Empirical Applications of the Credit Augmented Balance of Payments Model

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Abstract

Using a cross section of 124 distinct currency crisis episodes, we utilize the framework developed in our paper "A Model of Balance of Payments Crises" to empirically examine the relationships between currency attack size and type to the magnitude of exchange rate devaluation and unemployment caused by balance of payments crises. We find that for crises characterized by large financial flows the credit augmented model is able to reject its original no credit specification. Using the attack specification from the model we are able to identify two distinct types of currency attack and document their unique attributes and impacts on macroeconomic variables. We also find that the type of attack experienced by a country directly affects the pattern of changes in output growth that precede and follow a balance of payment crisis.

I. Introduction

In the paper entitled "A Model of Balance of Payments Crises," we develop and solve a simple one period model that is designed to explain the origins of balance of payments crises as well as provide some insight into the how financial and currency markets will respond to "successful" currency attacks. In this paper we make use of cross sectional data from twenty-one countries in order to test the relationships suggested by the model. We find that there exists a significant relationship between the size of the attack directed at a currency and the resulting depreciation, that this relationship holds regardless of crisis type, and that debt flows play a significant role in currency crises and are especially significant for credit crisis episodes. Our investigation also leads us to categorize crises into two distinct groups based on fluctuations in employment levels: Those followed by increases in unemployment and those followed by decreases in unemployment. For the first group, consistent with the model, there is a significant correlation between improvement to the current account following a crisis and rising unemployment levels, suggesting that the increased unemployment is the result of crisis induced fiscal contraction. For the second group, capital flight preceding the crisis is significantly correlated with increased employment levels following the crisis, suggesting that tight fiscal or monetary policy used to forestall the crisis was subsequently abandoned. An examination of representative crises confirms this observation. Finally, using different measures for credit flows, we find evidence supporting the claim that the international banking sector did not anticipate the "Asian Flu" crisis period.

This paper is laid out as follows. In Section II we provide a brief explanation of the model and its key results. In Section III we describe the data and methodology used in identifying crisis periods as well as quantifying the size and sign of currency attacks. Section IV describes the empirical methodology used to test our model and documents the results. Section V summarizes our findings.

II. The Model

The credit augmented balance of payments model that we develop is an improvement on a simple one period model first suggested by Aaron Tornell (2000) in his paper, "Common Fundamentals in the Tequila and Asian Crises". We improve on the model by including the impact of credit flows on currency crises as well as the interactions of borrowers and lenders during periods of crisis. Although originally intended to explain currency crisis contagion, the augmented model allows us to quantify and examine not only the sources of crisis, but also meaningful relationships between the size of the devaluation caused by a crisis and how it is related to the magnitude of the currency attack. We are also able to draw inference about how a country's response to crisis will impact its level of unemployment. In order to motivate the origins of our empirical analysis we briefly outline the main points of the model.

We consider a small country that is undergoing financial liberalization and is characterized by imperfect capital markets, a fixed nominal exchange rate, sticky prices and an overly appreciated real exchange rate. We further assume that all agents are characterized by perfect foresight, that the exchange rate is normalized to one and that due to ongoing financial liberalization, both domestic and international investors can choose to hold either domestic or foreign currency deposits. Agents will choose to hold domestic deposits, D, only so long as the exchange adjusted total return to domestic deposits, r, equals or exceeds the interest rate available on foreign currency deposits, $\bar{r}$. Or, put simply, agents will hold domestic deposits so long as

$$\frac{1+r}{1+\pi^e} \geq 1+\bar{r} \tag{1}$$

holds where π^e is the expected devaluation. So long as $\pi^e \leq \bar{\pi}$, where

$$\bar{\pi} = \frac{r-\bar{r}}{1+\bar{r}} \tag{2}$$

no attack will occur and no crisis will result. If, however, agents expect a devaluation that violates (1), i.e. $\pi^e > \overline{\pi}$, they will immediately redeem their domestic deposit positions at the prevailing exchange rate. We call this redemption the "currency attack," with the foreign currency value of the attack being equal to:

$$\frac{\Delta D}{1+\pi} < 0 \tag{3}$$

where $\Delta D = -D$.

This flight from domestic deposits to foreign currency holdings represents an increase in foreign assets held domestically as well as a decrease in domestic assets held abroad. Both capital flows create a gap in the balance of payments that can be financed in any of three ways. First, if the country chooses to defend the exchange rate peg, the central bank can use foreign exchange reserves to redeem domestic deposits. If reserves are inadequate, i.e. $\frac{\Delta D}{1+\pi} < -R$ where R is the value of available reserves, the country can negotiate with international lenders for additional capital. Finally, if the government does not have sufficient reserves, or cannot raise additional capital, it can close the external gap by devaluing the domestic currency, which reduces the foreign currency value of the attack and lowers domestic absorption, and pursue macroeconomic policies that will improve the current account but result in increased unemployment.

The above financial flows and changes to the current account can be summarized in a traditional balance of payments framework. The currency attack, new credit and changes in official reserves represent an increase in foreign assets held domestically, an increase in domestic assets held abroad, and a reduction in official reserves respectively. These three together comprise our capital account. Using the accounting identity for the balance of payments, we add the components of the capital account to the current account with the resulting sum equaling zero. Thus the balance of payments condition for the country becomes:

$$\frac{\Delta D}{1+\pi} - \Delta R + B(r_c) + CA(\pi, u) = 0 \quad (4)$$

where

$$CA(\pi, u) = \beta\pi + \varphi u + CA_0 \quad (5)$$

and $\frac{\Delta D}{1+\pi}$ is the size of the attack, ΔR is the change in foreign reserves, $B(r_c)$ is the additional financing made available to the country and $CA(\pi, u)$ is the current account which is a function of the size of the devaluation and the level of unemployment resulting from contractionary fiscal or monetary policy.

Since the agents in our model are characterized by perfect foresight and have complete knowledge of one another's assets and preferences, an attack will not occur unless deposit holders expect it to be successful. Likewise, given an incipient crisis, the government will immediately devalue the currency and increase unemployment while simultaneously negotiating for additional financing.

In a crisis lenders seek to maximize profits net of opportunity costs by extending loan package B at interest rate r_l, the interest rate on new lending. We assume that lenders are either willing to extend additional financing in order to safeguard the viability of previous loan commitments or they are a lender of last resort such as the IMF. Thus lenders maximize

$$\max_{r_l} \ (r_l - \rho) B(r_l) \quad (6)$$

where r_l is the interest rate on new loans, ρ is the opportunity cost of lending, and B is the size of the optimal loan. We assume that $\frac{dB}{dr} < 0$.

Faced with crisis the government seeks to maximize the following objective function

$$\max_{\pi,\, u \geq 0} \ [\pi^* - \pi + \alpha(u^* - u)] \quad (7)$$

where π^* and u^* are the devaluation and unemployment that result if no lending occurs, and α represents the governments' relative preference for unemployment over depreciation. The variables π and u represent the size of the depreciation and the increase in unemployment in the event that lending occurs. Since additional lending serves to loosen the balance of payments constraint, the lending outcomes will be smaller than the no lending outcomes.

We employ a Nash Bargaining framework where the need for lenders to maximize profits by charging high interest rates is mitigated by the government's need to obtain low cost financing in order to reduce the unemployment necessary to close the external gap. Thus governments and lenders jointly maximize the following objective function subject to the balance of payments constraint:

$$\max_{\pi, u, r_c \geq 0} [\pi^* - \pi + \alpha(u^* - u)]^{\gamma}[(r_c - \rho)B(r_c)]^{1-\gamma} \tag{8}$$

$$\text{s.t.} \quad \frac{\Delta D}{1+\pi} - \Delta R + B(r_l) + \beta\pi + \varphi u + CA_0 = 0 \tag{9}$$

where all variables are as before, and γ represents the relative bargaining power of the government.

Solving this system of equations results in three simple relationships that relate the components of a currency attack to the optimal devaluation, level of unemployment, and crisis interest rates respectively:

$$\pi_c = \sqrt{\frac{-\alpha\Delta D}{(\varphi - \alpha\beta)}} - 1 \tag{10}$$

$$u_c = \frac{1}{\varphi}\left[\Delta R + \beta - B(r_c) - CA_0 + \frac{(\varphi - 2\alpha\beta)\sqrt{-\Delta D}}{\sqrt{\alpha(\varphi - \alpha\beta)}}\right] \tag{11}$$

$$r_c = \rho + \frac{-(1-\gamma)B(r_c)}{(1-\gamma)B' + \frac{\gamma}{\varphi}B'} \tag{12}$$

In short, there exists a positive relationship between the domestic currency size of an attack and the devaluation and unemployment that follow. The optimal crisis interest rate, however, is only a function of the optimal loan size, B, the government's relative bargaining power, γ, and the influence of unemployment on the current account, φ.

Using the accounting identity for the balance of payments (4), we can further simplify (10) and (11) to obtain the following linear forms:

$$1+\pi_c = \frac{\alpha}{\varphi-\alpha\beta}(CA + B(r_c) - \Delta R) \tag{13}$$

$$u_c = \frac{1}{\varphi}\left[(1-\theta)(\Delta R - B(r_c) - CA_0) + \theta\Delta CA_C + \beta\right] \tag{14}$$

where $\theta = \frac{\varphi - 2\alpha\beta}{\varphi-\alpha\beta}$, CA_0 is the value of the current account at the onset of the attack, and ΔCA_C is the improvement of the current account resulting from government policy.

In this paper, we examine the first two relationships implied by the model, leaving the interest rate condition for examination in the future. It is important to note that our model envisions a particular type of currency crisis that is not indicative of all crises. Specifically, the model envisions crises where agents attack the domestic currency, but financial markets continue to function, and where the country in question had a fixed exchange rate. Such a crisis essentially mirrors the traditional Krugman (1979) macroeconomic fundamentals type crisis but does not describe recent crises where both the currency and credit markets of affected countries were attacked, and where few countries were maintaining a fixed peg. As a result, we use the findings of our model as a framework for investigating the crises within our sample instead of attempting to explicitly estimate the model itself. Overall, we find that the direction provided by the model is very useful in helping us understand the components and effects of balance of payments crises regardless of the underlying cause of crisis. Indeed, we find that it is sufficiently flexible to accurately describe several different forms of attack including the recent “Twin Crisis” attacks that characterized the 1990’s.

III. Methodology and Data

The primary objective of the previous section was to demonstrate that the key characteristics of currency crises, i.e. attack, devaluation, and unemployment, do not result from a random process. Instead, they are determined by measurable fundamentals. In order to investigate these relationships, we gather data from several sources including the International Financial Statistics database, the Bank of International Settlements, and central banks. The countries in our sample include Argentina, Bolivia, Brazil, Chile, Colombia, Denmark, Finland, Indonesia, Israel, Korea, Malaysia, Mexico, Norway, Peru, Philippines, Spain, Sweden, Thailand, Turkey, Uruguay, and Venezuela, and are chosen to represent a grouping of both developed and developing countries that have experienced multiple crises. All data are expressed in U.S. Dollar terms and are monthly in frequency with the exception of quarterly financial account data from the IFS database and B.I.S. external debt data, which we convert to monthly frequency using constant sum interpolation.

The greatest obstacle to our investigation is data availability and coverage. Many countries in our sample either inconsistently report data, or recently began reporting data in the late 1990’s. For measures of the current account, net financial flows, and the changes in official reserves we use data published in the IFS database, with the addition of external debt flows from the BIS. To obtain maximum coverage, we proxy for the current account by using the difference of merchandise imports and exports in US$. Although this proxy measure does not include other components of the current account such as interest remittances and trade in services, the resulting difference is small with the two series closely tracking one another. Likewise we use differences of total official reserves to measure changes in reserve holdings. We use two measures of net financial flows: Financial account data and external debt data from the BIS. The financial account data is more broadly defined and includes several forms of debt that are not captured by the BIS data such as portfolio investment and financial derivatives. The BIS data however allows us to use a measure that is directly related to banking financial flows and also provides us with useable data for several countries that do not report financial account data.

With regard to unemployment data, a survey of available data and central bank publications quickly reveals that they are unavailable, inconsistent or irregularly defined for the majority of the countries in our sample. Consequently, we proxy for unemployment by using percentage changes in industrial output data.

A second problem that must be addressed in collecting and utilizing the data is one of comparability. Our sample consists of twenty-one countries that vary both in size, level of development, and financial integration. It is unreasonable to assume that a one billion dollar attack against the Swedish Kroner would have the same effects as a similar attack directed at the Brazilian Real. This is likewise true for comparisons of attacks within countries across time. A simple and effective method of dealing with this problem would be to include country specific dummies in our regression equation. Unfortunately, the low number of observed crises prevents us from using this strategy. Other authors have addressed this issue by making comparisons between stable and unstable periods, using percentage change measures, or calculating indices based on volatility measures (see Eichengreen, Rose and Wyplosz (1996), Kaminsky (1998) and Tornell (2000)). We choose to address this problem by scaling the components of the balance of payments by the average of the sum of exports and imports over the preceding year. Thus, when comparing flows of reserves, debt or changes in the current account we represent them as a fraction of the U.S. dollar value of the county's average total monthly trade. It is hoped that by scaling the observations by the size of each country's external sector we will capture the relative size and health of the foreign exchange markets that serve each country, and consequently properly scale them for comparison with each other. By utilizing a moving average of total trade we are also able to dynamically scale the data to reflect improvements in trade and market participation over time. It is expected that given a currency attack of size ΔD, a country with well-developed and fluid foreign exchange markets will better be able to defend itself against the attack, whereas countries characterized by thin currency markets will have more difficulty equilibrating the market. To the extent that total trade captures this characteristic, it will appropriately weight the observations of each attack.

Finally, each attack in our sample is characterized by a corresponding depreciation of the nominal exchange rate. We create our depreciation measure by taking the log first difference of national currency exchange rates *vis a vis* the US dollar.

Identifying a Crisis

In order to identify periods of crisis, we construct two indices of currency market turbulence, and for purposes of definition, we say that a country has experienced a currency crisis if, for a given month, the crisis index exceeds its mean by more than three standard deviations. The first measure we employ is a simple index created by calculating the period on period percentage changes in the exchange rate for each country within the sample, and then isolating those observations that exceed three standard deviations above its mean. Referred to as the simple, or Std3, measure, this definition of a currency crisis is similar to those employed by Eichengreen, et al. (1996) and also has the benefit of mirroring the theoretical description of a crisis as presented in the augmented model: Indeed, the model foresees expected fluctuations in the exchange rate that do not lead to crisis - so long and they are not too large.

A second measure, used by Kaminsky and Reinhart (1999b), is an index constructed by adding the weighted percentage changes of the nominal exchange rate and reserve asset holdings.

$$I = \Delta e - \frac{\sigma_{\Delta e}}{\sigma_{\Delta R}} \Delta R \qquad (10)$$

Where $\sigma_{\Delta e}$ and $\sigma_{\Delta R}$ are the sample standard deviations of the percentage changes in the exchange rate and the level of reserves respectively. Weighting reserves in this fashion ensures that both components of the index have identical sample volatilities. Since during times of crisis Δe and

ΔR enter the index positively the KM3 measure indicates that a crisis has occurred if the observed value of I rises above its mean by three standard deviations.

For several countries, notably Argentina, Brazil, Bolivia, Chile and Peru, that experienced episodes of hyperinflation during the sample period, simply using the sample means and standard deviations to calculate the crisis indices would cause the index to over indicate crisis during periods of high inflation while missing crises in periods of low inflation. To avoid this problem, we subdivide the data into hyper and low inflation periods and calculate the above two indices based on the sub-sample means and variances.

Crises and Empirical Regularities

Using the two measures described above, we are able to identify 124 unique exchange rate crises over the sample period of 1970:1 to 2002:1. Of the 124 crises, the simple Std3 measure accounts for 115, the KM3 measure accounts for 80, with both measures jointly indicating crisis in 71 cases. See Table 1. By categorizing the crises by decade and type we confirm that the frequency with which crises occur has increased over the past three decades. This trend is largely blamed on increased financial liberalization and integration (see Glick and Hutchison (1999), Jeanne (1999) and Flood and Marion (1998)).

We also notice that there is a consistency over time in the size and pattern of crises that individual countries experience. For example, Columbia's crisis induced devaluations fall in a band between 5% and 8%, whereas for Argentina devaluations tend to be between 50% and 95%. Thailand and Malaysia, on the other hand, experience both large and small crises with two distinct episodes where smaller 8-9% devaluations immediately precede larger 15-20% devaluations. Finally, members of the European Union experience similar devaluations that range between 10-15%.

Next, we can clearly identify well-known periods of instability, such as the "Asian Flu" period with devaluations in Indonesia, Korea, Thailand, the Philippines and Malaysia occurring in late 1997 and early 1998, as well as the ERM crisis in Europe, the Latin America debt crisis of the early 1980's and the "Tequila Crisis" of 1994. The argument in support of contagion is clearly visible by looking at the timing of crisis for Pacific Rim countries in the late 1990's. Consistent with Radlet and Sachs (1998) and others, the "Asian Flu" had its beginning in Thailand in early July 1997 and then spread across Asia with Indonesia experiencing the beginning of its crisis period in December, 1997. Table 2 illustrates this idea by listing the participant countries and the month in which they experienced a currency crisis.

Defining the Attack

According to the theory we have developed, we can measure the size of the currency attack that a country experiences by using a simple balance of payments accounting identity. In the classic Krugman style currency attack, the amount of currency that must be redeemed will be equal how the redemptions are financed. Thus we define the size of an attack or currency reversal as

$$\frac{\Delta D}{1+\pi} = \Delta R - B(r_c) - CA \tag{16}$$

where $\frac{\Delta D}{1+\pi}$ is the foreign currency value of the attack, ΔR is the change in reserves resulting from the government's defense against the attack, $B(r_c)$ is the change in the external debt position of the country, and CA is the current account.[1] Since the actual attack is unobserved, we can use the above definition to measure it as the residual of the change in domestic holdings of foreign assets that is not explained by changes in official reserves, borrowing and the current account.

For each country in our sample, we construct three separate series of attack measures. The first measure is based purely on changes in total reserves and the size of the current account. We call this type of attack the "No Credit" or ΔD_{NC} attack since it does not include the credit component developed in the augmented model. This attack measure is useful since it allows us to

[1] Recall equation (4) and the accounting identity KA+CA=0.

estimate the crisis relationship over the entire sample period and for all the countries in the sample. It also allows us to construct a baseline against which can evaluate the contribution of credit flows to the fit of the model.

Second, we construct an attack measure that includes credit, as described above, and has two variants. The first variant, ΔD_{FA}, is constructed by using net flow financial account data from the IFS database. The second variant, ΔD_{BIS}, uses BIS total external debt flow data.

Finally, to account for the fact that the duration of an attack can last several periods, that the depreciation is only observed in the last period, and that in many cases by the time the depreciation is observed asset flows have reversed, the above measures are constructed using a variable lag window that permits the attack to be from one to four months in duration with a fifth specification that comprises the three months preceding the devaluation. We denote these attacks as ΔD^{t-i} and define them as

$$\Delta D^{t-i} = \sum_{j=0}^{i} \Delta R_{t-j} - B(r_c)_{t-j} - CA_{t-j} \qquad (17)$$

where i is the number of prior months included in the measure, dropping the $1+\pi$ term for notational convenience. We denote the prior three months attack measure, ΔD^{t1-3}, which is identical to those defined in (17) with $j=1$ instead of zero. It is expected that the greater the duration of an attack, the greater the resulting devaluation. As such when estimating the model, we expect that the attacks based on extended lags as well as the prior-three-month measure should be the most significant. Empirical analysis confirms this hypothesis.

The model suggests that the sign on ΔD should be negative since the level of domestically held foreign assets is rising as deposit holders shift from domestic currency to foreign currency deposits. In practice, we observe that for about one-half of all crises the sign of ΔD is positive. An examination of the components of our attack measure quickly reveals what can cause the measure to be positive and also provides a useful tool for classifying different types of crisis. Specifically, crises with $\Delta D < 0$ generally fit the description of classic currency crises as outlined by our model whereas episodes with $\Delta D > 0$ are generally characterized by attacks against both the currency and credit of the country. The intuition for this relationship is illustrated in Table 3.

For crises where the attack variable is negative, we find that the signs on the components of the attack generally match those predicted by the model: Given an attack, reserves are expended, financial flows are positive, and the current account is generally negative. In order for an attack to result in $\Delta D > 0$ it must be the case that during the attack the country suffers a large financial reversal, or the current account deficit is so large that it overwhelms the other components. The data verify these claims. Thus, attacks where $\Delta D > 0$ are the result of crisis episodes where agents not only attacked the domestic currency, but also chose to redeem or recall short-term loans and other financial assets. We refer to this type of attack as a “credit crisis” attack. This description is consistent with the “Twin Crisis” or “Debt Crisis” attacks that characterized the “Tequila” and “Asian Flu” crises.

Consistent with the notion that countries that experience both currency and financial crises experience larger macroeconomic fluctuations, we expect that the estimation results using the credit crisis sample will be very significant, and that the debt component of the model will take on added significance.

IV. Empirics

Using a cross-section of the 124 crisis episodes in our sample we test the relationships suggested by the model using simple OLS estimation over several specifications of attack length. We find that for classic currency crises the data support the model and that we can reject the no credit specification using financial account data as our measure of debt. However, regressions for currency crises that make use of BIS debt data tend to be both inconsistent and insignificant. In contrast, for estimation using credit crises, both BIS and financial account data produce significant and robust results over different attack length specifications. We reject the no credit model for the credit crisis sub-sample as well.

Estimation of the relationship between currency attacks and unemployment produce very interesting results. Using the entire sample, we cannot reject the no-credit model, and the regression itself is insignificant. If, however, we divide the sample by crisis type we find that for currency crises that resulted in increased unemployment the current account becomes significant; confirming our model's specification of the current account. If, however, we limit our sample to credit crises that resulted in decreased unemployment, the current account becomes insignificant, and the coefficient on debt becomes significant over all lag specifications. This enables us to draw conclusions about the type of attack a country experiences as well as the source of the attack itself.

Devaluations

Recall from the discussion presented above that the size of the optimal devaluation, given an attack, is a linear function of the components of the balance of payments and is represented as:

$$1+\pi_c = \frac{\alpha}{\varphi-\alpha\beta}(CA + B(r_c) - \Delta R) \tag{18}$$

Which translates into the general linear form of

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_2 B(r_c)_i + \alpha_3 \Delta R_i + \varepsilon_i \tag{19}$$

or the restricted form implied by the model of

$$\pi_i = \alpha_0 + \beta_1 (CA_i + B(r_c)_i + \Delta R_i) + \varepsilon_i \tag{20}$$

We make use of both in estimation.

Classic Currency Crises

We examine those attacks in our sample that have been classified as currency crises and begin testing the model by first estimating the no credit attack specification

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_3 \Delta R_i + \varepsilon_i \tag{21}$$

over Std3 crisis events where the attack variable $\Delta D_{NC}^{t-1} < 0$, and the expected signs of the coefficients are $\alpha_1 < 0$, $\alpha_3 > 0$. We then estimate a restricted version of the model

$$\pi_i = \alpha_0 + \beta_1 (CA - \Delta R)_i + \varepsilon_i \tag{22}$$

over the same sample. The results are presented in Table 4. In the table, column one lists the varying definitions of attack length used in estimation, columns two through four contain the coefficients for the intercept, current account, and the change in reserves respectively. Column five contains the results for the restricted regression. We find that the current account enters both significantly and with the expected sign, and that with the extension of the attack to additional months, the current account remains significant. Reserve holdings also enter with the expected sign, but are not significant beyond the current month. The model suggests that the coefficients on the components of the general form should be equal to one another, thus we perform a Wald Test on the restriction that $\alpha_1 = -\alpha_3$, and find that we cannot reject the null hypothesis (F-Stat: 0.2520 Pr: 0.617 for the t-3 regression). Wald tests on the remaining regressions produce similar results.

Estimation of the restricted model also produces results with the model, with the coefficient on the aggregate variable, β_1, being both positive and significant. The interpretation of the coefficient on the restricted regression is straightforward: On average, for the current period t regression, an attack equal to 50% of total trade would result in a depreciation equal to 37%. This result is roughly consistent to the December 1997 depreciation in Korea. We extend our analysis by adding debt to the regression framework and estimating the full general form using Std3 crises and attacks that satisfy $\Delta D_{FA}^{t-1} < 0$ as our sample. Thus, for the relationship

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_2 B(r_c)_i + \alpha_3 \Delta R_i + \varepsilon_i \tag{23}$$

we obtain the results presented in Table 5.

As with the no credit results, the current account has the expected sign, and is significant at 95% or greater in every specification. Reserves become significant in the longer attack specifications in addition to the period t attack specification. The coefficient on debt is significant beginning with the t-2 regression. As before, we test the restriction that $\alpha_1 = \alpha_2 = -\alpha_3$ and find that we narrowly fail to reject the null hypothesis (F-Stat: 2.30, Pr: 0.11 for the t-3 regression). Similar results are obtained for the remaining regressions.

Most importantly, we perform likelihood ratio tests of our model and the original no credit specification in order to determine whether or not the addition of credit improves the model's ability to explain the data. For regressions t-2 through t1-3 the likelihood statistics for this test are 3.53, 3.10, 3.50, respectively, and with 30 d.f. we are able to reject the no credit specification at the 99% level. We are unable to reject the no credit model for those regressions in which the coefficient on credit is insignificant.

As a further part of our investigation, we estimate the model over different geographic regions to see if different regions respond to crises in different ways. For European, Latin American, and Mediterranean subgroups we cannot reject the no credit model, and the coefficients resemble those in the no credit estimation above, with the current account being the primary explanatory variable. For the Asian subgroup, however, we find a dramatic increase in the significance of debt. The results for this sub-group are presented in Table 6.

The small number of observations raises questions about the robustness of these results, but it is clear that for the Asia, debt played a major role in the currency crises of the 1990's. This stands in contrast to European countries where the opposite is true: Credit flows play a small role relative to the current account and reserve expenditures.

Credit Crises

For almost half of all observed crises the attack measure is positive, and in some case quite large. Recall that in order for an attack to be positive, it must be the case that credit flows are negative and large, or the current account deficit is large. For Asian countries in the 1990's the credit crises we observe can be traced to the large financial reversals the resulted in widespread crisis. Radlet and Sachs (1998) document these reversals and describes them as the result "of a euphoric inflow of capital that could not be sustained." As such, the capital flight we observe in the months leading up to a crisis supports the observation that the "Asian Flu" crises were not caused by a classic currency reversal, but instead by sudden debt recall. Specifically, the sudden collapse of the banking sector in the Pacific Rim caused Standard and Poor's to downgrade the foreign currency sovereign debt ratings for all five countries in our sample to junk status. Under the "sovereign ceiling," doctrine, where no private lender can have a credit rating higher than the country's government, all private debt was accordingly downgraded (see Montiel and Reinhart (1999) and Rodrik and Velasco (1999)). This resulted in a widespread panic as lenders attempted to recall their short-term loans before debtors ran out of foreign currency reserves with which to repay them. Thus, even though the proximate cause of the crisis was not a currency reversal as envisioned by our model, the result was the same: A signal to market participants causes agents to redeem a country's assets thus forcing the country to exhaust its foreign reserves, resulting in crisis. The other countries that fall into the credit crisis sample are largely South American countries with large current account deficits, or European countries during the ERM crisis.

What makes these crises of particular interest is the fact that the capital flight from the countries precludes the possibility that credit will be obtained in order to finance the external gap. We estimate the same regression equations presented above, but now use the subset of Std3 observations that are also credit crises. The results are presented in Table 7. We notice immediately that the sign on reserves is now ambiguous, and insignificant. Debt changes sign and becomes very significant. Wald tests reject the null hypothesis of $H_{0:}\ \alpha_1 = \alpha_2 = -\alpha_3$ at the 99% level (F = 7.76 P = 0.001 for the t-3 regression). The significance of debt and its corresponding change in sign reflects the fact that unlike traditional crises, these credit crises were characterized by large negative flows of capital as lenders recalled credit simultaneously with the attack on the currency. Likelihood ratio tests strongly reject the no credit model over all lag specifications (LR = 125.44, 131.20, 127.45, 128.20, 127.62, CV = 2.39 for 99% for the unrestricted regressions. Similar results are obtained for the restricted version).

For a set of regressions using BIS data we find that the sign on the debt coefficient changes as lag length grows. The period t attack it is negative, but beginning with the t-1 attack the coefficient becomes positive and very significant. This finding is clearly at odds with the results for the financial account data. A close inspection of the data reveals that the subset of crises used in estimation is comprised almost entirely of the Asian-5 countries, and that for the countries in question, bank lending remains positive up until the crises begins. This stands in contrast to the debt flows represented by the financial account that are negative for up to six months prior to the attack. The difference in the sign on debt flow for BIS and financial account data confirms that the banking sector was completely surprised by the onset of currency crises in the 1990's, whereas domestic agents, represented in the broader financial account data, were fleeing domestic assets early on. Such preemptive flight has been well documented in the literature by Kaminsky (1998) and Frankel and Schmukler (1996).

Unemployment

Unemployment can both cause and be caused by the realization of a rapid devaluation. Consistent with our model, it can be caused by a governments raising domestic interest rates, or reducing spending in order to close the external gap created by an attack. This process follows the conventional wisdom from the currency crises of the 1980's wherein countries that experienced crisis were characterized by current account and fiscal deficits, an expanding monetary base as well as rising domestic credit. As such, the appropriate response, outlined in the model and adopted by the IMF, is to contract: Hence increased unemployment.

Unemployment can also cause a crisis if, as was the case with the European Exchange Rate Mechanism failure of the Early 1990's, a country is forced to pursue restrictive monetary or fiscal policy in an effort to maintain an exchange rate peg. In our model this is equivalent to the government increasing unemployment in an effort to strengthen the current account to forestall crisis. Equation (1) provides motivation for a second strategy: Increasing domestic interest rates increases $\bar{\pi}$, the maximum depreciation that is consistent with agents retaining domestic assets. The practical effect of such policies is to induce agents to retain or increase their holdings of domestic deposits with an eye to avoiding a crisis. For example, in an effort maintain its exchange rate within the band set forth by the ERM, Sweden raised central bank lending rates in 1992 to 500%. Such contractionary policies are ultimately unsustainable since they result in unemployment that can only be relieved by simultaneously abandoning the policy and the exchange rate.

Thus for some countries in our sample we expect to find that a crisis will be followed by an increase in unemployment whereas for others we expect that the crisis will signal a policy change that leads to improved employment levels. Whether or not a country fits into one category or another will be largely determined by whether they had to close an external gap: unemployment following a crisis, or were avoiding a gap: unemployment preceding a crisis. This description is consistent with our categorization of attacks by sign. We would expect currency attacks to be characterized by crisis-induced unemployment and credit crises to be characterized by crisis-relieved unemployment.

In terms of the model itself, the level of unemployment that will result from a currency crisis is a function of the government's willingness or ability to expend reserves and raise capital, and the governments' relative preferences over unemployment and devaluation. Recall the simplified linear form presented in Section II

$$u_c = \frac{1}{\varphi}\left[(1-\theta)\left(\Delta R - B(r_c) - CA_0\right) + \theta \Delta CA_C + \beta\right] \quad (24)$$

which is, essentially, the weighted sum of the un-financed portion of the external gap and the improvement in the current account necessary to close the gap. We generalize this relationship as

$$\Delta u_i = \alpha_0 + \alpha_1 \Delta R_i + \alpha_2 B(r_c) + \alpha_3 CA_0 + \alpha_4 \Delta CA_i + \varepsilon_i \quad (25)$$

and estimate using ordinary least squares.

Since we cannot obtain reliable unemployment data for the majority of the countries in our sample, we utilize percentage changes in industrial output to proxy for unemployment. Specifically, using twelve month differencing we construct annualized growth rates for each month in our sample. We then isolate the peaks and troughs in the data by taking the difference of the maximum growth rate in the period prior to the crisis and the maximum growth rate following the crisis. A second measure using the difference in average growth rates is also used. Both measures produce similar results; only the max-to-max outcomes are presented below.

As with the devaluations, we divide the sample into currency and credit crisis groups and estimate (25) for each group. We find that for currency attacks, the current account plays a major role in explaining the unemployment resulting from the attack. More specifically, this is true for crises that are also characterized by decreases in output growth. For the subgroup of credit crises characterized by improvements in output growth we find that the current account loses significance, and that the debt measure becomes the dominant variable. A summary of relationships is presented in Table 8.

In addition to the lagged variables that we constructed in order to perform the analysis of the crisis devaluation, we construct two additional groups of variables that include leads and lags around the crisis month of three and four months respectively. Including leads in our analysis is necessary to capture the improvements to the current account, and subsequent flows of reserves and debt that follow a crisis. In the case of currency attacks, we expect the improvement in the current account that occurs after the devaluation to reduce output growth. Likewise, for credit crises abandoning contractionary policies and devaluing the exchange rate should halt capital flight and permit increased output growth. We begin by investigating the currency crisis group.

Classic Currency Crises

Estimating (25) using OLS yields the results documented in Table 9. With ΔCA being the only significant variable in the regression equation, we conclude that our priors regarding classic currency attacks are correct: In response to a classic currency crisis, countries pursue contractionary fiscal or monetary policy. Although ΔCA is not itself a common policy variable, it can proxy for the underlying macroeconomic stance of an economy. This is especially true for a country that has experienced a crisis and has accepted the policy recommendations of the IMF. Such recommendations traditionally focus on improved domestic budgets, bank asset re-capitalization, increased interest rates, etc; all of which increase unemployment. The estimates we obtain are remarkably consistent indicating that an improvement in the current account equal to approximately 10% of total trade would, on average, result in a decrease in output growth of 8%; ignoring insignificant variables. Regressions using short attack lags do not produce significant results. Only a longer attack window allows the improvements in the current account to become large enough to explain unemployment.

To check the robustness of these regressions we first conduct Wald tests on the restriction implied by the model that $H_0 : \alpha_1 = -\alpha_2 = -\alpha_3$ and find that we cannot reject the null hypothesis (F-Stat=1.041, P=0.376). This result is unsurprising since none of the regressors in question are significantly different from zero. We next test the composite hypothesis that the sum of the regressors equals one (see equation (25)) and can reject the null hypothesis at the 99% level (F-Stat=299, P=0.0 for t-4). It is important to note that rejecting the null hypothesis on the sum of coefficients equaling one does not necessarily compromise our model's validity. As constructed the components of the balance of payments equation enter with equal weight in our regression. If the data we use were completely exhaustive of all financial flows, and if financial flows did not have any second round effects, we would expect this relationship to hold. A more general form of the model could include separate coefficients for each component thus circumventing this problem. Finally, we check to see if the specification of our model can reject the no credit specification. Likelihood ratio tests of the two models confirm our expectations and we are unable to reject to no credit model. Since for classic currency crises the current account plays the dominant role, this result is unsurprising.

Credit Crises

Estimating our unemployment equation (25) using the set of crises that are characterized by both a credit crisis and positive output growth reveal that unlike the negative attack group, the current account is not a significant component in describing the changes in output following a crisis. Instead, the debt measure becomes significant over every lag that we specify. The results are reported in Table 10.

The intuition that we developed above suggests that if a country experiences a crisis and output subsequently increases it must have been the case that the country was pursuing contractionary policies in order to maintain a fixed exchange rate. A quick review of the countries and attacks in the sub-sample seem to support this conclusion; with the attack on the Spanish Peseta in July 1993 being a prime example. In this case, as with those previously discussed, Spain resisted devaluing the Peseta in order to maintain its exchange rate within the limits set by the ERM. Other countries in the sample include Colombia, Sweden and Norway and are characterized by similar circumstances.

As before, we test the restrictions implied by our model and find that for $H_0 : \alpha_1 = -\alpha_2 = -\alpha_3$ and we fail to reject the null hypothesis (F-Stat: 0.181, Pr: 0.838 for t-4). For the restriction that the coefficients on the regressors should sum to one, we can reject the null hypothesis at the 95% level (F-Stat: 8.978, Pr: 0.020 for the t-4 regression).

A last hypothesis test is performed to determine whether or not our model can reject the no credit specification. We find that with the use of the credit crisis sub sample we are able to reject the no credit model for equations t-1 to t-4 at the 95% level and above (LR: 9.607, 5.483, 9.312, 6.668, CV: 3.79). Using the first two equations in Table 10 we cannot reject the no credit model. This is unsurprising since the lags they employ were designed to capture the ongoing improvement in the current account following a classic attack.

Interpretation of these coefficients follows the following logic: For countries resisting attack using contractionary policy, negative debt flows serve as a proxy for the policy impact on dampened output growth. Thus, for the t-4 regression, policies that cause financial flight worth 10% of total monthly trade correspond to a reduction in output growth equal to approximately 13% that will only be relieved once the crisis has occurred. Alternatively, since it is understood that the policies that are reducing output growth must ultimately be abandoned, the capital flight we observe prior to the depreciation may represent the actions of lenders fleeing the market prior to an inevitable depreciation.

V. Conclusion

In this paper we have briefly reviewed a simple theoretical model that provides a framework for understanding and analyzing the proximate causes and effects of an exchange rate crisis. Specifically, the model provides us with two equations that relate the primary observable outcomes of crisis, namely devaluation and unemployment, to the components of the balance of payments used to measure the size of the attack directed at the country.

Using the relationships suggested by the model, we are able to categorize attacks into two categories: Classic currency crises and credit crises. We provide a framework for understanding the causes and implications of the different types of attack and conclude that currency crises are largely characterized by episodes in where a country is forced to respond to a crisis whereas credit crises generally correspond to countries that are trying to avert crisis. We make further use of the division of crisis type to estimate both the devaluation and unemployment relationship.

We find that we are able to reject the no credit model in favor of our credit-augmented model for both classic currency crises and credit crises and their corresponding devaluations. We also find that the data support the notion that the size of a currency attack directly impacts the consequent devaluation. This relationship holds especially well for the credit crisis subset, which is largely characterized by both currency and credit reversals. Further estimation of regional subgroups demonstrates the key role that credit flow played in the "Asian Flu" crisis episode, and the limited role of credit in the European, Latin American and Mediterranean regions.

We next estimated the unemployment relationship and found that for currency attacks resulting in decreased output growth the improvement in the current account resulting from the crisis explains the majority of the fluctuation in output. This result is consistent with the theory developed in our model that directly relates improvement in the current account to increased unemployment. We also find that when using the credit crisis subset the variable of interest is the measure for credit flows. This is also consistent with our contention that credit crises correspond to large financial reversal brought on by either financial panic (Asia) or attempts to avert devaluation (Spain). We are unable to reject the no credit model for the classic currency crises, where credit is unimportant, but strongly reject for credit crises, where credit is important.

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Table 1 – Crises

Decade	1970	1980	1990	Full Sample
Std3	31	40	44	115
KM3	17	32	31	80
Joint	15	30	26	71
Total	33	42	49	124

Notes: Number of currency crises by decade and type for two measures of crisis. Std3 crises are indicated by a percentage change in the nominal national currency/US$ exchange that exceeds three standard deviations from its mean. KM3 crises are indicated by a composite exchange rate/reserves index that has exceeded three standard deviations beyond its mean.

Table 2 – Contagion in the Pacific Rim

Date	Thailand	Malaysia	Philippines	Korea	Indonesia
July, 1997	21.7%	4.1%			
August, 1997	6.8%	11.7%			
September, 1997		7.6%	14.3%		
October, 1997	8.4%				
November, 1997				18.7%	
December, 1997	16.3%	10.5%	38.32%	37.6%	24.27%
January, 1998	15.0%	16.0%			80.25%

National Currency Depreciations

Notes: Percentage changes in the nominal national currency/US$ exchange rate for the “Asian-5” countries. Contagion is defined as an increase in the probability of crisis at home given the existence of a crisis elsewhere. The sequential nature of balance of payments crises in the Pacific Rim is largely blamed on contagion.

Table 3 - The Components of the Attack Variable

$\frac{\Delta D}{1+\pi}$	=	ΔR	-	$B(r_c)$	-	CA
-	Expected	Negative		Positive		Negative
	Observed	Generally Negative		Generally Positive		Generally Negative
+	Expected	Negative		Negative		Negative
	Observed	Negative or Small		Negative		Generally Negative

Notes: Expected and observed signs of the components of the balance of payments during crises.

Table 4 – No Credit Results for Classic Currency Crises

LAG	α_0	α_1	α_2	α_3	β_1	R^2	OBS
t	0.199 (0.026)*	0.435 (0.131)*		-0.189 (0.088)**		0.225	36
t-1	0.205 (0.030)*	0.213 (0.074)*		-0.110 (0.074)		0.151	36
t-2	0.227 (0.029)*	0.140 (0.050)*		-0.056 (0.066)		0.146	35
t-3	0.225 (0.030)*	0.103 (0.039)**		-0.055 (0.059)		0.126	35
t1-3	0.227 (0.030)*	0.133 (0.054)**		-0.055 (0.060)		0.103	35
t	0.192 (0.027)*				0.244 (0.086)*	0.168	36
t-1	0.192 (0.028)*				0.161 (0.063)**	0.136	36
t-2	0.210 (0.026)*				0.116 (0.046)**	0.131	35
t-3	0.212 (0.026)*				0.093 (0.037)**	0.134	35
t1-3	0.211 (0.027)*				0.101 (0.048)**	0.090	35

* - Significant at 99%, ** - Significant at 95%, *** - Significant at 90%

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_3 \Delta R_i + \varepsilon_i \qquad \pi_i = \alpha_0 + \beta_1 (CA - \Delta R)_i + \varepsilon_i$$

Estimation results for the depreciation relationship using both the restricted and unrestricted models. LAG refers to the number of periods prior to the depreciation, including the current period, used in estimating the equation. See equation (2.3). LAG t1-3 consists of the total financial flows in the three months preceding the observed devaluation.

Table 5 – Classic Currency Crises with FA Credit Data

LAG	α_0	α_1	α_2	α_3	β_1	R^2	OBS
t	0.188 (0.032)*	0.480 (0.153)*	0.107 (0.181)	-0.223 (0.106)**		0.209	36
t-1	0.175 (0.043)*	0.287 (0.106)**	0.116 (0.119)	-0.187 (0.109)***		0.150	36
t-2	0.190 (0.035)*	0.220 (0.065)*	0.121 (0.066)***	-0.150 (0.082)***		0.203	35
t-3	0.195 (0.034)*	0.158 (0.050)*	0.080 (0.046)***	-0.118 (0.068)***		0.175	35
t1-3	0.199 (0.033)*	0.213 (0.068)*	0.103 (0.057)***	-0.118 (0.068)***		0.162	35
t	0.176 (0.033)*				0.266 (0.109)**	0.122	36
t-1	0.154 (0.042)*				0.227 (0.102)**	0.101	36
t-2	0.176 (0.032)*				0.171 (0.061)*	0.164	35
t-3	0.189 (0.030)*				0.112 (0.045)**	0.131	35
t1-3	0.192 (0.032)*				0.119 (0.055)**	0.098	35

* - Significant at 99%, ** - Significant at 95%, *** - Significant at 90%

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_2 B(r_c)_i + \alpha_3 \Delta R_i + \varepsilon_i \qquad \pi_i = \alpha_0 + \beta_1 (CA_i + B(r_c)_i + \Delta R_i) + \varepsilon_i$$

Estimation results for the depreciation relationship using both the restricted and unrestricted models. LAG refers to the number of periods prior to the depreciation, including the current period, used in estimating the equation. See equation (2.3). LAG t1-3 consists of the total financial flows in the three months preceding the observed devaluation. For these regressions we use financial account data to proxy for total credit flows in the country. Debt is significant in the long estimation windows.

Table 6 – Classic Crises in the Asian Sub-Sample.

LAG	α_0	α_1	α_2	α_3	β_1	$\bar{R}^2$	OBS
t	0.197	0.491	0.434	0.207		0.902	7
	(0.017) *	(0.110) **	(0.101) **	(0.129)			
t-1	0.184	0.326	0.224	-0.088		0.819	7
	(0.030) *	(0.096) **	(0.062) **	(0.119)			
t-2	0.189	0.245	0.121	-0.087		0.873	7
	(0.040) **	(0.108)	(0.031) **	(0.169)			
t-3	0.213	0.161	0.097	-0.015		0.842	7
	(0.036) **	(0.061) ***	(0.029) **	(0.139)			
t1-3	0.221	0.224	0.126	-0.030		0.794	7
	(0.037) **	(0.088) ***	(0.041) ***	(0.150)			
t	0.219				0.277	0.342	7
	(0.038) *				(0.136) ***		
t-1	0.175				0.268	0.578	7
	(0.038) *				(0.088) **		
t-2	0.205				0.153	0.547	7
	(0.033) *				(0.053) **		
t-3	0.219				0.112	0.578	7
	(0.029) *				(0.036) **		
t1-3	0.228				0.132	0.414	7
	(0.034) *				(0.057) ***		

* - Significant at 99%, ** - Significant at 95%, *** - Significant at 90%

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_2 B(r_c)_i + \alpha_3 \Delta R_i + \varepsilon_i \qquad \pi_i = \alpha_0 + \beta_1 (CA_i + B(r_c)_i + \Delta R_i) + \varepsilon_i$$

Estimation results for the depreciation relationship using both the restricted and unrestricted models. LAG refers to the number of periods prior to the depreciation, including the current period, used in estimating the equation. See equation (2.3). LAG t1-3 consists of the total financial flows in the three months preceding the observed depreciation. For these regressions we use financial account data to proxy for total credit flows in the country. Debt is significant regardless of lag length. The robustness of these results is questionable due to the low number of observations, but clearly suggests the importance of credit flows in the Asian crises of the 1990's.

Table 7 - Credit Crises with FA Credit Data

LAG	α_0	α_1	α_2	α_3	β_1	$\bar{R}^2$	OBS
t	0.146 (0.027)*	-0.345 (0.123)*	-0.260 (0.103)**	0.007 (0.076)		0.281	34
t-1	0.152 (0.028)*	-0.162 (0.067)**	-0.125 (0.051)**	-0.061 (0.064)		0.348	34
t-2	0.138 (0.032)*	-0.126 (0.051)**	-0.085 (0.035)**	-0.051 (0.050)		0.300	33
t-3	0.138 (0.031)*	-0.088 (0.038)**	-0.055 (0.027)***	-0.057 (0.043)		0.310	33
t1-3	0.140 (0.031)*	-0.108 (0.050)**	-0.064 (0.034)***	-0.066 (0.042)		0.296	33
t	0.171 (0.019)*				-0.123 (0.076)	0.045	34
t-1	0.167 (0.019)*				-0.095 (0.050)***	0.071	34
t-2	0.170 (0.019)*				-0.065 (0.035)***	0.065	33
t-3	0.172 (0.019)*				-0.052 (0.029)***	0.065	33
t1-3	0.183 (0.019)*				-0.031 (0.035)	-0.007	33

* - Significant at 99%, ** - Significant at 95%, *** - Significant at 90%

$$\pi_i = \alpha_0 + \alpha_1 CA_i + \alpha_2 B(r_c)_i + \alpha_3 \Delta R_i + \varepsilon_i \qquad \pi_i = \alpha_0 + \beta_1 (CA_i + B(r_c)_i + \Delta R_i) + \varepsilon_i$$

Estimation results for the depreciation relationship using both the restricted and unrestricted models. LAG refers to the number of periods prior to the depreciation, including the current period, used in estimating the equation. See equation (2.3). LAG t1-3 consists of the total financial flows in the three months preceding the observed devaluation. For these regressions we use financial account data to proxy for total credit flows in the country. Debt is significant regardless of lag length. These credit crises differ from the classic currency crisis in that they are characterized by large negative flows of debt from the country in crisis suggesting an attack on both the currency and financial sectors of the country. Such attacks are consistent with the “Twin Crises” described in the literature.

Table 8 - Attacks and Output Growth

		Currency Crises: $\Delta D < 0$	Credit Crises: $\Delta D > 0$
Increased Output Growth	$\Delta u_{M12} > 0$	Regressions Insignificant	Debt Significant
Decreased Output Growth	$\Delta u_{M12} < 0$	Current Account Significant	Regressions Insignificant

Notes: Table 8 documents the general regression results for the two types of attack that we consider in the paper and the subsequent changes in output growth. We find that classic currency crises followed by decreases in output growth closely match the theory developed in our model with the improvement in the current account being strongly correlated to the change in output. Credit crisis attacks, however, tend to exhibit a strong correlation between credit flight preceding the actual depreciation and subsequent output growth. Cross estimation of these groups produces mixed results, with the debt component improving in significance any time credit crisis attack are used.

Table 9 – Classic Currency Crises and Negative Output Growth

LAG	α_0	α_1	α_2	α_3	α_4	R^2	OBS
t-3, +3	-0.042	0.014	-0.002	-0.096	-0.193	0.046	21
	(0.011)*	(0.021)	(0.012)	(0.080)	(0.092)***		
t-4, +4	-0.045	-0.015	-0.004	0.006	-0.210	0.332	19
	(0.012)*	(0.011)	(0.007)	(0.065)	(0.100)***		
t-1	-0.049	0.004	0.023	-0.031	-0.003	0.110	21
	(0.015)*	(0.025)	(0.018)	(0.058)	(0.150)		
t-2	-0.055	-0.012	0.005	0.020	-0.173	0.074	20
	(0.014)*	(0.031)	(0.022)	(0.058)	(0.125)		
t-3	-0.073	-0.057	-0.001	0.101	-0.153	0.294	21
	(0.018)*	(0.033)	(0.011)	(0.091)	(0.096)		
t-4	-0.066	-0.039	0.000	0.070	-0.179	0.342	19
	(0.016)*	(0.030)	(0.012)	(0.066)	(0.072)**		

* - Significant at 99%, ** - Significant at 95%, *** - Significant at 90%

$$\Delta u_i = \alpha_0 + \alpha_1 \Delta R_i + \alpha_2 B(r_c) + \alpha_3 CA_0 + \alpha_4 \Delta CA_i + \varepsilon_i$$

Notes: As with the depreciation experiments, LAG refers to the window over which the regression were estimated, with t-3, t+3 suggesting that the total financial flows from three months preceding the attack to the three months following the attack were utilized. Notice that consistent with our model, the coefficient on the change in the current account is significant and has the right sign: An improvement to the current account is correlated with decreased output growth following a classic currency crisis.

Table 10 – Credit Crises and Positive Output Growth

LAG	α_0	α_1	α_2	α_3	α_4	R^2	OBS
t-3, +3	0.148	0.064	-0.036	0.155	-0.148	0.622	12
	(0.064)***	(0.041)	(0.009)*	(0.222)	(0.123)		
t-4, +4	0.142	0.054	-0.039	0.069	0.054	0.152	12
	(0.054)**	(0.044)	(0.017)***	(0.263)	(0.207)		
t-1	0.135	0.189	-0.250	0.028	-0.105	0.389	12
	(0.094)	(0.149)	(0.090)**	(0.426)	(0.222)		
t-2	0.151	0.041	-0.103	0.082	-0.275	0.375	13
	(0.090)	(0.120)	(0.046)***	(0.391)	(0.238)		
t-3	0.153	0.110	-0.091	0.071	-0.177	0.560	12
	(0.069)***	(0.085)	(0.030)**	(0.318)	(0.158)		
t-4	0.127	0.099	-0.083	-0.061	-0.070	0.155	12
	(0.042)**	(0.075)	(0.037)***	(0.263)	(0.287)		

* - Significant at 99%, ** - Significant at 95%, *** - Significant at 90%

$$\Delta u_i = \alpha_0 + \alpha_1 \Delta R_i + \alpha_2 B(r_c) + \alpha_3 CA_0 + \alpha_4 \Delta CA_i + \varepsilon_i$$

Notes: As with the depreciation experiments, LAG refers to the window over which the regression were estimated, with t-3, t+3 suggesting that the total financial flows from three months preceding the attack to the three months following the attack were utilized. Notice that the coefficient on the change in the current account is insignificant and ambiguous in sign. For credit crisis that are followed by improvements in output growth, the large, negative credit flow that precede the depreciation are correlated with the corresponding improvement in output. This suggests that agents understand that a crisis is inevitable and consequently redeem or recall credit lines as the country simultaneously pursues concretionary policies to forestall the depreciation. Once the depreciation occurs, the policies are abandoned leading to increased growth rates.

Table 11 - Devaluations, Attacks and Unemployment

Country	Date	Type	π_{US}	ΔD_{NC}^{t-1}	ΔD_{FA}^{t-1}	ΔD_{BIS}^{t-1}	Δu_{M12}
Argentina	Mar-1975	Joint	69.31%	4.72%			
	Jun-1975	Joint	95.55%	-0.35%			
	Nov-1976	Joint	61.88%	-48.36%	-29.53%		
	Jul-1982	Joint	90.77%	-32.61%	16.40%		18.6%
	Jan-1991	Joint	52.28%	-28.26%	5.00%		12.9%
Bolivia	Oct-1972	Joint	52.09%				3.3%
	Feb-1982	Joint	56.68%	5.37%			-1.0%
	Nov-1982	Joint	152.24%	-77.51%			-15.8%
	Mar-1987	Joint	2.44%	33.65%			8.8%
	Aug-1989	Joint	4.38%				
	Sep-1989	Std3	2.47%	3.91%	-45.42%		
Brazil	Dec-1979	Std3	28.32%	32.50%	-25.30%		
	Sep-1982	KM3	6.77%	-49.90%	-93.37%		
	Feb-1983	Joint	32.62%	-28.81%	8.65%		
	May-1987	Std3	29.02%	-13.10%	72.53%		-8.1%
	Jun-1987	Joint	24.37%	-59.78%	25.35%		-11.6%
	Jan-1999	Joint	49.52%	-37.12%	-20.74%	3.35%	6.5%
Chile	Jul-1971	Joint	109.86%	-13.05%			11.4%
	May-1973	Std3	95.55%	43.70%			9.4%
	Oct-1973	Std3	88.73%	41.72%			
	Oct-1975	KM3	10.38%	-6.26%			41.9%
	Dec-1975	KM3	8.59%	-13.50%			43.2%
	Jan-1976	Std3	16.25%	-46.95%			45.5%
	Jun-1982	Joint	17.50%	29.44%			-1.4%
	Jul-1985	Joint	52.65%	-45.43%			-1.0%
Colombia	Apr-1985	KM3	4.88%	-26.11%			0.6%
	Aug-1995	Joint	6.74%	91.87%		89.95%	-3.9%
	Jan-1997	Std3	6.32%	92.05%	9.21%	43.05%	5.8%
	Sep-1997	Std3	6.55%	31.83%	-25.12%	19.69%	8.0%
	Sep-1998	Joint	7.70%	10.82%	-21.04%	3.86%	-21.8%
	Aug-1999	Std3	7.88%	-23.57%	0.11%	22.92%	18.5%
Denmark	Nov-1978	Std3	10.46%	27.78%	3.16%		-1.6%
	Mar-1991	Std3	10.27%	-32.49%	-15.91%		-0.4%
Finland	Oct-1982	Std3	12.85%	9.48%	-5.32%		-1.6%
	Mar-1991	Std3	9.90%	-39.83%	-40.53%		-5.4%
	Sep-1992	Joint	15.11%	-63.60%	-72.34%		3.5%
Indonesia	Nov-1978	Joint	40.95%	-37.17%			-10.3%
	Apr-1983	Std3	32.06%	-12.64%	-47.09%		24.9%
	Sep-1986	Joint	36.64%	-39.65%	-91.55%		-6.9%

Table 12 – Devaluations, Attacks and Unemployment

Country	Date	Type	π_{US}	ΔD_{NC}^{t-1}	ΔD_{FA}^{t-1}	ΔD_{BIS}^{t-1}	Δu_{M12}
Indonesia	Dec-1997	Joint	24.27%	-58.80%	12.03%	-93.73%	0.2%
	Jan-1998	Joint	80.25%	-38.08%	23.65%	-32.36%	0.2%
	May-1998	Std3	33.89%	-16.43%	-18.25%	-5.45%	9.7%
	Jun-1998	Joint	34.76%	-43.38%	-45.24%	-32.12%	9.7%
Israel	Aug-1971	Std3	18.23%	104.17%			1.8%
	Nov-1974	Joint	35.67%	103.73%	54.18%		-2.2%
	Nov-1977	Joint	38.96%	73.77%	73.95%		3.8%
	Oct-1983	Joint	27.37%	37.29%	14.21%		0.5%
	Jul-1984	Joint	17.84%	12.88%	-23.13%		
	Sep-1984	Joint	20.33%	10.73%	-2.70%		
	Oct-1984	Joint	24.74%	25.98%	29.30%		
	Jun-1985	Std3	17.97%	52.30%	21.78%		-6.9%
Korea	Jun-1971	Std3	12.77%	104.12%			-22.5%
	Dec-1974	Std3	19.31%	56.74%			1.8%
	Jan-1980	Joint	18.09%	32.30%	0.07%		-14.8%
	Nov-1997	Joint	18.72%	-25.33%	33.30%	-44.71%	-7.9%
	Dec-1997	Joint	37.60%	-52.57%	6.30%	-72.03%	-8.3%
Malaysia	Jul-1975	Std3	7.89%	24.77%			7.3%
	Jul-1997	KM3	4.11%	-23.43%		-38.02%	-1.5%
	Aug-1997	Joint	11.73%	-34.35%		-47.99%	-0.2%
	Sep-1997	Std3	7.66%	-1.96%		-15.59%	-2.2%
	Dec-1997	Joint	10.47%	-14.25%		7.00%	-4.2%
	Jan-1998	Joint	16.00%	-21.94%		-2.66%	-11.7%
Mexico	Sep-1976	Joint	46.23%	20.15%			-12.2%
	Oct-1976	Joint	25.02%	-22.85%			-12.2%
	Feb-1982	Joint	51.71%	-32.15%	-75.25%		-6.5%
	Dec-1982	Joint	65.73%	-80.32%	1.76%		-8.8%
	Jul-1985	Joint	20.87%	-59.11%	-53.03%		-2.6%
	Dec-1987	Std3	22.57%	-47.77%	-0.43%		-0.2%
	Dec-1994	Joint	43.41%	-63.43%	-43.57%	-56.35%	-6.3%
Norway	Jul-1975	Std3	9.63%	48.00%	4.47%		1.9%
	Nov-1978	Joint	9.19%	-2.96%	-24.68%		-3.8%
	May-1986	Joint	11.47%	-4.59%	-62.54%		29.1%
	Mar-1991	Std3	9.73%	-52.45%	-53.29%		3.7%
	Oct-1992	Std3	8.90%	-31.21%			-10.0%
	Nov-1992	KM3	4.67%	-67.42%			-8.8%
Peru	Jun-1976	Joint	36.77%	11.28%			
	Oct-1977	Std3	23.32%	24.58%	-23.28%		
	Oct-1987	Joint	23.00%	-26.67%			-20.2%
	Dec-1987	Joint	50.08%	23.18%			-15.6%
	Sep-1988	Std3	202.50%	28.66%			-27.0%
	Aug-1990	Std3	197.51%	69.19%			1.5%
	Apr-1991	Std3	20.54%	48.12%	70.94%	66.49%	30.0%

Table 13 – Devaluations, Attacks and Unemployment

Country	Date	Type	π_{US}	ΔD^{t-1}_{NC}	ΔD^{t-1}_{FA}	ΔD^{t-1}_{BIS}	Δu_{M12}
Peru	May-1991	Std3	17.03%	57.98%	70.44%	75.97%	30.0%
	Oct-1991	Std3	14.55%	26.58%	3.53%	1.44%	-15.4%
	Sep-1992	Joint	13.06%	17.85%	-13.74%	-6.14%	-25.8%
Philippines	Feb-1970	Joint	24.11%	48.65%			
	Oct-1983	Joint	25.13%	32.93%	68.94%		22.7%
	Jun-1984	Joint	14.02%	-0.42%	-6.23%		8.5%
	Feb-1986	Joint	11.59%	-5.51%	-0.45%		-0.4%
	Sep-1997	Std3	14.28%	65.66%	40.63%	51.40%	14.3%
	Dec-1997	Joint	38.32%	7.64%	21.63%	3.01%	-8.7%
Spain	Feb-1976	Std3	10.70%	63.80%	43.34%		10.5%
	Jul-1977	Std3	19.91%	62.34%	28.33%		-6.1%
	Mar-1991	Std3	11.25%	25.46%	-18.45%		-0.1%
	Sep-1992	KM3	7.88%	-60.22%	-10.47%		-4.3%
	Oct-1992	Std3	9.81%	-91.48%	-56.25%		-2.6%
	Nov-1992	KM3	5.53%	-66.89%	-45.59%		0.7%
	Jul-1993	Std3	11.14%	30.89%	32.98%		9.1%
Sweden	Aug-1977	Std3	10.85%	-2.14%	-11.32%		-1.0%
	Oct-1982	Std3	16.70%	21.38%	18.05%		7.0%
	Nov-1992	Joint	17.21%	-2.53%	-9.49%		1.7%
Thailand	Jul-1981	Std3	9.10%	50.91%	30.57%		
	Nov-1984	Std3	16.29%	67.78%	37.19%		
	Jul-1997	Joint	21.78%	-10.51%	12.49%	14.40%	-5.1%
	Aug-1997	KM3	6.82%	-53.60%	-18.41%	-1.18%	-8.0%
	Oct-1997	Std3	8.39%	45.53%	88.59%	86.58%	-12.3%
	Dec-1997	Joint	16.31%	-54.29%	-2.69%	-24.63%	-11.2%
	Jan-1998	Joint	15.05%	-8.02%	33.47%	37.26%	-7.1%
Turkey	Aug-1970	Joint	50.14%	99.57%			
	Mar-1978	Std3	26.13%	82.77%			
	Jun-1979	Std3	27.82%	158.68%			
	Jan-1980	Joint	69.31%	67.25%			
	Mar-1994	Joint	19.25%	-25.90%	-40.76%	-35.24%	-12.1%
	Apr-1994	Joint	43.16%	1.09%	15.59%	-3.75%	-1.2%
	Feb-2001	Joint	30.83%	27.77%	47.71%	23.15%	-21.1%
Uruguay	Mar-1972	Joint	69.11%	6.61%			
	Nov-1982	Joint	32.72%	-29.15%			14.4%
	Dec-1982	Joint	58.04%	-97.92%			19.5%
Venezuela	Feb-1984	Joint	55.63%	-87.79%			-3.1%
	Dec-1986	Joint	65.92%	-61.13%			-19.5%
	Mar-1989	Joint	93.37%	46.24%			4.0%
	May-1994	Joint	34.23%	-136.64%	-69.11%	-138.55%	5.7%
	Dec-1995	Joint	53.41%	-36.08%	-54.70%	-39.37%	
	Apr-1996	Joint	47.48%	-95.42%	-67.91%	-81.20%	-5.3%

Data

The data for this paper were obtained from the International Financial Statistics database, the Bank of International Settlements, Standard and Poor's RatingsDirect service.

Crisis Indices

The crisis indices are constructed as described in the paper. For countries that experienced hyperinflations during our sample we create sub-samples of hyper and low inflation periods and use sample standard deviations for the sub-samples in constructing the crisis indices. We define a period of hyperinflation as one in which the rate of inflation exceeded 150% in the preceding six months.

Current Account

Current account data was constructed using US$ Imports and Exports from the IFS CD (series 70,71).

Debt

We use two sources of data for net debt flows. The first is from the BIS and comprises the sum of flows A-F. The second is financial account data from the IFS CD-Rom, (series 78)

Devaluations

Devaluations are month on month percentage changes in the US$/Foreign exchange rate

Reserves

Changes in reserves are calculated by taking first differences of total reserves minus gold (IFS series 1).

Scaling Measure

In order to scale each observation to account for differences in country size and characteristics, we divided by the average of the previous years total trade (imports plus exports).

Unemployment

We use two measures for unemployment in our study. Both were constructed by taking twelve month differences of industrial output data from the IFS database, series 66, and then constructing peak trough measures around each crisis. The first measure, called D12_Dmax, was simply made by taking the difference in the maximum growth rates in the period before and after the devaluation. The second measure, called D12_Dave, was constructed using the difference in the average growth rates that preceded and followed the crisis. Both measures produced similar results.