Common Shocks and Currency Crises*

Ramon Moreno and Bharat Trehan
Federal Reserve Bank of San Francisco
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Abstract

This paper attempts to determine the extent to which common external shocks explain simultaneous currency crises. We define crises on a country by country basis using a new criterion that takes into account variations in the volatility of exchange rates over time and across countries. Using a Poisson regression model, we find that over the post-Bretton woods period, a small number of common external shocks can explain between sixty to eighty percent of the variation in the total number of crises over time, depending upon the set of countries one looks at. Our findings provide one explanation of why currency crises sometimes bunch together and sometimes do not.

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I. Introduction

The experience of collapsing currency pegs in the 1990s—Europe in 1992–1993, Mexico in 1994–1995 and Asia in 1997–1998—has stimulated new research into the causes of currency crises. The fact that the crises occurred simultaneously in a number of countries has drawn particular attention. One view is that currency crises spread to those countries that are tied together by international trade (Eichengreen, Rose and Wyplosz, 1997, Glick and Rose 1999). Another view is that currency crises spread to countries which share common fundamentals, such as recent credit booms (suggesting weakness in the banking system), real exchange rate appreciation or are illiquid internationally (Sachs, Tornell and Velasco, 1996 and Tornell, 1999).

While these studies shed light on the common features of the countries that have currency crises at about the same time, they generally do not have much to say about why the 'first victim' experienced a crisis. Nor do they provide an explanation of the variation in the total number of crises over time, and, in particular, why crises sometimes bunch together and sometimes do not. This is the task we take up in this paper. More specifically, we try to explain the distribution of crises over time in terms of common external shocks. Informal observation (and some empirical evidence) suggests that such common external shocks may be important. For example, the debt and currency crises in 1982 were preceded by a period of rising U.S. interest rates, sharply increasing the external debt burdens of heavily indebted developing countries. The European currency crises of 1992–1993 were preceded by an extended period of deutschemark appreciation that made it costly for European economies to maintain their linked currency arrangements.

We begin by defining crises on a country by country basis using a new criterion that takes into account variations in the volatility of exchange rates over time and across countries. This measure is then aggregated across (several different sets of) countries to obtain (several different) time series on currency crises. Each of these series consists of a count of crises over time, and we attempt to explain the time series variation in each count in terms of common external shocks. Since our dependent variable can only take on values that are non-negative integers, we employ the Poisson regression model for estimation.

Some of our explanatory variables (such as the U.S. interest rate) have been used before, but in models that attempt to predict the occurrence of a crisis in a given country at a given point in time. Several other variables are new to this study. These include measures of inflation, third-country exchange rates and investment flows. We find that common shocks can explain between sixty to eighty percent of the variation in the total number of currency crises over the post-Bretton woods period, depending upon the group of countries one is looking at.

Our analysis is concerned with predicting how many countries are likely to be hit by a currency crisis at a given point in time, given that the impulse takes the form of a common external shock. We view it as complementary to studies that examine the transmission of shocks by focusing on how country characteristics (such as debt-income ratios or the amount of bank lending) determine which countries are likely to be hit by a crisis[1]. However, our ability to explain a reasonably large proportion of the time series variation in crises using a small set of global variables restricts the potential role of explanations in which a domestically-precipitated currency crisis in a single small country leads to simultaneous devaluations by a group of

[1] Huh and Kasa (forthcoming) present a theoretical model that is consistent with our interpretation of the complementarity between external shocks and country characteristics. In their model, adverse external shocks lead to strategic devaluations by a group of countries that export to the same markets.

countries (perhaps because the initial devaluation serves as a coordinating device or "wake up" call).

The plan of our paper is as follows. In section II we review some of the existing research on currency crises. Section III motivates our focus upon common shocks and also deals with some issues having to do with estimation strategy. The empirical analysis in this paper can be divided into two parts. The first part is in Section IV, where we discuss issues surrounding the construction of a currency crisis index and present the index that we use. We also present some comparisons of our index with those proposed by others. Section V contains the second part, where we try and explain the movements in our index in terms of common shocks. Section VI concludes.

II Previous research

Most models of sharp depreciations or currency crises focus on domestic conditions that trigger such crises. These may involve money creation that is incompatible with a pegged exchange rate because of ongoing budget deficits (Krugman, 1979, Flood and Garber, 1984), or to prop up a weak financial sector (Calvo and Mendoza, 1996, Corsetti Pesenti and Roubini, 1998, Burnside Eichenbaum and Rebelo, 1998), or situations in which the costs exceed the benefits of pegging, possibly because the real exchange rate has become overvalued (Obstfeld, 1994, Drazen and Masson, 1994, and Flood and Marion, 1997). Currency crises may also reflect panics due to illiquidity in even normal financial systems (Chang and Velasco, 1998), or excessive lending that makes the economy vulnerable to adverse shocks (McKinnon and Pill, 1998).

In line with this, empirical analyses of episodes of speculative pressure on the exchange rate are almost always concerned with conditions in individual countries, rather than on global conditions[2]. For example, two well known studies by Eichengreen, Rose, and Wyplosz (1995) and Kaminsky and Reinhart (1999) model the influence of external conditions around episodes of speculative pressure by focusing on country-specific variables such as foreign reserves, changes in dollar exports or imports, current account, real effective exchange rate and the interest rate differential (domestic and foreign). Part of the reason for this emphasis is that researchers have mainly been interested in describing the conditions that may predict the timing of episodes of speculative pressure or currency crises in specific countries.

One limitation of this country-focused approach is that it does not directly explain a well established phenomenon: the (occasional) nearly simultaneous occurrence of crises in a large number of countries. For example, according to Glick and Rose (1999), in 1973 alone eighteen countries experienced speculative pressures, reflecting the collapse of the Bretton Woods system. In 1992, nine countries experienced such pressures, due to the attacks on the exchange rate mechanism of the European Monetary System. More recently, in 1997, sixteen countries were affected by currency speculation in East Asia and its aftermath.

Recent research has explored a number of explanations for the bunching of episodes of speculative pressure. One explanation is that the spread of currency crises reflects country-specific fundamentals that just happen to be common to several countries at a given point in time. Sachs, Tornell, and Velasco (1996) and Tornell (1999) study the spread of currency crises

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[2] Frankel and Rose (1996) and Milessi-Ferretti and Razin (1998) are exceptions that we discuss below.

in emerging markets in 1995 and 1997 and find that currency crises spread to countries which experience credit booms (suggesting weakness in the banking system), real exchange rate appreciation or are illiquid internationally.

Glick and Rose (1999) offer an alternative explanation. Using data for five different currency crises they show that currency crises spread to those countries that are tied together by international trade. They also find that after controlling for trade links, macroeconomic and financial influences are not closely associated with the cross-country incidence of speculative attacks, which appears contrary to the findings of Sachs, Tornell, and Velasco (1996) and Tornell (1999). Eichengreen, Rose, and Wyplosz (1997) reach similar conclusions in a study of contagion in OECD countries.[3]

These studies take the "first victim" as given; but it is not clear what, if anything, triggers the first episode. Perhaps a more fundamental problem is that these studies provide no explanation for why crises sometimes bunch together and at other times do not. For example, the sharp depreciation experienced by Thailand in 1997 spread to its trade competitors in the region, but a similarly sharp depreciation in 1984 did not. For another example, consider the crisis measure constructed by Frankel and Rose (1996). While there are three years in their twenty year (eighty country) sample when 10 or more countries have crises, the sample also contains eight years when there are only 1 to 4 crises per year, and another seven years where the number of

[3] Another literature tests for contagion by examining the behavior of asset markets across countries. Thus, Eichengreen, Rose, and Wyplosz (1997), Baig and Goldfajn (1998), Dekle, Hsiao, and Wang (1999) test whether news in a neighboring country affects a country's exchange rate or asset returns, after controlling for fundamentals. Another approach involves tests to determine if the covariance of returns increases during periods of market turmoil. Forbes and Rigobon (1999) reexamine the evidence in this literature and conclude that high market co-movements reflect cross-market linkages or interdependence, rather than pure contagion.

crises is between 5 and 9. Clearly, not every crisis leads to contagion or spills over to other countries.

III. A Role for Common Shocks

One explanation that may account for this pattern but that has received relatively less attention is the possibility that these countries are being hit by common shocks (global or regional). It is not hard to imagine scenarios in which such shocks result in simultaneous crises in a number of countries. A global shock may alter the environment in such a way that a group of countries who were in no danger of insolvency find their position untenable. A worldwide disinflationary shock, for example, may make it impossible for primary commodity exporters to service their existing debt. Thus, Frankel and Rose (p. 356) state that "The debt crisis of 1982, and subsequent debtor devaluations, were to a large extent triggered by the tight northern monetary policy which resulted in high interest rates and a global recession."[4] At other times, the problems may be country specific, with global shocks playing a role largely in the timing of the crisis. For instance, an increase in global interest rates may serve to coordinate banking system failures across countries whose systems might otherwise have collapsed at different points in time. Note that neither of these scenarios denies the importance of country specific factors in determining exactly which countries are hit by a crisis. For instance, in order to predict whether a given country was going to be hit under our second scenario, we would need to know something about the health of its banking sector, just as in Tornell (1999). Finally, as mentioned above,

[4] The effect of global interest rates on external debt burdens is emphasized by Balassa, 1986.

Huh and Kasa (forthcoming) describe another way in which common external shocks can lead to simultaneous currency crises.

A number of earlier studies have taken common shocks into account when trying to explain the timing of crises in individual countries. Generally speaking, these studies have focused on how shocks to interest rates and output growth in the developed economies affect capital flows or the incidence of currency crises in developing countries. Writing well before the recent East Asian currency crises, Calvo, Leiderman, and Reinhart (1996) issued a warning about capital inflow surges in the first half of the 1990s in both Latin America and East Asia, noting that external factors driving such flows contain an "…important cyclical component, which has given rise to repeated booms and busts in capital inflows (p. 124)."

Using principal components analysis, Calvo, Leiderman, and Reinhart (1993) find that proxies for capital inflows (foreign reserve accumulation and real exchange rate appreciation) to Latin America were significantly negatively correlated with U.S. interest rates in the early 1990s, suggesting that external factors were the primary determinant of capital flows in that period. This was confirmed by Fernandez-Arias (1994), who estimated that global interest rates accounted for nearly 90 percent of the increase in portfolio flows for the "average" emerging market in 1989-1993[5]. Studies using panel data over longer sample periods also suggest that U.S. interest rates

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[5] Fernandez-Arias (1996) overturns the conclusion of an earlier study by Chuhan, Claasens and Mamingi (1993) that domestic factors were more important by taking into account that country creditworthiness depends on global as well as external factors. Agénor and Hoffmaister (1998) confirm that these results carry through in the East Asian context. Using VAR models, they find that world interest rates have a significant impact on capital flows and the real exchange rate in Korea, Philippines and Thailand.

are important determinants of capital flows or currency crises (Milesi-Ferretti and Razin,1998, Frankel and Rose, 1996).[6]

The evidence on the implications of output growth for currency crises is mixed. Milesi-Ferretti and Razin (1998) find evidence that slower output growth is associated with an increased probability of crises. However, Frankel and Rose (1996) find this to be the case in only one of three sets of regressions that they present. These findings reflect the theoretical ambiguity of the effects of global economic activity on the incidence of crises. On the one hand, a decline in the growth of industrial countries tends to reduce the incidence of crises by increasing capital flows to small open economies. On the other hand, the reduction in growth tends to increase the incidence of crises through its unfavorable effect on demand and the terms of trade in these economies. This may make it difficult to maintain a currency peg by raising unemployment, and by making it more difficult for a country to service its foreign debt.[7]

While existing research provides important insights on how external shocks may influence capital flows and currency crises, there appears to be scope for further empirical analysis of this question. For example, it is generally believed that the appreciation of the deutschemark against the U.S. dollar starting in the late 1980s set the stage for the wave of speculative attacks experienced by currencies linked to the deutschemark via the Exchange Rate

[6] Agénor (1998) develops an intertemporal optimizing model that spells out the conditions that determine the impact of global interest rate shocks on the real exchange rate of a small open economy.

[7] Casual observation suggests that demand shocks and terms of trade effects may be important predictors of crises. For example, the stagnation in oil prices in the early 1980s adversely affected Mexico's export revenues and output performance, contributing to the debt crisis Mexico experienced after 1982. Similarly, steep declines in semiconductor prices in the second half of the 1990s were followed by currency crises in East Asia in 1997.

Mechanism of the European Monetary System. Yet we are unaware of any systematic examination of the role that major-currency fluctuations might play in causing simultaneous crises in a number of countries.

In order to focus on the role played by common shocks in the distribution of crises over time, we suppress the variation in crises across countries. We do so by adding up the number of crises across countries at each point in time, so that we end up with a time series of crises. Given a large enough sample, the number of crises due to independent country-specific factors should be approximately constant over time. Based on this assumption, we will try and explain the variation in the aggregate number of crises over time in terms of common shocks. To the extent that we are unable to do so, we will leave the door open for explanations such as those based on 'contagion', which we take to mean explanations where random developments in some (small) country can lead to simultaneous crises in other countries.

An important benefit of our approach is that by suppressing the cross country variation in crises we do not have to take a stand on the set of country specific variables that is best at predicting which country will have a crisis[8]. However, the decision to aggregate data across countries rules out the most common method of estimating crisis equations–probit regressions on panel data that include all possible determinants of currency crises. We provide more details of the estimation procedure we employ below.

[8] To see how big the list of potential candidates can be, one only needs to compare the set of variables used by Frankel and Rose (1996) with that used by Tornell (1999).

IV. Defining Crises

One of the key questions to be addressed in the analysis of exchange rate crises is how to identify indicators of speculative pressure in foreign exchange markets, and to decide under what conditions the movement in these indicators represents a "crisis." The most obvious indicator is the behavior of the foreign exchange rate. If a country's exchange rate is floating, or if a peg has collapsed, a sharp depreciation is an unambiguous indicator of a shift in sentiment or speculative pressure against a currency.

If exchange rate stability is maintained, however, pressure on the exchange rate will be reflected in other ways. If investors want to switch away from a country's assets, the exchange rate will tend to depreciate and a country's central bank may respond in two ways to prevent depreciation. First, it may seek to sell foreign reserves, to accommodate the increased demand for foreign assets. Second, it may allow interest rates to rise. Thus, the depletion of foreign reserves or increases in interest rates can serve as indicators of speculative pressure. Examples where such variables would provide information not given by the exchange rate are Argentina's costly efforts to defend its peg in 1995, and similar efforts by Hong Kong in 1998.

While some researchers have proposed indexes that use an explicit analytical framework to weight the different sources of exchange rate pressure discussed above, such measures are not easy to construct[9]. Consequently, empirical researchers have resorted to simpler, *ad hoc*

[9] Girton and Roper (1979), for instance, propose an index in which the weights reflect the sensitivity of the exchange rate to changes in foreign reserves. Construction of the index requires knowledge of the underlying money demand parameters, which are often unstable and difficult to estimate. Weymark (1998) generalizes the Girton-Roper method in a way that is less demanding in terms of information needed, but the approach still requires more information than the alternatives currently in use.

weighting schemes. For example, in their study of currency crises in OECD countries, Eichengreen, Rose, and Wyplosz (1995) employ weights that adjust for differences in the volatility of the components of the index to ensure that the units (exchange rate, foreign reserve, or interest rate changes) are comparable. Implicit in this approach is the assumption that a one standard deviation change in the interest rate represents as much of a currency crisis as a one standard deviation change in exchange rates or reserves.

Another difficulty is that data for some of the indicators of exchange market pressure are often not available. For example, Kaminsky and Reinhart (1999) construct an index similar to Eichengreen, Rose, and Wyplosz (1995), but exclude interest rates because market-determined rates are not consistently available for even their 20 country sample. Working with a set of 91 developing countries, Frankel and Rose (1996) go a step further and construct an indicator based on the behavior of foreign exchange rates alone, on the grounds that foreign reserve data contains a lot of noise. A recent example can be found in the Thai crisis of 1997: The Bank of Thailand suffered heavy losses in the forward market trying to defend the Thai baht peg, but since these were off-balance-sheet transactions they were not fully reflected in the official statistics.

Another question that needs to be addressed is when a movement in an indicator of speculative pressure constitutes a crisis. Researchers have come up with a number of different criteria. Eichengreen, Rose, and Wyplosz (1995) identify a crisis whenever the change in their index is two standard deviations above the mean. Kaminsky and Reinhart (1999) use a similar rule, but compute separate standard deviations for episodes when annualized monthly inflation exceeds 150 percent. Frankel and Rose (1996) use an absolute cutoff. As suggested by Kaminsky and Reinhart's (1999) adjustment for high inflation episodes, one disadvantage of using standard deviations computed over a full sample is that "too many" crises may be identified during periods when the exchange rate is very volatile.

As is apparent from the preceding discussion, no measure of currency crises is perfect. After weighing the pros and cons of the alternative approaches, we opted for a measure of speculative pressure based on the behavior of the exchange rate alone. The main reason is that we would like to predict the global incidence of currency crises, which suggests the use of an index that maximizes the number of countries in our sample. Using data on exchange rates, we ended up with a sample of 121 countries over the (post-Bretton woods) 1974-1997 period; by contrast, we could find foreign reserve data for 85 countries only.[10]

In formulating a crisis rule, we specifically attempt to accommodate changes in the variability of exchange rates, as it is apparent that exchange rate volatility tends to vary over time and across countries. Thus, the rule we employ declares a currency crisis if the change in the exchange rate in a given quarter exceeds the average change over the past five years by two standard deviations (measured over the same period). One advantage of this definition is that we do not have to respecify the condition to deal with high inflation episodes.

Obviously, elements of arbitrariness remain. When computing the standard deviation, should we look at data over the last five years? Or two? Or ten? Similarly, is an event large if it exceeds two standard deviations or three? To answer these questions we looked at how the set of crises detected by the rule changed in response to changes in these criteria. For instance, a move to three standard deviations essentially eliminated the 1992 crisis in Europe, so we decided to retain two standard deviations as the cutoff. Also, in the course of this examination we discovered

[10] See the data appendix for a description of the data.

that our criterion would sometimes find crises where a brief sudden appreciation was followed by a sharp depreciation. Since these short-term reversals appear to reflect volatility in currency markets that has no lasting implications, we decided to include a subsidiary condition which ensures that a currency crisis is only declared if the value of the currency at the end of the crisis quarter is below where it was a year ago. Finally, we also imposed a window to ensure that no country had two crises within a 4 quarter period, by dropping the three quarters following a crisis from the sample.[11]

As discussed at the end of the previous section, we aggregate our currency crisis index over countries in order to obtain a count of the total number of crises occurring per year. Aggregating crises in this way gives us a straightforward way to examine our crisis index. The crisis measure (CC_E) for our 121 country set is shown in Figure 1 (panel A). We also distinguish between currency crises in developing and developed countries. Panel B shows crises in the former, where the set of developing countries is that defined by Frankel and Rose (1996), while panel C shows crises in the set of countries that were members of the OECD in 1975. To further illustrate its properties, we show our measure aggregated over the twenty countries studied by Kaminsky and Reinhart , as well as the Asian economies as grouped by the IMF (panels D and E).

[11] Since our definition of currency crises in terms of the recent variability of exchange rates is new to the literature, we also explored the properties of a measure based on a more familiar definition, one that is related to Frankel and Rose's (1996). Specifically, a crisis was said to occur if the annualized change in a given quarter's exchange rate exceeded the rate of inflation over the prior year by 40 percent, and if the quarter's depreciation exceeded the previous quarter's by 20 percent. The subsidiary condition is meant to rule out cases of relatively large, but steady, deviations. As in the first criterion, we ruled out two crises within the same year in any country. We found that this measure found too many crises in the latter part of our sample (probably because of an increase in exchange rate volatility over time), and decided against using it in the subsequent analysis.

In panels B and D we include the actual crisis measures used by Frankel and Rose, and Kaminsky and Reinhart, for purposes of comparison.

Turning to panel A, our global measure has peaks in the mid-1970s, the early 1980s and the early 1990s. The OECD set (panel B) shows the currency crisis of the early 1990s (which is the dominant crisis in the OECD set), while the 1997 crises dominate the series for Asia. The correlation between our measure and the Frankel and Rose measure (for the Frankel and Rose country set) is 0.68, though our measure shows more crises than the Frankel and Rose measure after the early 1980s. An important reason that the original Frankel and Rose measure does not show an increase in crises during the latter period is that it is based on a rule that permits no more than one crisis per country every four years. The correlation between our measure of crises and the Kaminsky-Reinhart measure (for their set of countries) is 0.67; panel D shows that the two measures are most closely related during the 1990s.

The peak in crises around 1975 (see panel A) has not previously been reported in the literature. To see whether such a peak could be identified by other means, we checked the IMF *Report on Exchange Rate Arrangements and Exchange Rate Restrictions* for 1976, and found that close to half the countries identified as having a crisis or sharp depreciation episode in 1975 had implemented explicit currency realignments (devaluations or re-pegging from one currency to another). About half of the remainder were pegged to sterling, which experienced a steep drop against the dollar in 1975. Several others used the rand as their national currency, and this currency was realigned in 1975 as well.

As another check, Figure 2 plots a measure of crises based on foreign reserves (CC_R) against CC_E. Because of data limitations, the CC_R series begins in 1975, and also contains a total of 85 countries only. However, it shows a peak in 1975 as well, and generally moves pretty closely with CC_E (which is calculated for the same sample of countries here). The exception is 1992, when CC_E shows a marked peak that is not reflected in CC_R. An examination of the individual components shows that the reserves based measure fails to pick up many of the European countries that were affected by the ERM crisis, so we interpret the discrepancy in 1992 as indicating more of a problem with CC_R than CC_E.

V. Predicting Crises

1. Estimation Technique

The data we are trying to predict is a series of counts: the number of crises in the world during a year. The estimation technique we employ needs to take this into account; specifically, it needs to account for the fact that the dependent variable is an integer which cannot be negative. This rules out least squares estimation; instead, we will use the Poisson regression model. Thus, we assume that—conditional on the set of regressors x_i—the density of our crisis variable c_i is given by

$$f(c_i \mid x_i) = \frac{e^{-\mu_i} \mu_i^{c_i}}{c_i!}, \quad c_i = 0,1,2,....$$

and that its mean is given by

$$E[c_i \mid x_i] = \mu_i = e^{c_i' \beta},$$

which ensures that μ_i is greater than zero.

A characteristic of the Poisson distribution is that the variance is equal to the mean, so that the conditional variance of c is nonconstant. Note also that

$$\frac{\partial E(c|x)}{\partial x} = \beta e^{(x\beta)}$$

so that the effect of a change in x on c does not equal the regression coefficient β.

The equations are estimated using maximum likelihood.

2. Interest Rates, Output and Inflation

In identifying global variables that may predict crises, we take the literature cited earlier as a starting point, that is, we begin by looking at the role played by global interest rates and variations in economic activity in explaining crises.

As discussed above, an increase in global interest rates can matter for a variety of reasons. For instance, higher interest rates will raise the cost of servicing variable rate debt, and therefore raise doubts about a country's abilities to meet its external obligations. Or it may cause an outflow of funds which policymakers in a small open economy may find too costly to counter by raising domestic interest rates, resulting in a currency collapse. The reasons for the reluctance to raise rates may be high domestic unemployment, or a weak domestic banking system.

Considerations such as these imply a role for interest rates, but do not provide firm guidance about which measure to include. If the focus is on U.S. monetary policy shocks, one can include U.S. short term rates, as Frankel and Rose do. However, we have decided to use the U.S.

triple-A corporate bond rate instead. A long term corporate rate is likely to be more sensitive to perceptions of risk in the economy and to provide a better measure of inflation expectations than a short term rate.

Interest rates alone do not seem to be enough to capture the different kinds of shocks associated with variations in global economic activity. In response, researchers have used measures of output growth to explain crises. In our own analysis, we did not find convincing evidence of a role for output shocks (we will discuss this below); we did, however, find more convincing evidence for inflation shocks. This evidence is consistent with several accounts of the role played by U.S. monetary policy in the debt crises of the early 1980s (recall the statement by Frankel and Rose cited above). To see how such a shock might work, consider what would happen following a deflationary shock in the U.S. The direct effect of such a shock would be to lower export revenues and consequently economic activity in countries that export to the U.S. The resulting unemployment would make it more difficult for them to maintain a pegged currency (as in Obstfeld, 1994, Drazen and Masson, 1994).

Another effect would work through a debt channel. In the case of a closed economy, a number of papers have shown that changes in inflation can cause problems for borrowers, and that these problems can be large enough to have substantial effects on the macroeconomy[12]. The same considerations apply with regard to the burden of external debt in open economies. For example, a disinflationary shock that lowered the demand for exports and their prices would raise the burden of debt even if nominal interest rates—and therefore nominal payments—were held fixed. Thus, disinflation in a major economy (such as the U.S.) could be associated with an increase in the total

[12] See, for instance, Mishkin (1997) and the references there.

number of crises. Commodity exporters, in particular, are likely to be hit hard by such a development.

These considerations argue for including a variable measuring inflation in our crises-prediction equation. Once again, we have opted to stay with a measure of U.S. inflation. A related question is whether it is the change in inflation or the unpredicted component of the change in inflation that matters. While certain kinds of models suggest working with inflation surprises, we have decided to go with the change in inflation (in part because of the difficulty in determining how exactly to define an inflation surprise).[13]

Table 1 shows the results for regressions that include (the log of) interest rates and the (log of the) inflation rate. We have included a contemporaneous value and a lag for both these variables. In the first column we impose the restriction that the coefficient on the lag is the same size as the coefficient on the contemporaneous term, but has the opposite sign. The data do not reject this restriction for either variable at the 10 percent level. Both variables can thus be entered as changes; we have retained levels to allow for comparability across specifications where this restriction is rejected by the data. The estimates in Table 1 show that an increase in the interest rate leads to an increase in crises. Under the assumption that interest rates are a random walk, this implies that it is interest rate surprises that matter for crises, and not the level of interest rates. Similarly, it is the change in the inflation rate that matters, and not the level. These results are consistent with the debt deflation story above.

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[13] As a check on our results, we did estimate the regressions in Table 1 below with the inflation-surprise specification, where annual U.S. inflation was modeled as an AR(2) process estimated over the whole sample period. The results were about the same as those shown in Table 1; this may reflect the fact that for much of this period inflation is close to a random walk.

Turning to the goodness-of-fit measures, the Chi-square statistic shows that the set of explanatory variables (taken together) is highly significant. Since the equation is nonlinear, one cannot use the usual R^2 measure; we report a couple of pseudo-R^2 measures instead[14]. These measures are both about 0.5, suggesting that the two variables do a reasonably good job of explaining the variation in currency crises over time. It is worth pointing out that the inflation surprise variable is responsible for most of this; when only interest rates are included, the pseudo-R^2 s are just below 0.1. Finally, the overdispersion test shown at the bottom of the table is based on a specification that the variance equals k times the mean. We are unable to reject the null that k equals 1.[15]

The remaining two columns of the table show the results for two subsets of our sample. The first subset contains the countries that were in the OECD in 1975. The coefficients in the second column (for the OECD) have the same signs as in the first column. However, the interest rate variables are no longer significant at conventional levels (and dropping the inflation terms actually leads to a negative R^2_p). The pseudo-R^2 are about half those for the first equation. The second subset (the results for which are shown in the third column) contains the 91 countries classified as "developing" by Frankel and Rose (1996). Our specification performs about as well for the developing country set as it does for our full sample. The pseudo-R^2s indicate a reasonably

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[14] The R^2_p measure compares the fit of the model with that provided by a model with only a constant term. It can be negative and also fall when variables are added to the model. When the model is estimated by MLE, R^2_d measures how much the fit improves in going from a model that contains only a constant term to the given model relative to the improvement in going from a model that contains only a constant term to the perfect model. Thus, it is bounded between 0 and 1. See Greene (1997).

[15] If the restriction that the mean equal the variance were rejected, we would have to employ an alternative estimation strategy. See Cameron and Trivedi (1998) for a discussion.

good fit, though the t-test suggests a tendency towards overdispersion, as it is significant at 10, but not at 5, percent. As was the case in the full sample regression, excluding the inflation variable reduces the pseudo-R^2 to less than 0.1. Overall, our results suggest that variations in global interest rates and inflation are much more important for explaining crises in developing countries than in the OECD.

Given the importance attached to the output growth variable in earlier studies, it seems useful to describe what happened when we included this variable in our equation before concluding this section. Echoing the findings of Frankel and Rose (1996), we found that U.S. income growth did not help explain crises in the developing countries. Output growth did matter for the OECD countries (and for the aggregate index). A closer look revealed that the explanatory power of the output variable had to do largely with its ability to explain the 1992 crises. We found it hard to understand this result, and so decided to drop the output variable.

3. Third country exchange rates

Although previous empirical work has not paid much attention to the role of third country exchange rates in contributing to currency crises, it is not hard to see why movements in the bilateral exchange rates of large economies might trigger such crises. Countries that peg to a major currency will experience a trade-weighted appreciation if that currency appreciates. As is well known (Flood and Marion, 1997, Kaminsky and Reinhart, 1999), such appreciation is often followed by sharp depreciations or currency crises. The crisis in the exchange rate mechanism (ERM) of the European Monetary System in 1992 is consistent with this description, since it was preceded by an extended period of deutschemark appreciation.

Note that common currency shocks are likely to have effects that would satisfy the conditions that have been taken as evidence of spillovers (for example, by Glick and Rose, 1999). An appreciation of the deutschemark, for instance, would cause the currencies that were linked to it to appreciate, and would cause the associated economies to slow (with a loss in trade competitiveness playing a role in the slowdown). Domestic conditions may then force a devaluation in many of these countries. Since it is likely that these countries have similar trading patterns (after all, they do peg to the same currency), tests that look for evidence of spillovers based on trading patterns are likely to find it, even though the underlying cause of depreciation is a common shock.

Table 2 adds bilateral exchange rates to the interest rate and inflation variables in Table 1. We include two exchange rates: the mark-dollar rate and the yen-dollar rate. To eliminate the effects of short run volatility we look at the effect of cumulative changes over a four year span[16]. Also, the dollar has shown a trend depreciation over the sample period (especially against the yen); thus, a one yen change (for example) represents a much larger percentage change at the end of our sample than at the beginning. Consequently, we include the change in the log of the exchange rate. Finally, to avoid simultaneity problems, we lag this variable by one year.

The table shows that neither exchange rate variable is significant in the aggregate equation; however, both are significant in the other two equations (at 10 percent for developing countries, and at 1 percent for the OECD countries). These findings may be reconciled by

[16] We repeated the regressions below using exchange rate changes over a 3 year period (instead of the 4 year period in the text) and obtained similar results.

observing that each of the exchange rates has the opposite sign in the two equations, so the effects are likely to cancel on the aggregate.

In the OECD equation, the coefficient on the deutschemark (Dmchg) is negative, and on the yen (Yenchg) is positive. Thus, a sustained appreciation of the mark (a decrease in DMchg) leads to an increase in crises in the OECD countries, a result which is consistent with the description of the 1992 crisis above. On the other hand, an appreciation of the yen (a decrease in Yenchg) *reduces* the crises in OECD countries, which is intuitive since these countries compete with Japan.[17] Inclusion of the bilateral exchange rates leads to an approximate doubling of the pseudo-R^2, from about .25 in Table 1 to about .5 in Table 2.

In the developing countries equation, the coefficient on the deutschemark is positive, while that on the yen is negative. Thus, a mark appreciation leads to fewer crises in the developing countries, which is understandable given the large set of countries that tend to peg to the dollar rather than the deutschemark and trade with European countries whose currencies are linked with the deutschemark. In contrast, a yen appreciation *increases* the number of crises in developing countries. This coefficient is difficult to explain in the context of East Asian developing economies whose currencies appear to experience depreciation pressures during periods of yen depreciation. However, developing countries in Africa or Latin America are unlikely to face the same pressures. As a comparison of panels B and E in Chart 1 indicates, the yen depreciation in the period up to 1997 appears to have been far more significant for Asia (where it is associated with a global peak in the currency crisis measure) than for the set of developing countries as a

[17] Note also that with the mark-dollar rate held fixed, a change in the yen-dollar rate is really a change in the mark-yen rate.

whole (where the value of the crisis measure in 1997 is less than half as much as the global peak). In any event, the exchange rate variables are only marginally significant in the developing country equation, and do not lead to any improvement in either the pseudo-R^2 or the result of the overdispersion test.

4. Capital flows

While our results up to this point suggest that shocks to U.S. interest rates and inflation, as well as movements in major currency exchange rates, account for a large proportion of the variation in the incidence of currency crises, much of the recent discussion of currency crises does not emphasize these channels. Instead, many commentators have emphasized the role played by capital flows.

One well known story is based on “boom and bust” cycles in capital flows. As discussed by Calvo, Laderman, and Reinhart (1996), there have been a number of episodes in which international capital flows to developing countries increased sharply for a number of years and then suddenly reversed direction, precipitating crises in the recipient countries. While these authors emphasize the role of shocks to global interest rates in inducing such reversals and crises, the cumulative value of such flows may influence the incidence of crises separately from the effect of global interest rates. At least two reasons may be offered for this. First, these funds may be used to finance risky investments (McKinnon and Pill, 1998, Corsetti, Pesenti, and Roubini, 1998, Tornell, 1999), the impact of which will be larger the larger their cumulative value. The risk of crises may be accentuated if for some reason borrowers do not or cannot hedge their foreign currency exposure. Second, as the cumulative stock of external financing rises, the benefit to defaulting on external debt goes up, so that an adverse external shock is more likely to trigger defaults and related currency crises (because such a shock can raise the cost of repayment above the penalty for defaulting on external debt).[18]

The data we use to determine whether investment flows matter is from the IMF's balance of payment statistics. To emphasize the acquisition or liquidation of foreign assets, we focus on *gross* outflows. These are further broken down into direct, portfolio and "other flows." For most of the analysis to come, we use the "other flows" component. This component is dominated by bank lending, and its use reflects our beliefs about the role of banks in crises episodes. For instance, the 1997 crises in Asia were to a large extent the result of uncertainty about the willingness of commercial banks to roll over loans that were maturing. This is consistent with the argument of Chadha and Folkerts-Landau (1999), who point out that while the share of banks in international capital flows has declined, they continue to play a key role, particularly in emerging markets.

To look for boom-and-bust effects, we include the sum of investment flows over the previous four years[19]. The idea is that during lending booms this variable will become unusually large. So the hypothesis is that large values of this variable should be followed by an increase in crises. Table 3 shows that when this variable is included in our specification it is significant only in the aggregate and developing country equations, indicating that sustained increases in

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[18] For a model describing the incentives for debt repayment, see Eaton and Gersovitz, 1981.

[19] Milesi-Ferretti and Razin (1998) show that the lagged 3-year average value of the current account of a middle-income country helps predict whether it will have a currency crisis (in some specifications).

investment flows are followed by an increase in currency crises in developing countries but not in the OECD. We find these results plausible. One reason why developing countries which experience large inflows may be more vulnerable to crises is that they are unable to borrow in their own currencies, and therefore cannot fully hedge their external debt (Eichengreen and Hausmann, 1999).

Capital flows can matter for other reasons as well. For instance, some commentators have suggested that Thailand's 1997 crisis spread to other East Asian economies because the collapse of the Thai currency triggered a generalized "flight to quality." Similar shifts in the international allocation of portfolios have been observed in other contexts, such as in the aftermath of the Gulf War of 1990.

Consequently, we have included an additional variable in Table 3: the lagged change in the amount of "other" foreign investment by U.S. residents (denoted *ΔInvfl*). The inclusion of this variable is variable is meant to capture shifts in the supply of funds, shifts that are not correlated to changes in interest rates, inflation and major currency exchange rates. To the extent that these supply shifts represent exogenous shifts in preferences—such as a desire to increase portfolio diversification—the *ΔInvfl* variable is similar to the variables that we have already included in our analysis. However, this may not always be the case. In the Thailand example above, a shock to a single small country ends up affecting everyone because it affects international capital flows. In that case, 'contagion' can look like a common shock to capital flows.

Nevertheless, we have decided to include this variable in our analysis. One reason is that it has some important implications for the other coefficient estimates in our regressions. In particular, note that the "flight to quality" story implies that funds would flow back to the U.S.

(and other countries not experiencing crises), causing U.S. interest rates to decline. Thus, falling U.S. interest rates can sometimes be associated with a withdrawal of liquidity from foreign markets, instead of an injection, as is commonly assumed in the literature. Consequently, attempts to measure the effects of interest rate shocks on currency crises without controlling for the effects of such shifts will lead to biased coefficients.

When the supply shift variable (*ΔInvfl*) was included in our regressions, it had the expected sign, with a decrease in investment flows out of the U.S. in a given year led to an increase in currency crises the following year. However, the marginal significance level of this term varied between 1 percent (in the OECD equation) and 20 percent. Addition of a second lag led to the first lag becoming insignificant in all cases, while the second one was highly significant. Since we only have a limited number of degrees of freedom, we decided to drop the insignificant first lag and report the results with the second lag only. Table 3 shows that *ΔInvfl* is significant in all three equations, and that it has the largest effect on the OECD countries.

Several other results in Table 3 are worth pointing out as well. Note first that the inclusion of the investment flow variables increases the size of the interest rate coefficients (relative to Table 2) in line with the discussion on omitted variables above. Second, the inclusion of these variables leads to a noticeable improvement in fit, with the pseudo-R^2s going up by between 0.10 and 0.25. Chart 3 shows actual and fitted values from each of the equations, in order to provide another measure of their performance.

We have tested the robustness of the results in Table 3 across several dimensions. First, we employed flows accumulated over three years rather than four. Second, we lagged this 3-year measure an additional year. Finally, we used the measure for total investments (that is, the sum of portfolio flows, direct investment and the "other" component) instead of the "other" component. None of these substitutions leads to a noticeable change in the overall results.

5. An Alternative Measure of Crises for Developing Countries

In Table 4 we show how the variables we have employed here perform when we use the crisis measure devised by Frankel and Rose (1996). (This measure is shown in panel B of Chart 1.) Their sample extends over the period 1973–1992. As we are missing data on cumulative investment flows for 1973, the first column reports the results without the investment flow variables. The interest rate variable is significant at 10 percent, all others at 1 percent. All variables have the same signs as before; the pseudo-R^2 measures are about 0.5. The second column estimates the model over 1974–1992 and includes the investment flow variables. The cumulative investment variable is significant at 1 percent; however, the flow variable is not significant. Even so, the pseudo-R^2 measures are above 0.65. In neither specification is overdispersion a problem.

For comparison purposes, the final column of the table shows what happens when we use our measure of currency crises and estimate the equation for the same set of (developing) countries and over the same (1974–1992) period. The goodness of fit statistics indicate that our set of common shocks explains more of the variation in the Frankel-Rose measure of crises than in the measure constructed in this paper. In addition, a comparison of the coefficients in the last two columns indicates that (with one exception) the Frankel-Rose measure of crises is more responsive to common shocks than our measure. This suggests that our finding that external shocks play an important role in causing currency crises is not an artifact of the procedures we have employed to define currency crises.

It is also useful to assess the sensitivity of our results to changes in the length of the data sample by comparing the last column of Table 4 with the middle column of Table 3. This comparison suggests that the addition of the last 5 years of data does not lead to much of a change in the coefficients of the developing country equation. As might be expected, the smaller sample has larger standard errors, which causes some of the coefficients in the developing country equation in Table 4 to become insignificant.

VI. Conclusions

Recent empirical research has focused on the transmission of crises across countries. Relatively less attention has been paid to what initiates such crises, and, importantly, to why some crises spread, and others do not. To address these issues, we have suppressed the cross-country variation in the data, and tried to explain the bunching of currency crises in time using common shocks alone. We find that a relatively small number of common external shocks can explain a fairly large proportion of the variation in the total number of crises over time. In common with earlier studies, we have found a role for global interest rates in causing currency crises in developing countries. However, our focus on the global incidence of crises allows us to measure more directly the role that such shocks play in the concentration of such crises at any given point in time. We have also found a role for some other shocks that had not been previously examined in the empirical literature, including inflation shocks and third-country exchange rates. Inflation and nominal interest rates alone can explain about half the variation in our full sample (though they play a noticeably smaller role in explaining crises in the OECD). Adding exchange rates and investment flows allows us to explain close to three fourths of the variation in the full sample, and between 60 to 80 percent in our two sub-samples.

We view our work as complementary to recent research on the transmission of crises across countries. In particular, our findings do not rule out transmission channels such as trade links, or common financing links emphasized in the literature, but they do suggest that the extent of transmission—how far "contagion" spreads—may depend upon the aggregate shock hitting the world economy. Our approach helps explain why not all crises are equally contagious; and clarifies what causes the "first victim" in a contagious crisis episode to succumb, filling a gap in existing empirical research. Finally, our ability to explain a reasonably large fraction of the time series variation in crises using a small number of common shocks suggests a relatively limited empirical role for contagion or spillover models in which purely domestic developments in one (small) country are the trigger for simultaneous currency crises in a group of countries.

Table 1

Dependent Variable: Number of Currency Crises
Sample period: 1974–1997

	All Countries	OECD Countries	Developing Countries
Constant	2.46	2.92	2.73
	(.00)[1]	(.00)	(.00)
$3ARate_t$	3.26 [a]	1.58	4.10 [a]
	(.00)	(.46)	(.00)
$3ARate_{t-1}$	-3.26 [a]	-3.39	-4.10 [a]
	(.00)	(.14)	(.00)
Inf_t	-1.64 [a]	-1.79	-1.94
	(.00)	(.02)	(.00)
Inf_{t-1}	1.64 [a]	2.78	1.64
	(.00)	(.00)	(.00)
Chi-Sq [2]	67.70	28.01	54.76
	(.00)	(.00)	(.00)
R^2_p [3]	.51	.22	.53
R^2_d [3]	.48	.27	.46
t-test for overdispersion [4]	1.65	1.18	1.87
	(.11)	(.25)	(.07)

Notes: [a] Contemporaneous and lagged coefficients are restricted to be equal but of opposite sign. The restriction is not rejected at 10%.
[1] Marginal Significance Levels are shown in parentheses.
[2] Tests the hypothesis that all three explanatory variables belong in the equation.
[3] Pseudo R-squared; for a description, see text.
[4] See text for discussion.

Table 2

Dependent Variable: Number of Currency Crises
Sample period: 1974–1997

	All Countries	OECD Countries	Developing Countries
Constant	2.48	1.06	2.18
	(.00)[1]	(.00)	(.00)
$3ARate_t$	3.37 [a]	8.94 [a]	2.78 [a]
	(.00)	(.00)	(.00)
$3ARate_{t-1}$	-3.37 [a]	-8.94 [a]	-2.78 [a]
	(.00)	(.14)	(.00)
Inf_t	-1.61 [a]	-1.94 [a]	-1.65 [a]
	(.00)	(.00)	(.00)
Inf_{t-1}	1.61 [a]	1.94 [a]	1.65 [a]
	(.00)	(.00)	(.00)
$DMchg_{t-1}$	0.04	-2.95	0.64
	(.88)	(.00)	(.06)
$Yenchg_{t-1}$	.11	7.30	-0.87
	(.80)	(.00)	(.07)
Chi-Sq [2]	67.90	49.15	55.00
	(.00)	(.00)	(.00)
R^2_p [3]	.51	.52	.51
R^2_d [3]	.49	.48	.46
t-test for overdispersion [4]	1.66	1.07	1.93
	(.11)	(.29)	(.07)

Notes: [a] Contemporaneous and lagged coefficients are restricted to be equal but of opposite sign. The restriction is not rejected at 10%.
[1] Marginal Significance Levels are shown in parentheses.
[2] Tests the hypothesis that all three explanatory variables belong in the equation.
[3] Pseudo R-squared; for a description, see discussion of Table 1 in text.
[4] See text for discussion.

Table 3
Dependent Variable: Number of Currency Crises
Sample period: 1974–1997

	All Countries	OECD Countries	Developing Countries
Constant	4.71 (.00)[1]	0.80 (.00)	4.71 (.00)
$3ARate_t$	4.93 (.00)	11.73 [a] (.00)	4.13 (.00)
$3ARate_{t-1}$	-6.12 (.00)	-11.73 [a] (.00)	-5.45 (.00)
Inf_t	-2.04[a] (.00)	-2.54[a] (.00)	-2.12[a] (.00)
Inf_{t-1}	-2.04[a] (.00)	2.54[a] (.00)	2.12[a] (.00)
$DMchg_{t-1}$		-3.70 (.00)	0.78 (.02)
$Yenchg_{t-1}$		7.82 (.00)	-1.16 (.04)
$CumInvfl_{t-1}$	.27 (.00)		0.26 (.00)
$\Delta Invfl_{t-2}$	-.94 (.00)	-2.01 (.00)	-0.75 (.00)
Chi-Sq [2]	101.17 (.00)	72.11 (.00)	73.82 (.00)
R^2_p [3]	.74	.79	.63
R^2_d [3]	.72	.70	.61
t-test for overdispersion [4]	.94 (.36)	.81 (.43)	1.00 (.33)

Notes: [a] Contemporaneous and lagged coefficients are restricted to be equal but of opposite sign. The restriction is not rejected at 10%.
[1] Marginal Significance Levels are shown in parentheses.
[2] Tests the hypothesis that all three explanatory variables belong in the equation.
[3] Pseudo R-squared; for a description, see discussion of Table 1 in text.

Table 4
Dependent Variable: Currency Crises in 91 Developing Countries

	Frankel-Rose measure		Our measure
	Sample: 1973-1992	Sample: 1974-1992	Sample: 1974-1992
Constant	1.36	7.92	4.73
	(.00)[1]	(.03)	(.00)
$3ARate_t$	1.66[a]	4.92	3.67
	(.10)	(.00)	(.00)
$3ARate_{t-1}$	-1.66[a]	-8.44	-4.99
	(.10)	(.00)	(.01)
Inf_t	-1.26[a]	-2.75[a]	-2.02[a]
	(.00)	(.00)	(.00)
Inf_{t-1}	1.26[a]	2.75[a]	2.02[a]
	(.00)	(.00)	(.00)
$DMchg_{t-1}$	2.13	2.81	0.92
	(.00)	(.01)	(.27)
$Yenchg_{t-1}$	-2.80	-3.64	-1.32
	(.00)	(.00)	(.10)
$CumInvfl_{t-1}$		0.75	0.24
		(.00)	(.13)
$\Delta Invfl_{t-2}$		-0.37	-0.65
		(.25)	(.01)
Chi-Sq [2]	29.43	42.26	52.69
	(.00)	(.00)	(.00)
R^2_p [3]	.56	.72	.56
R^2_d [3]	.47	.67	.55
t-test for overdispersion [4]	0.98	-0.57	1.0
	(.33)	(.58)	(.30)

Notes: [a] Contemporaneous and lagged coefficients are restricted to be equal but of opposite sign. The restriction is not rejected at 10%.
[1] Marginal Significance Levels are shown in parentheses.
[2] Tests the hypothesis that all three explanatory variables belong in the equation.
[3] Pseudo R-squared; for a description, see discussion of Table 1.

CHART 1. Currency crises as defined in terms of the nominal exchange rate (CC_E).

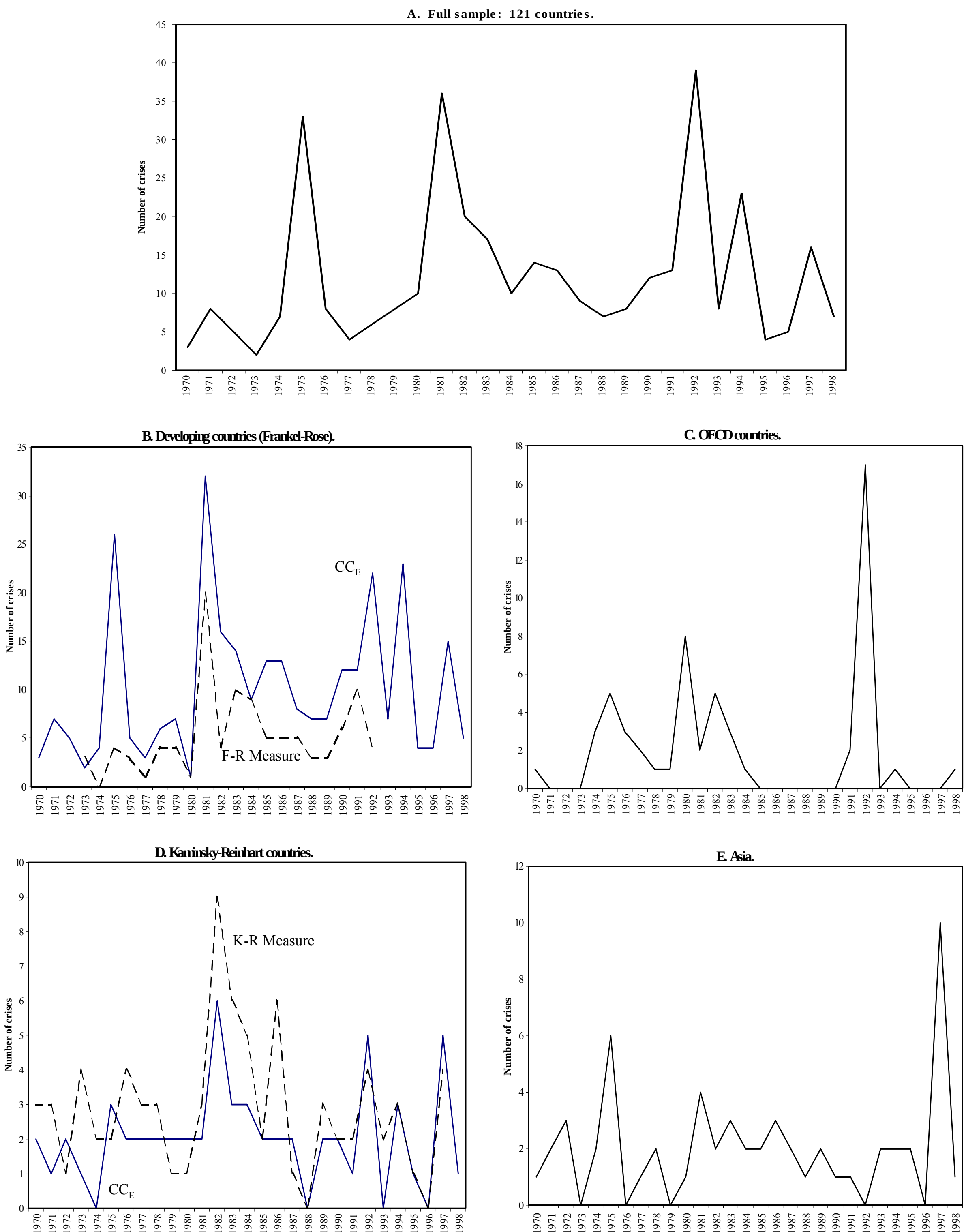
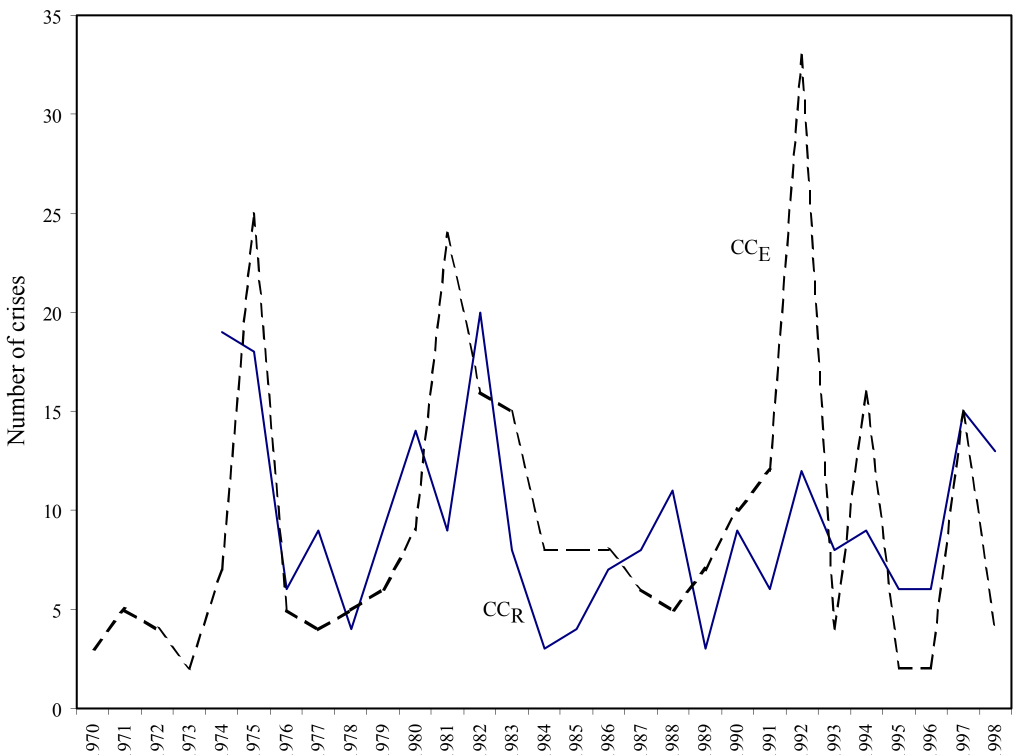


CHART 2. Alternative measures of crises.

85 countries.

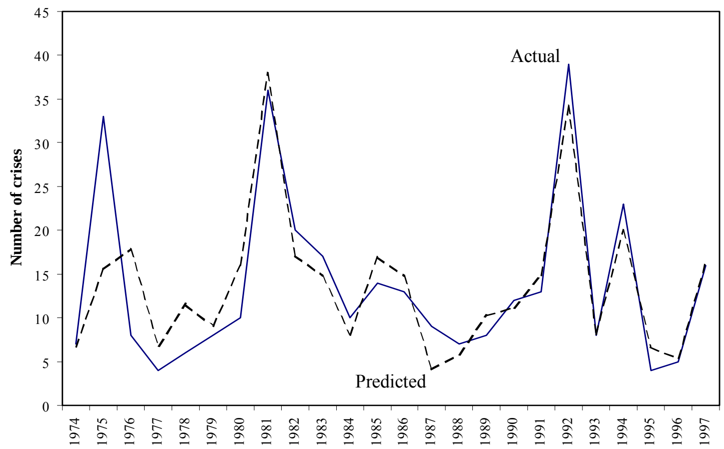


CC_R--Currency crises as defined in terms of foreign reserves.

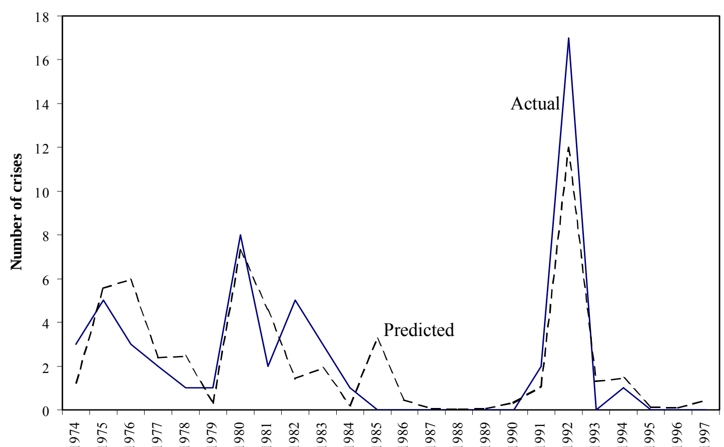
CC_E--Currency crises as defined in terms of the nominal exchange rate.

CHART 3. Actual and predicted currency crises.

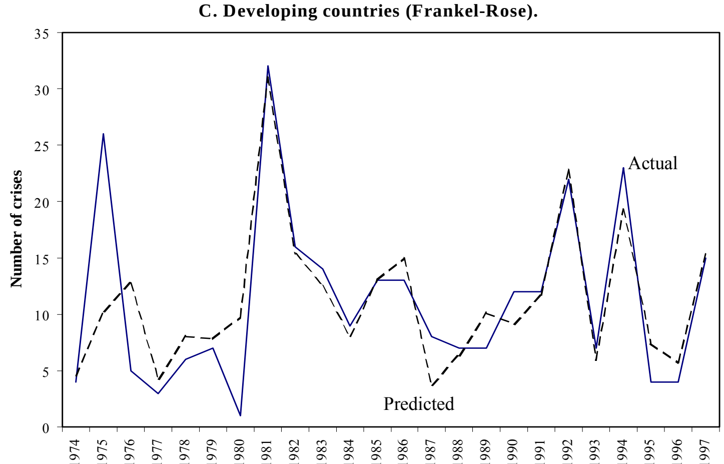
A. Full sample: 121 countries.



B. OECD countries.



C. Developing countries (Frankel-Rose).



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APPENDIX.
DATA DESCRIPTION AND SOURCES

The end of period exchange rates (line ae), total reserves less gold (line 1l.d), and US inflation (line 64) are from the International Financial Statistics CD-ROM. The 30 year AAA US bond rate (mnemonic FYAAAC) and US inflation (mnemonic PUNEW) are from the Board of Governors FAME database. Other U.S. assets abroad is line 4703 from the IMF Balance of Payments Statistics CD-ROM.

The data ranges from 1974 to 1998, collected at a quarterly frequency and then annualized for all series except US bank lending abroad, which has an annual frequency. The values for the US bond rate and inflation are three month averages. A number of macroeconomic series did not span the entire time period or contained missing values. Estimates were then constructed using the available data for each country.

Full country set (121 countries, developing and industrialized): Algeria, Argentina, Australia, Austria, Bahrain, Bangladesh, Barbados, Belgium, Belize, Benin, Bhutan, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Canada, Central African Republic, Chad, Chile, People's Republic of China, Colombia, Democratic Republic of Congo, Republic of Congo, Costa Rica, Cote d'Ivoire, Cyprus, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Fiji, Finland, France, Gabon, The Gambia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Islamic Republic of Iran, Ireland, Italy, Jamaica, Japan, Jordan, Kenya, Korea, Kuwait, Lao People's Democratic Republic, Lesotho, Luxembourg, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Myanmar, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Rwanda, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, South Africa, Spain, Sri Lanka, Sudan, Swaziland, Sweden, Switzerland, Syrian Arab Republic, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Kingdom, Uruguay, Vanuatu, Venezuela, Republic of Yemen, Zambia, and Zimbabwe.

Developing country set (91 countries, as defined by Frankel and Rose, 1996): Algeria, Argentina, Bangladesh, Barbados, Belize, Benin, Bhutan, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Chile, People's Republic of China, Colombia, Democratic Republic of Congo, Republic of Congo, Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Fiji, Gabon, The Gambia, Ghana, Grenada, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Islamic Republic of Iran, Jamaica, Jordan, Kenya, Korea, Lao People's Democratic Republic, Lesotho, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Morocco, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Romania, Rwanda, Senegal, Seychelles, Sierra Leone, Sri Lanka, Sudan, Swaziland, Syrian Arab Republic, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Uruguay, Vanuatu, Venezuela, Republic of Yemen, Zambia, and Zimbabwe.

The OECD country set (23 countries listed as members in the July 1975 *OECD Economic Outlook*): Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom.

Kaminsky-Reinhart country set (19 countries): Argentina, Bolivia, Brazil, Chile, Colombia, Denmark, Finland, Indonesia, Malaysia, Mexico, Norway, Peru, Philippines, Spain, Sweden, Thailand, Turkey, Uruguay, Venezuela.

The Asia country set (18 countries as grouped by the IMF): Bangladesh, China, Fiji, Hong Kong, India, Indonesia, Korea, Laos, Malaysia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Singapore, Sri Lanka, Thailand, Vanuatu.