDP; (b) the ratio of M2 to reserves; (c) the ratio of current account deficit (surplus) to GDP; (d) the ratio of government budget deficit (surplus) to GDP; (e) the growth rate of domestic credit; (f) the growth rate of per capita GDP; (g) the ratio of banks' claims on the private sector to GDP; (h) the CPI inflation rate; (i) the real exchange rate; and (j) a foreign

interest rate variable.

The external debt variable is a measure of a country's vulnerability to external shocks while the ratio of M2 to reserves is a measure of reserve adequacy. The use of a broad measure of money, as opposed to the monetary base, in the definition of the reserve adequacy variable can be rationalised on the grounds that it measures the potential amount of liquid monetary assets that agents can try to convert into foreign exchange. The ratio of the current account deficit (surplus) to GDP and the real exchange rate are indicators of external competitiveness. Fiscal and monetary policies are captured by the ratio of budget deficit (surplus) to GDP and the growth rate of domestic credit respectively.

The ratio of banks' claims on the private sector to GDP is a measure of the health of the domestic banking system and is known as a lending boom variable. Sachs, Tornell and Velasco (1996) argue that lending booms increase the ratio of bad loans to total assets thereby weakening the banking system. A weak banking system increases the probability of a speculative attack because investors know that the government will be reluctant to resist an attack by increasing interest rates since this would result in bankruptcies and a recession. Kaminsky and Reinhart (1996) identify another channel through which developments in the banking sector could cause a currency crisis. They argue that in a banking crisis as the central bank finances the bail out of troubled financial institutions, its ability to maintain the prevailing exchange rate commitment erodes. If the bail out is financed through a monetary expansion, the central bank losses international reserves and ultimately abandons the peg. If the bail out is financed by issuing large amounts of debt, then the fact that agents expect future monetization leads to a currency crisis. In this case, the crisis is self-fulfilling.[13]

Our sample has nineteen developing countries selected solely on the basis of data avail-

ability.[14] Data on all the variables used in the empirical exercise were obtained from the IMF's International Financial Statistics and the World Bank's World Tables. A description of these variables can be found in the Appendix. Using pooled annual data for 19 developing countries, we estimate a probit model linking macroeconomic variables and a measure of contagion to the crisis index by maximum likelihood. Since estimated coefficients in probit models are difficult to interpret, we report the effects of one-unit changes in the regressors on the probability of a crisis (in percentage points), evaluated at the mean of the data.[15] We also report the p-values associated with each coefficient. Following Eichengreen, Rose and Wyplosz (1996), we estimate an equation of the form:

$$Crisis_{i,t} = \theta R(Crisis_{j,t}) + \lambda I(L)_{i,t-1} + \varepsilon_{i,t} \qquad (2)$$

where: θ is the coefficient on the regional contagion variable $R(Crisis_{j,t})$; $I(L)_{i,t-1}$ is an information set of ten lagged explanatory variables (economic fundamentals); λ is the vector of coefficients on the ten lagged regressors; and ε is a normally distributed disturbance term. With the exception of the regional contagion variable, all explanatory variables were lagged one period. We use lagged values of economic fundamentals for two reasons. First, theoretical models that associate crises with changes in fundamentals suggest that crises arise due to persistent deteriorations in economic fundamentals. This implies that it takes some time for deteriorations in economic fundamentals to trigger a currency crisis. Besides, we do not expect a very brief and short-lived decline in fundamentals to result in a currency

13. The link between banking crisis and currency crisis is not unidirectional. For example, some economists argue that exchange rate crisis cause financial crisis. See Kaminsky and Reinhart (1996) for a summary of the causal patterns between banking crisis and currency crisis.

14. The countries included in the analysis are Brazil, Chile, Peru, Venezuela, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Panama, Mexico, Thailand, Philippines, Malaysia, Korea, Sri Lanka, Kenya, Mauritius and Ghana.

15. The difficulty arises from the fact that probit models are nonlinear and the marginal contribution of each variable depends on the other explanatory variables in the model (See Judge, Hill, Griffiths, Lutkepohl and Lee 1988).

crisis.

Second, when there is a currency crisis, economic fundamentals such as the gross domestic product and the exchange rate are generally affected. Under this scenario, using contemporaneous economic fundamentals as explanatory variables in estimated equations makes it difficult to interpret the results obtained from the estimations. This is because it is difficult to distinguish between the effects of currency crises on economic fundamentals and the effects of economic fundamentals on currency crises in contemporaneous regressions. The contemporaneous regression does not tell us what causes what.[16] Using lagged economic fundamentals enables us to isolate the effects of economic fundamentals on currency crises. It also provides a simple test of the ability of the explanatory variables to predict future crises.

6. Analyses of Results

All equations were estimated with constant terms by maximum likelihood and standard errors were adjusted for heteroskedasticity. Two definitions of real exchange rate misalignment were used in the estimations: the deviation of the real exchange rate from a historical average and the deviation of the real exchange rate from trend. Since both definitions tend to give similar results, we report results for estimations using the real exchange rate defined as the deviation from a historical average. Table 1 presents the results of the benchmark regression in which crisis is defined as values of the index of exchange market pressure that are 1.5 standard deviations above the mean. Because the inflation rate is highly correlated

16. This is basically a causality problem. Currency crises affect economic fundamentals and economic fundamentals also affect crises. Contemporaneous regressions cannot distinguish between these directions of causality.

with the growth rate of domestic credit, we avoid the problem of multicollinearity by including an interactive variable that captures the combined effects of high fiscal deficits and inflation. This variable is labelled (Fiscal Dummy*Inflation). A positive and significant coefficient on this variable will suggest that a fiscal deficit financed by a monetary expansion increases the probability of a currency crisis.

The lending boom variable, which captures the weakness of the domestic banking system, is significant at the 1 per cent level and has the expected sign. The result supports the notion that lending booms weaken the structure of the banking system and increase the probability of speculative attacks on the domestic currency. A similar result was obtained by Sachs, Tornell and Velasco (1996) using a different methodology and sample.[17] An increase in the growth rate of real GDP in the previous period reduces the probability of a currency crises. The GDP growth rate variable is negative and significant at the 10 per cent level. The ratio of M2 to reserves has a positive coefficient and is significant at the 1 per cent level. This suggests that countries with low reserves relative to a broad measure of money are more likely to experience currency crises. The result is consistent with the view, expressed in traditional models of currency crises, that reserve inadequacy triggers a currency crisis.

We find very strong evidence of regional contagion. The regional contagion variable has a positive sign and is significant at the 1 percent level. A currency crisis in a neighbouring country increases the probability of a speculative attack on the domestic currency by about 8.5 percentage points.[18] Two channels of international transmission of speculative

17. Our result is also consistent with the conclusions of Kaminsky and Reinhart (1996) that a banking crisis helps to predict currency crises.

18. We estimated different specifications using the general measure of contagion used in Eichengreen, Rose and Wyplosz (1996) and found no evidence of a general contagion effect. This supports our contention that contagion effects are more likely to be regional than general.

attacks have been identified in the literature. The first channel is trade links, and the idea is that if a currency crisis in an economy forces the government to devalue the domestic currency, this will affect the international competitiveness of this country's trading partner. To avoid a loss of competitiveness, the trading partner may be forced to devalue its currency. The second channel is information effects, and the hypothesis is that a currency crisis in one country sends a signal to speculators that pegs in countries with similar macroeconomic policies are unsustainable.[19] To avoid a capital loss, speculators attack pegs in countries that have macroeconomic policies similar to those of the country currently experiencing a currency crisis.

The external debt burden variable is insignificant suggesting that external debt burden cannot be linked to currency crises.[20] The ratio of external debt to GDP is also insignificant. The real exchange rate misalignment variable is significant at the 5 percent level and has the expected sign. The result suggests that if the real exchange rate is overvalued relative to its historical average, this increases the probability of a currency crisis.

The rate of growth of domestic credit, the ratio of fiscal surplus to GDP, the ratio of the current account surplus to GDP and the interactive variable (Fiscal Dummy*Inflation) are insignificant at conventional levels.[21] This is interesting given the fact that these are economic fundamentals emphasized in some theoretical models as determinants of currency crises. Since it is possible that fiscal and current account deficits affect currency crises only after a certain threshold level has been reached, we tried alternative definitions of the fiscal and current account deficit variables. In particular, we constructed dummy variables to cap-

19. Eichengreen, Rose and Wyplosz (1996) describe this link as macroeconomic similarities rather than information effects.

20. The external debt burden variable is defined as [(foreign interest rate)*Debt]/GDP.

21. These results are common in the empirical literature. See Frankel and Rose (1996), Eichengreen, Rose and Wyplosz (1996) and Kaminsky, Lizondo and Reinhart (1997).

ture the effects of high fiscal and current account deficits. The fiscal deficit dummy takes the value 1 in any period in which the ratio of fiscal deficit to GDP is more that 2 percent, otherwise it takes a value of 0. For the current account deficit variable, the dummy takes the value 1 in any period in which the current account deficit to GDP ratio is more that 4 percent, otherwise it takes the value 0.[22] Table 2 shows that changing the definitions of the fiscal and current account variables does not alter the conclusions based on the benchmark model.

To check for robustness, we did a number of sensitivity analyses. The first involves performing the estimation using a Latin American subsample. The results of the exercise are reported in Table 3. The lending boom variable, the ratio of M2 to reserves, the real exchange rate misalignment variable and the regional contagion variable are still significant. The only significant difference between this result and the benchmark result is that the real GDP variable is no longer significant. To ascertain whether or not the definition of the contagion variable matters, we performed an estimation using a general contagion rather than a regional contagion variable. The results are presented in Table 4. As expected, the general contagion variable is insignificant, but the lending boom variable, the real exchange rate misalignment variable and the measure of reserve adequacy remain significant.

Table 5 contains results of another sensitivity analysis. In this case we changed the threshold for the crisis index from 1.5 standard deviation to 1 standard deviation and re-estimated the equation using the full sample.[23] This perturbation results in an increase in the number of significant variables. The growth rate of domestic credit, the ratio of fiscal

22. These threshold values are not unreasonable. The 1989-93 average of the ratio of current account deficit to GDP in Mexico and the Philippines were -4.92 and -3.94 respectively. The figures for the ratio of fiscal deficit to GDP were 1.22 and 2.56 respectively. These figures were computed using data presented in Sachs, Tornell and Velasco, 1996.

23. Changing the threshold to 1 standard deviation increased the number of crises in the sample from 23 to 39. Figure 2 shows the number of crises per year for the 1 standard deviation threshold.

surplus to GDP, the lending boom variable, the ratio of M2 to reserves, real GDP growth rate, the real exchange rate misalignment variable and the regional contagion variable are significant and have the expected signs. The interactive variable (Fiscal Dummy*Inflation) is significant at the 10 percent level but does not have the expected sign. We also estimated the equation using the 1 standard deviation threshold and Latin American subsample. The results are presented in Table 6. Clearly, there is no significant difference between these results and those presented in Table 1. Table 7 presents results of an estimation using the 1 standard deviation threshold and a general contagion variable. The general contagion variable is insignificant. However, domestic credit growth, the real GDP growth rate, the lending boom variable, the ratio of fiscal surplus to GDP and the measure of reserve adequacy are significant and have the expected signs. The interesting aspect of this result is that the real exchange rate misalignment variable is now insignificant. However, the fact that this variable is significant in most of the estimations suggests that it is one of the important determinants of currency crises in developing countries.

We also performed other sensitivity analyses not reported here. This includes estimating a random-effects probit model that accounts for differences in cross-sectional units, using a threshold greater than 1.5 standard deviation and using the foreign interest rate rather than the external debt burden variable. These perturbations did not change the central results of the paper. A bar chart summarizing the number of estimations in which each economic fundamental was found significant and had the expected sign is presented in figure 3. The main message that we get from this exercise is that lending booms, real exchange rate misalignment and reserve inadequacy are important determinants of currency crises in developing countries. The growth rate of domestic credit, fiscal and current account deficits, external debt and the growth rate of per capita GDP are not consistently linked to currency crises in developing countries. There is also strong evidence of regional contagion effects.

7. Conclusion

We use a panel of annual data for 19 developing countries spanning the period 1977-1993, to examine the determinants of currency crises in developing countries. We consider the roles played by economic fundamentals and contagion in speculative attacks on fixed exchange rates in developing countries. The empirical findings indicate that lending booms, real exchange rate misalignment and reserve inadequacy increase the probability of a speculative attack on a currency. The results also provide support for the idea that currency crises could be contagious. The finding of a significant and robust regional contagion effect is interesting in the light of the recent experiences of countries in East Asia. In particular, it is consistent with the observation that the recent currency crisis in Thailand spread to Indonesia, Malaysia, the Philippines and South Korea.

In future research, it would be interesting to examine the sources of contagion using the approach identified by Eichengreen, Rose and Wyplosz (1996). It would also be interesting to develop an empirical framework that could discriminate between warranted and unwarranted contagion.

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Data Appendix

Data for the 19 countries included in our sample was obtained from the IMF's International Financial Statistics and the World Bank's World Tables.

- Reserves, excluding gold, were obtained from IFS series 1l.d, converted to local currency.
- Current account deficit (or surplus) is IFS series 78ald, converted to local currency.
- Domestic credit is IMF series 32 in local currency and M2 is IFS series 34 plus 35.
- CPI is IFS series 64, indexed to 1990=100.
- Real GDP is IFS series 99b.p. This series is reported in local currency at 1990 prices.
- Credit to the private sector is IFS series 32d (Claims on the private sector).
- Central government budget deficit (or surplus) was obtained from the IFS and World Tables.
- Nominal GDP and external debt were obtained from the World Tables.
- Bilateral nominal exchange rate with the US dollar is IFS series ae.
- Real exchange rates computed using nominal exchange rates as well as domestic and US CPIs.

Table 1: Probit Estimates (1.5 Std. Deviation Threshold)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.070	**0.020**
Fiscal Dummy*Inflation	2.958	0.410
Lending Boom	0.170	**0.001**
Real GDP Growth Rate	-0.335	**0.062**
Domestic Credit Growth	0.785	0.843
Fiscal Surplus (Deficit)/GDP	0.043	0.864
Current Account /GDP	-0.323	0.191
M2/Reserves	0.276	**0.009**
Debt/GDP	-0.014	0.788
Regional Contagion	8.546	**0.002**
Debt Burden	-0.003	0.515
Chi2(11)=42.60	P=0.000	Pseudo R2=0.226

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Table 2: Probit Estimates (Fiscal and Current A/C Dummies)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.072	**0.013**
Fiscal Dummy*Inflation	2.716	0.429
Lending Boom	0.159	**0.003**
Real GDP Growth Rate	-0.302	**0.071**
Domestic Credit Growth	1.055	0.781
Fiscal Deficit Dummy	0.360	0.874
Current Account Deficit Dummy	2.870	0.166
M2/Reserves	0.273	**0.004**
Debt/GDP	-0.019	0.711
Regional Contagion	8.510	**0.002**
Debt Burden	-0.002	0.646
Chi2(11)=44.18	P=0.000	Pseudo R2=0.222

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Table 3: 1.5 Std. Deviation Threshold (Latin American Subsample)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.062	**0.012**
Fiscal Dummy*Inflation	2.190	0.121
Lending Boom	0.100	**0.009**
Real GDP Growth Rate	-0.021	0.775
Domestic Credit Growth	0.764	0.638
Fiscal Surplus (Deficit)/GDP	0.076	0.555
Current Account/GDP	-0.031	0.795
M2/Reserves	0.136	**0.003**
Debt/GDP	-0.022	0.280
Regional Contagion	3.140	**0.019**
Debt Burden	-0.003	0.281
Chi2(11)=24.09	P=0.012	Pseudo R2=0.360

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Table 4: 1.5 Std. Deviation Threshold (General Contagion Variable)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.078	**0.033**
Fiscal Dummy*Inflation	3.192	0.466
Lending Boom	0.182	**0.004**
Real GDP Growth Rate	-0.392	**0.096**
Domestic Credit Growth	1.458	0.754
Fiscal Surplus (Deficit)/GDP	0.123	0.693
Current Account/GDP	-0.361	0.237
M2/Reserves	0.324	**0.007**
Debt/GDP	-0.055	0.259
General Contagion	0.792	0.782
Debt Burden	0.001	0.790
Chi2(11)=28.00	P=0.003	Pseudo R2=0.168

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Table 5: Probit Estimates (1 Std. Deviation Threshold)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.081	**0.076**
Fiscal Dummy*Inflation	-10.683	**0.060**
Lending Boom	0.230	**0.016**
Real GDP Growth Rate	-0.700	**0.015**
Domestic Credit Growth	15.134	**0.006**
Fiscal Surplus (Deficit)/GDP	-0.947	**0.018**
Current Account/GDP	-0.516	0.156
M2/Reserves	0.441	**0.007**
Debt/GDP	0.081	0.366
Regional Contagion	14.047	**0.000**
Debt Burden	-0.015	0.113
Chi2(11)=37.00	P=0.000	Pseudo R2=0.204

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Table 6: 1 Std. Deviation Threshold (Latin American Subsample)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.096	**0.041**
Fiscal Dummy*Inflation	-2.892	0.400
Lending Boom	0.200	**0.006**
Real GDP Growth Rate	-0.151	0.468
Domestic Credit Growth	8.444	**0.012**
Fiscal Surplus (Deficit)/GDP	-0.310	0.385
Current Account/GDP	-0.138	0.646
M2/Reserves	0.364	**0.014**
Debt/GDP	0.056	0.417
Regional Contagion	15.380	**0.000**
Debt Burden	-0.010	0.162
Chi2(11)=42.17	P=0.000	Pseudo R2=0.323

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Table 7: 1 Std. Deviation Threshold (General Contagion Variable)

CRISIS	Marginal Effects(%)	P-Value
Real Exchange Rate Misalignment	-0.075	0.139
Fiscal Dummy*Inflation	-8.919	0.160
Lending Boom	0.240	**0.015**
Real GDP Growth Rate	-0.643	**0.059**
Domestic Credit Growth	15.301	**0.010**
Fiscal Surplus (Deficit)/GDP	-0.898	**0.034**
Current Account/GDP	-0.561	0.188
M2/Reserves	0.449	**0.014**
Debt/GDP	0.039	0.703
General Contagion	4.974	0.326
Debt Burden	-0.009	0.367
Chi2(11)=31.46	P=0.000	Pseudo R2=0.140

Intercept term not reported. Model estimated by maximum likelihood. Slopes significantly different from zero at conventional levels are in bold.

Figure 1: Total Crises Per Year (1.5 Std. Dev. Threshold)

Figure 2: Total Crises Per Year (1 Std. Dev. Threshold)

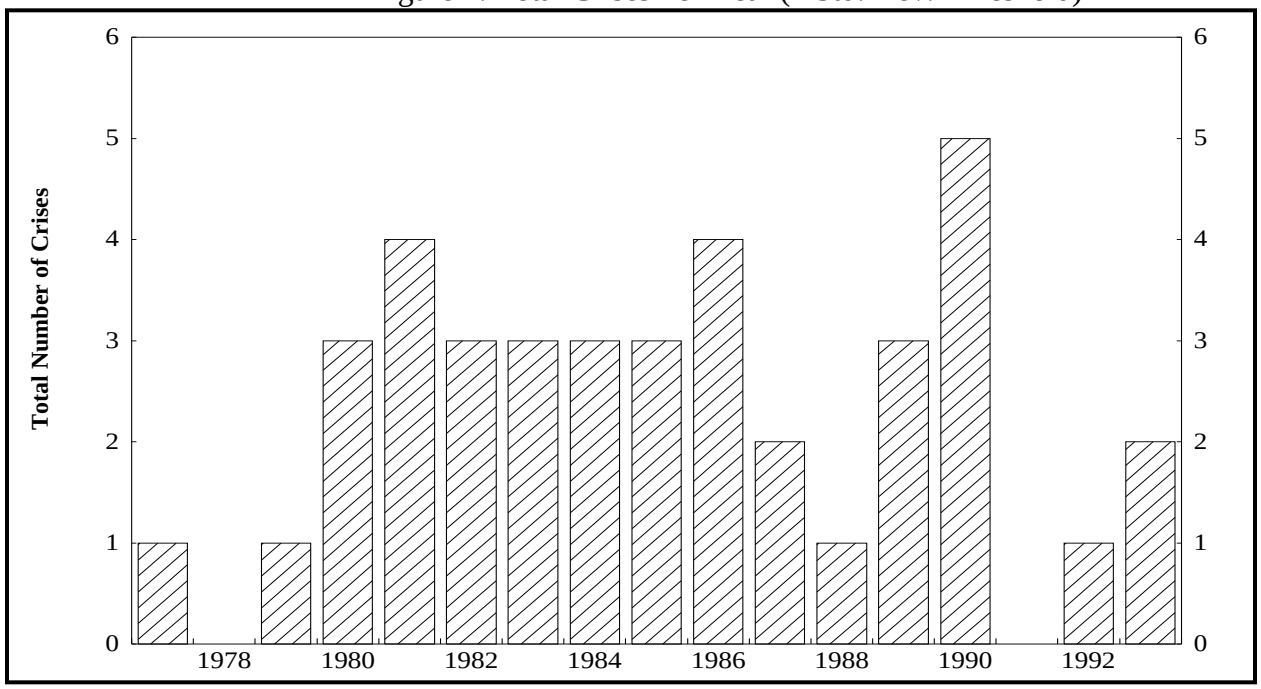
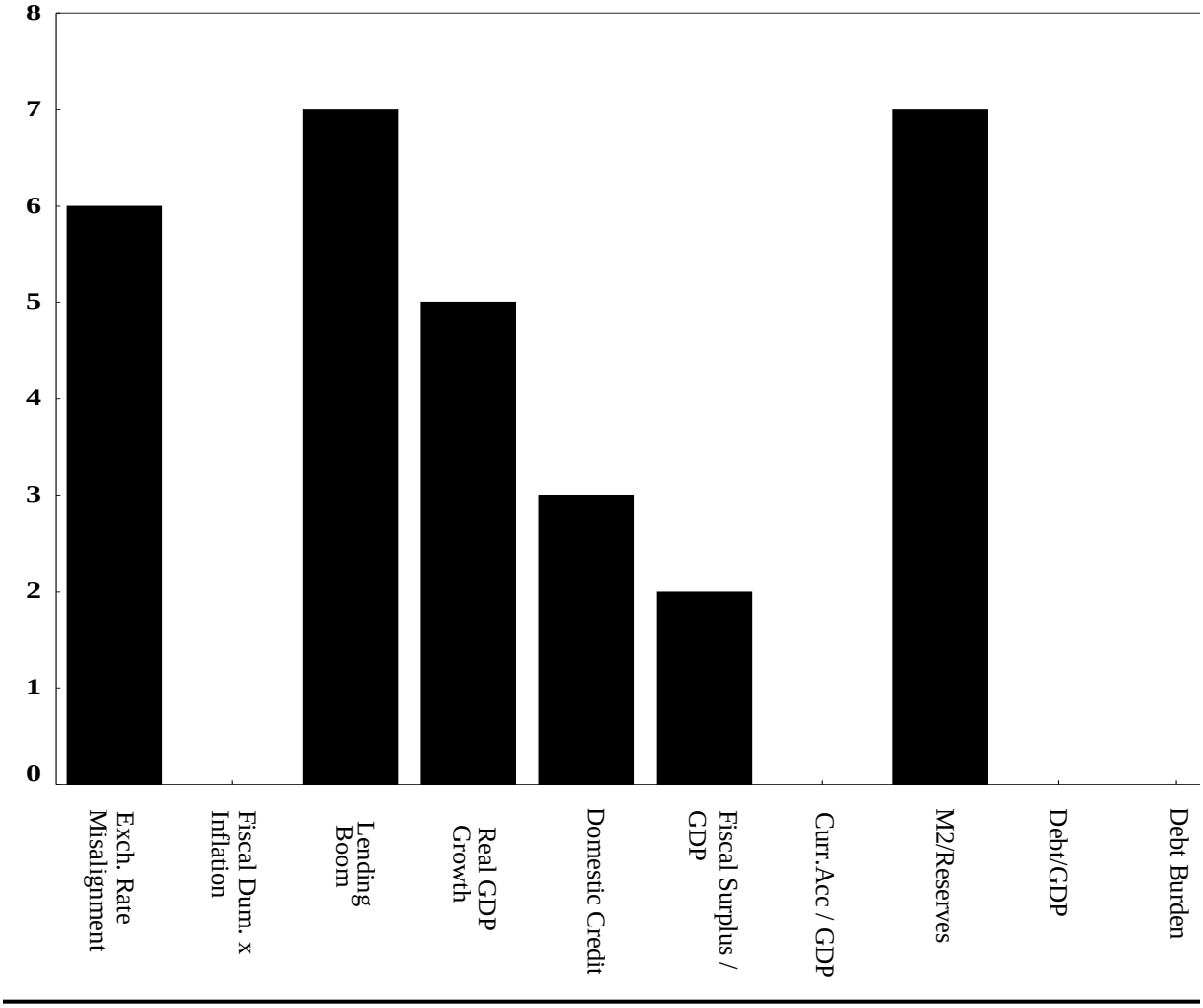


Figure 3: Summary of Estimation Results



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