Exchange Rate Crises in Emerging Markets: An Empirical Treatment

PRELIMINARY DRAFT

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Abstract

We use a panel of annual data for over one hundred developing countries from 1971 through 1992 to analyze currency crises. We define a currency crisis as a large change of the nominal exchange rate (at least 25 per cent) that is also a substantial increase in the rate of change of the nominal depreciation rate (exceeding the previous year's change by at least 10 per cent). The aim is to see what variables would help predict these crises. We examine eight different characteristics regarding the *composition* of the accumulated capital inflow, including the fractions of external debt that are commercial, concessional, variable-rate, short-term, portfolio, non-dollar-denominated, and so forth. At the same time, we test for a variety of measures of overall indebtedness and other macroeconomic factors. They seem to be closely related to crisis incidence. The strongest of these variables statistically include output growth, the rate of change of credit, and the total debt burden. Foreign interest rates are also extremely important statistically. The combination of high indebtedness with an increase in foreign interest rates seems to be a recipe for a currency crisis. Many of the composition variables seem to have the hypothesized sign, and are statistically significant when considered one by one. The composition variable that has the most significant effect, even when included along with a long list of other variables, is the ratio of FDI to debt. Evidently relying on FDI to fill foreign financing needs is far safer than relying on portfolio capital.

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Introduction

Can currency crises in developing countries be foretold with standard economic indicators? We have by now enough years of data, through enough cycles of international financial conditions, pertaining to enough countries, that we ought to be able to answer this question.

The Mexican crisis

The crash of the Mexican peso in December 1994 vividly reminded everyone of the dangers that capital inflows can suddenly turn to capital outflows, that international confidence can give way to panic, that questions of what to do with accumulating reserves can give way to worries over rapid reserve loss, that credible commitment to an exchange rate anchor can give way to devaluation.[1] It is now the season for drawing lessons.

One possible set of lessons concerns, not just the magnitude of a country's debt burden, but the composition of the capital inflows. Clearly countries that never became heavily indebted are less prone to crashes. But even where countries have sought to finance their development, in part, through capital inflows, those countries where the inflows have tended to take the form of Foreign Direct Investment and equity purchases (especially in East Asia), more than the form of bank loans and bond purchases (as in Latin America), are said to have been relatively less vulnerable to crises. The specifics of Mexico's troubles in 1994 revolved around the unusually high concentration of borrowing in the form of short-term dollar-denominated debt (tesobonos). In the 1982

[1] Some view the Mexican crisis as merely the latest in an unending cycle of boom and bust in international lending, with little net progress to show for it (e.g., Krugman, 1995). Others view it as a minor setback on the path of development, as international debtors move upward and onward (Cline, 1995ab). Such questions are beyond the scope of this study.

international debt crisis as well, the shift in the composition of lending toward short-term and floating rate bank loans that had taken place in the late 1970s turned out to have left the debtors extremely vulnerable to an increase in short-term real interest rates as occurred at the beginning of the new decade. A final illustration of the potential importance of composition regards the currency of denomination of debt: countries with a relatively greater share of yen-denominated debt, for example, are adversely affected when the yen appreciates against the dollar.

The framework presumed by this study

The aim of this study is to look at a broad sample of developing-country experience, and to arrive at statistical patterns that might help predict future currency crashes. It is not an attempt to formulate or test specific theories of what causes crises. We take for granted that crises are the outcome of many factors. More usefully, we take for granted that crises are typically the outcome both of policies that add to a country's *vulnerability* and of *bad luck*. The variables that are related to the country's vulnerability will be seen to fall into three categories: general macroeconomic indicators, those variables associated with the level of indebtedness, and those associated with the composition of indebtedness. We will focus in particular on the third set of variables, aspects of debt composition, as they have attracted increased interest in the aftermath of the 1994 Mexican crises. The variables that are related to luck include political instability and world interest rates [and other world conditions, like G-7 exchange rates, the business cycle, and export prices, as well as real interest rates]. Of these "luck" variables, we focus most on world nominal interest rates.

One can make an analogy between the determinants of currency crashes and the determinants of car crashes. The vulnerability variables in the case of the automobile are the condition of the car, the sobriety of the driver, and the rate of speed. Even an

inebriated driver going too fast in an unsafe car will make it through most days without an accident. [Read a high-spending government in an overly-indebted, low-investment economy.] But one day, before long, he will meet adverse conditions, in the form of bad weather and other traffic [read political instability and high world interest rates], and the crash will come. We want to know how to read the signals that the driver is at risk.

We will pay special attention to the interaction of the country variables, particularly the composition of debt, with world interest rates. We find that the combination of high interest rates with a high level of debt is a useful predictor of the probability of a currency crash.

How do we define a currency crash?

One must begin an investigation of currency crises by defining the event to be explained. What is a currency crisis? Four conceptual issues (at least) arise in relation to the definition. First, are currency crises limited to episodes that end in a large fall in the value of the currency? Or should the term also be applied to speculative attacks that are successfully warded off by the authorities? Second, how big a change in the exchange rate is needed to qualify? Third, how should the exchange rate be measured? Fourth, how does one deal with high-inflation countries that undergo large changes in the exchange rate as a matter of routine?

The first question is whether currency crises should be defined so as to include speculative attacks that are successfully warded off by the authorities, through some combination of a sale of reserves and a tightening of monetary policy. The idea is that can make the idea of an unrealized speculative attack operational where one observes a sudden sharp fall in reserves and rise in interest rates. The econometric techniques that are applied in the heart of this paper to 117 devaluations, among a sample of 105 developing countries, have also been applied to the broader definition of currency crises,

among a much smaller sample of industrialized countries.[2] In this paper we concentrate on the narrower definition of currency crises, as episodes that do in fact end in a devaluation. Fewer of our countries have market-determined short-term interest rates than would be the case among industrialized countries. This means that the data are less likely to be available. It also means that, even at a conceptual level, increases in interest rates may be less relevant in our countries than sudden tightening of reserve requirements, imposition of controls on capital outflows, and emergency rescue packages from the IMF or other foreign institutions. We leave open the possibility, in future extensions of this work, of broadening the definition to include the speculative attacks that are successfully warded off.

The second question is how big a devaluation qualifies. The paper will define the phrase "large devaluation" to mean a decrease in the value of the local currency greater than or equal to 25 per cent. Needless to say, the 25 per cent cut-off is arbitrary.

The third question is how the exchange rate should be measured. We look at the nominal exchange rate vis-a-vis the dollar (in log form). Until the 1970s, devaluations were discrete changes in the exchange rate, which were easily identified *ex post*. There is no longer such a sharp dividing line, however, between "currency crashes" and more mundane changes in the exchange rate. This is due to the advent of monetary instability worldwide, including high inflation and volatile exchange rates, and in particular to the prevalence among developing countries of more flexible exchange rate arrangements, including frequent devaluations, crawling pegs, bands or target zones, and even gliding bands.

Many of the countries of concern to the international financial community in recent years use the U.S. dollar to define its exchange rate to a far greater extent than they use other international currency. This is true not only of the Latin American

[2] Eichengreen, Rose and Wyplosz (1995, 1996) and Rose (1995).

countries, but of East Asia as well.[3] Thus we will measure their exchange rates in terms of the dollar.

The fourth question is how to deal with countries that would meet our criterion -- changes in the exchange rate of 25 per cent or more -- year after year. These are countries with very high inflation rates. The depreciation does not come as a surprise to anyone. In some cases, the changes in the exchange rate follow a pre-announced rate of crawl.[4] It does not seem right to apply the terms "crash" or "speculative attack" to these cases. Thus we require that the change in the exchange rate, not only exceed 25 per cent, but exceed the previous year's change in the exchange rate by a margin of at least 10 per cent.[5]

We also define a three-year "window" around attacks, as explained in the empirical section below.

The Variables of Interest

[3] Frankel and Wei (1994) document statistically that the East Asian currencies are linked far more closely to the dollar than to the yen, notwithstanding popular discussion of a yen bloc. Consider the four countries that are examined in Appendix 1. The Thai Baht, for example, has always put heavy weight on the dollar. It followed a basket peg in the early 1990s, with implicit weights of 81 per cent on the dollar, 12 per cent on the yen, and 7 per cent on the deutschemark. The Malaysian ringitt puts about 80 per cent weight on the dollar and less than 10 per cent on the yen. The Indonesian rupiah puts heavy weight on the dollar, though there is evidence of some weight on the yen as well in the late 1980s, especially 1985-86. The Philippine peso follows the dollar exclusively. Frankel and Wei (1995) extend the analysis to Latin American countries, with similar results, as one would expect.

[4] The first crawling peg was adopted by Chile in 1965, but the arrangement became more popular in the late 1970s. Writings on the subject are reviewed by the creator of the term "crawling peg", in Williamson (1981).

[5] We also tried requiring that the change in the exchange rate exceeded the change in each of the preceding two years by at least 10 per cent. But we decided this was too stringent a test. It reduced the number of episodes in our sample rather drastically, from 117 to __. If a country manages to stabilize for a period of 12 to 35 months, and then experiences a second large devaluation, we think that qualifies as a second crash.

We group the domestic variables into three categories: those pertaining to the level of international indebtedness, those pertaining the composition of capital inflows, and other macroeconomic variables.

Some traditional rules-of-thumb for dangerous levels of indebtedness

The international debt crisis of 1982 appeared to vindicate some traditional rules-of-thumb as to when countries are entering a danger zone. One traditional warning signal is Net debt/exports > 200 %. ("Net" refers to net of foreign exchange reserves.) The World Bank has apparently recently suggested that anything over a threshold of 220 per cent is an "unsustainably high" debt/exports ratio.[6] Other approximate traditional rules of thumb are the ratio of interest payments (net of interest earned on reserves) to exports of goods and services > 15 %, a ratio of total debt service to exports of goods and services > 50 %, a ratio of current account deficit to exports of goods and services > 25 %, and a ratio of foreign exchange reserves to monthly imports > 3 or 4.[7]

These indicators can also be translated as ratios to GDP; to keep it simple, one might divide by four, as a typical capital-importing country has a ratio of GDP to exports of goods and services in the vicinity of 1/4. This might give too optimistic a rule, however. Many of the countries with debt-servicing difficulties (particularly those in Latin America) exports of goods and services are closer to 1/6 of GDP. Only exports generate foreign exchange to service the debt. Using the 1/6 ratio to translate, we arrive at such rules of thumb as 36.6 per cent for debt/GDP and 4.2 per cent for current account deficit/GDP.[8] Given the choice, the rules of thumb phrased in relation

[6] "Leaked discussion document" cited in *The Economist*, Sept. 16, 1995, p.92.

[7] Cline (1984).

[8] The greater openness of East Asian debtors may explain why they have fared much better in debt crises, even those like Korea in the 1980s that have debt/GDP ratios as high as the Latin Americans.

to exports may be better.

Some of the traditional rules failed in the case of Mexico in 1994. (See Appenidx 1 for more discussion.) We will see if the rules need to be updated in light of two decades of experience across a hundred-plus countries. One possible response is to tighten the threshold; another is to consider new variables.

Several economists have recently suggested a rule of thumb that a country can rarely sustain a current account deficit of more than 3 per cent of GDP, or at most 4 per cent for a rapidly growing country, before risking trouble.[9] For a country growing at 5 per cent, plus 3 per cent inflation in dollar terms, a sustainable ratio of external debt to GDP of 40 per cent is consistent with a ratio of current account deficit to GNP of 3.2 per cent [= .40*8 per cent]. For a country that is growing more rapidly than 5 per cent a year (as in East Asia), a higher current account deficit is consistent with this same debt/GDP level; for a more slow-growing country, it would be a lower current account.

We examine many of these traditional variables. There are many domestic variables that we have not tried measuring. Measures of political stability may be important. Other economic variables include the unemployment rate (for which data is inadequate in many LDCs, commodity price variables such as changes in the terms of trade (ex post) and the variability of export prices (ex ante).

Composition of debt

As already noted, the composition of capital inflows has received much attention recently. Relevant indicators include Foreign Direct Investment vs. portfolio investment, long-term vs. short-term portfolio capital, securities sales vs. commercial bank

[9] E.g., Burki and Edwards (1995), Cline (1995b, p.20,23) or Williamson (1994, 1995 p.25).

borrowing, fixed-rate borrowing vs. floating-rate borrowing, domestic-currency vs. foreign-currency denomination, and dollar-denomination vs. denomination in yen and other currencies. These variables are a central focus of this study. Here we review the reasons why these variables are considered important.

The hypothesis regarding *Foreign Direct Investment (FDI)* is that, of the two components of capital inflow, FDI is a safer way to finance investment than is portfolio investment.[10] One argument is that FDI is directly tied to real investment in plant, equipment and infrastructure; whereas borrowing can go to finance consumption. Borrowing to finance consumption does not help add to the productive capacity necessary to generate export earnings to service the debt in the future. (In this regard, Appendix 1 includes a discussion of the so-called "Lawson Fallacy," in the context of the recent Mexican crisis.) There are issues of fungibility of funds, however. An FDI surplus in the balance of payments is no guarantee of high investment. Perhaps one should look at domestic saving and investment directly, if those are the variables that are thought to matter.

The strongest argument in favor of FDI regards stability. In the event of a crisis, investors can suddenly dump securities and banks can refuse to roll over loans, but multinational corporations cannot quickly pack up their factories and go home. This argument too has been questioned. Dooley *et al* (1995) have found that a high level of FDI seems to be associated with *higher* variability in money flows rather than lower. This probably reflects multinational corporations moving money in and out of the country, through transfers between subsidiary and parent, with greater ease than can be done outside the corporate walls. This does not necessarily detract from their argument that countries that host a lot of FDI may be more vulnerable to sudden outflows than

[10] One of many examples is Reisen ( ).

conventionally realized. At any rate, the FDI hypothesis is clearly one worth testing.

Two relevant aspects of the composition of capital inflows are the fraction of debt which is *concessional* and the fraction that comes from *multilateral development banks*. In both cases, the capital is far less likely to depart quickly in times of trouble than is the case for private market-rate debt. Indeed, the inflows from these sources may even increase in a crisis.

Within portfolio capital, the *maturity structure* is perhaps the most important of the composition issues, followed closely by the question of *variable-rate arrangements*. In the high-inflation 1970s, there was a worldwide movement toward shorter maturities and nominal interest rates that are indexed to short-term interest rates such as the U.S. treasury bill rate or LIBOR. The idea was to protect the creditor banks from sharp disparities between their cost of funds and the value of their assets. With monetarist thought in full swing, there may also have been a view that nominal interest rates were highly correlated with rates of commodity price inflation. It would then follow that variable-interest-rate liabilities were not very risky, in real terms, from the viewpoint of commodity-producing debtors. If this was the theory, it was proven dramatically wrong in the early 1980s, when U.S. and world nominal interest rates rose sharply, and stayed high for several years even though inflation began to fall. In other words, contrary to the monetarist theory, real interest rates rose sharply (even when measured ex ante). The high real interest rates were harder on the commodity exports of many LDCs than on other products. That so much of their international debt was tied to short-term nominal interest rates clearly contributed to the debt crisis that erupted in 1982.

In the Mexican crisis of 1994, the problem took the form of a heavy concentration of short-term debt, which describes the tesobonos as well as the CETES and

ajustobonos. In this instance, the problem was much worse than simply the fact that between February and December, 1994, the cost of borrowing rose in line with U.S. interest rates. The short maturities, and a disproportionate bunching of maturities in late 1994 and early 1995, meant that the Mexican government was perceived to have difficulties rolling over the debt even at modestly higher interest rates. In other words, short maturities apparently pose problems of default risk above and beyond those problems of interest rate risk that they share with floating-rate debt. Both composition questions, short-term vs. long-term and floating-rate vs. fixed-rate bear, investigating.

Next comes the distinction between securities sales and commercial bank borrowing. Syndicated commercial bank loans were the preferred vehicle of international finance in the 1970s, but the 1982 crisis changed that. Even 13 years later, many banks, particularly smaller ones, are unable to summon up much enthusiasm for investing in LDCs. In the 1990s, their place has, to an important extent, been taken by portfolio managers and institutional investors buying stocks and bonds. Some have argued that any crises in the 1990s are likely to be far less costly to the borrowing countries than was the crisis of the 1980s, because they need no longer deal with banks to the same degree.[11]

One may question the superiority of bonds over bank loans. After all, bonds were the preferred mode of lending prior to World War II, and they led to recurrent crises and defaults in that era. Furthermore, many have concluded from the 1994 Mexican crisis that in the event of crisis it is more difficult to organize thousands of small disparate bond holders into accepting a "workout package" than was true for a small number of large banks in the 1980s. (There is a danger of overstating this case. The strategy for managing the debt crisis in the 1980s was perpetually plagued by many

[11] Dooley (1994) argues that the resolution of the 1980s crisis, and with it the resumption of growth in the debtor countries, was delayed by a protracted game played between the bank and the G-7 governments over who was going to bear the losses.

small banks who were reluctant to go along with plans for "involuntary lending.")

There are good theoretical arguments, however, for thinking that equities are a more efficient vehicle for risk-sharing than either loans or conventional bonds. In the case of equities, unlike bonds or bank loans, the cost of the obligation does not stay fixed in dollar terms when the ability of the country to earn export revenue falls because of a world recession or a collapse in commodity prices.[12]

Before developing the arguments regarding *denomination of domestic vs. foreign currency*, we must warn the reader that we have not been able to obtain usable data on this question.[13] So this is one hypothesis that, at least for now, will have to remain untested.

In the 1970s and 1980s, it was taken for granted that lenders would not be willing to denominate lending to LDCs in local currencies. It was not just that local rates of inflation and currency depreciation were high, so that investors would require a higher nominal interest rate to compensate. There was a serious problem of moral hazard: a country that had incurred a large international debt denominated in its own currency would face a strong temptation to inflate it away. Denominating in dollars or other foreign currency seemed the effective mechanism to avoid this problem.

In the 1990s it became more common for countries like Mexico to issue debt in their own currencies. In large part this was a consequence of currency-based

[12] The same argument would apply directly to some indexed bonds or loans. If the repayment terms are tied to export prices or export revenues, they would be more like equity: the cost of the obligation automatically falls when the ability to pay falls, thus reducing the risk (e.g., Williamson and Lessard, 1987). Unfortunately, such indexed bonds have for some reason been unpopular with issuers and investors alike. (Indexed bonds like the ajustobonos of Mexico are tied to the domestic price level, or often the exchange rate, not to export prices or revenues.)

[13] The reason this data is not generally available is that, to the extent that less developed countries issue debt in domestic currency, most of it is held by domestic residents, not foreign investors.

stabilization plans that, at least for awhile, were successful at bringing down rates of inflation and depreciation. It was also a consequence of domestic financial liberalization: originally Mexican CETES were primarily marketed domestically.

Prevailing fashion on this question, in a sense, completed a second round-trip of the pendulum within the course of 1994. The first quarter of the year brought unrest in Chiapas, the assassination of candidate Luis Donaldo Colosio, and the first increases in U.S. interest rates. The government began to have trouble selling Cetes, and the net capital flow turned from positive to negative. In response, the government substituted dollar-denominated tesobonos for peso-denominated CETES. (Tesobonos rose to 75.1 per cent of Mexican debt in 1994, from a mere 3.3 per cent the year before, while Cetes fell to 13.5 per cent of total debt in 1994, from 52.2 per cent the year before.[14]) This policy was successful in the sense that it stanched the loss of reserves for six or eight months. It is common now to deride the policy as foolish, or at best as a trick of political expediency to stall for time until the election. There is no question that the strategy did indeed make the crisis worse when it finally arrived. Several things can be said in its defense however.

First, one cannot blame the onset of net capital outflow and reserve loss on the change in composition. To the contrary, Mexico was unusual among debtors in having a lot of domestic-currency debt held by foreigners; and the switch away from this composition was a *response* to the new capital outflows, not initially a cause of it. Second is the argument, made by some economists *ex ante* but now rarely defended, that denominating the debt in foreign currency is a commitment mechanism for credibly signaling an intention not to devalue. *Ex post*, it becomes clear that tying oneself to the masthead proves unwise in the event that the ship sinks. But it is hard to argue with the

[14] The source is the Banco de Mexico. Cited in Dornbusch, Goldfajn, and Valdes (1995).

proposition that a country with peso-denominated debt is more likely to devalue, whether by choice or not, than a country with dollar-denominated debt. None of this is to argue with the conclusion that Mexico made a mistake in issuing so much tesobono debt in 1994. But the preferred alternative was devaluing earlier (or tightening monetary policy, if the necessary political will existed). Continuing to issue peso-denominated debt was simply not an option.

For our purposes the relevant hypothesis must be that a high ratio of debt denominated in domestic currency, as opposed to domestic currency, makes a currency crisis more likely. It may be that countries that issue only domestic currency debt will not find many takers, and thus will not becoming highly indebted in the first place (excepting the United States!). Conversely, those who issue in foreign currency may be able to prolong needed adjustments, and thus face bigger problems when the day of reckoning comes. But the overall level of indebtedness is a separate variable that will be included in our regression tests. We would like to know the independent effect of the currency composition, conditional on the level of debt. Moreover, it should be emphasized that the focus of this study is on minimizing the probability of currency crisis, not on optimizing economic policy more broadly. In particular, the magnitude of the blow to the economy, conditional on a devaluation occurring, does not enter our analysis.

The final composition question concerns *which foreign currency* is chosen to denominate the debt. The dollar continues to be the favorite, and overwhelmingly so in Latin America. But other currencies have long had a role as well. An example is the French franc in French-speaking African countries. In the 1980s, most East Asian debtors decreased the percentage of their debt denominated in dollars, and increased sharply the percentage denominated in yen. Initially, this was described as a reaction on the part of the debtors to the appreciation of the dollar between 1980 and 1985. Given

that the trend accelerated during the tripling of the dollar/yen exchange rate that subsequently took place between 1985 and 1995, however, a different explanation is needed. The simplest explanation is the increased magnitude of Japanese investment in the region. Loans from the official Japanese sector, especially, tend to be yen-denominated.[15]

For our purposes, the point is that if a country finds itself (for whatever reason) with a lot of liabilities denominated in a particular non-dollar currency, and that currency then undergoes an appreciation against the dollar, the country's ability to service that debt will be adversely affected. The appreciation of the yen in recent years has created difficulties for those countries, mostly located in East Asia, with heavy yen debts. [To the extent that the debtor holds reserves in the yen, or exports to Japan, there are offsetting gains.]

World interest rates, and the pre-1994 warnings

It is critical to look not only at individual country variables, but at the global financial environment as well. Global variables include world economic activity, commodity prices, real interest rates, other financial market shocks, and bilateral exchange rates (e.g., the yen/dollar rate, for the reasons just noted). The debt crisis of 1982, and subsequent debtor devaluations, were to a large extent triggered by the combination of high real interest rates in industrialized countries, global recession, and low dollar commodity prices (all of which could be traced to some extent to the sharp U.S. monetary contractions of 1980 and 1981-82). The same was true of the

[15] Frankel and Wei (1994). A campaign launched in 1983-84 by the U.S. Treasury, to induce Japan to use the yen more -- ironic in light of current concerns about the decline in the international role of the dollar -- may also have been a factor.

international debt crises of the interwar period.[16]

It is quite striking that most of the econometric studies that were undertaken in 1993-94 on the causes of renewed large capital inflows to Latin America and East Asia in the early 1990s concluded that external factors were a major cause, perhaps *the* major cause. Calvo, Leiderman and Reinhart (1993, p. 136-137) found that "foreign factors account for a sizeable fraction (about 50 per cent) of the monthly forecast error variance in the real exchange rate…[and]…also account for a sizeable fraction of the forecast error variance in monthly reserves." They warned that "The importance of external factors suggests that a reversal of those conditions may lead to a future capital outflow." Chuhan, Claessens and Mamingi (1994) estimated that U.S. factors explained about half of portfolio flows to Latin America, though they explained less than country factors in the case of East Asia. Fernandez-Arias found that the fall in U.S. returns was the key cause of the change in capital flows in the 1990s.[17] Dooley, Fernandez-Arias and Kletzer (1994), in a study of the determinants of the increase in secondary debt prices among 18 countries since 1986, concluded that "International interest rates are the key underlying factor." These studies -- written well before the crisis -- were ignored by Wall Street investors.

The steep rise in U.S. interest rates that took place during the course of 1994 constituted a test of the warning, which most of these studies had carried [explicitly or implicitly], that an adverse shift in world financial conditions could lead to an abrupt halt to the inflows and a new crisis on the order of 1982. Asset prices in emerging markets did fall on the occasion of the initial tightening by the Federal Reserve Board in

[16] Eichengreen ( ).

[17] Fernandez-Arias (1994) emphasized that the decline in U.S. rates of return, in addition to reducing the opportunity cost of investing in the emerging markets, also improved country creditworthiness as measured by secondary debt prices.

February 1994. In many cases the decline in local asset prices was greater than the decline in securities prices in the United States, perhaps because many of the investors who had been holding the assets had been highly leveraged. Asset prices subsequently recovered, as healthy positive capital inflows resumed. The Mexican crisis that began December 20, 1994, however, and the apparent negative effects on securities prices in emerging markets worldwide, are precisely the sort of crisis about which Calvo and the others had warned.[18]

The macroeconomic indicators and the literature on "speculative attacks"

The academic literature on "speculative attacks" is relevant to our analysis, even though empirical tests are as yet rather meager, and largely limited to currency crises among industrialized countries, such as the European crises in the Exchange Rate Mechanism in 1992-93. The European experience is interesting because, although the attacks on the currencies seemed arbitrary to some observers (particularly to the European policy-makers themselves), the *order* in which the speculators picked off the currencies appears to have been highly correlated with such indicators as the currencies' deviations from purchasing power parity, the unemployment rate, and interest rates.

The analysis of Krugman (1979) has become the classic theoretical model of currency crises as speculative attacks. The original paper assumed that the pre-crisis regime was literally a fixed exchange rate, but the model has been extended to crawling pegs (Connolly, 1986, and Connolly and Taylor, 1983) and currency bands (Krugman and Rotemberg, 1991). The speculative attack model gives us several economic factors that should be important in predicting currency crises: monetary and fiscal expansions,

[18] Frankel and Okongwu (1995) show the effect of increases in U.S. interest rates, alongside political developments in Mexico, during the 18 months leading up to the crisis.

deviations from Purchasing Power Parity in the real exchange rate, increasing real wages, increasing relative unit labor costs, growing current account deficits, and rapidly accelerating losses in international reserves. Another, fairly self-evident, prediction to emerge from this literature is that a speculative attack is more likely if the exchange rate moves toward the edge of the band.

While many of the predictions of these models have been borne out to some extent empirically, some speculative attacks have taken place without large apparent monetary and fiscal imbalances. Some of the European currencies attacked in the crises of 1992-93 have been described as lacking the usual warning signs that past excessive monetary and fiscal expansions were leading to trade deficits.[19] As has also been remarked, a willingness to raise interest rates very sharply did not in 1992 save the United Kingdom and Sweden from having to devalue. The speculators did not believe that these high interest rates were politically sustainable, because of their implications for the domestic economy at a time when unemployment was already high.

The response has been a "second generation" of models.[20] Some are designed to construct examples where speculative attacks can take place without any prior basis in macroeconomic fundamentals.[21] Recent models focus on the domestic economy, and find that the unemployment rate is an important determinant of devaluation. The political strength of the government is also important. Along a similar vein, Larrain and Reisen (1994) argue that high unemployment in Argentina should raise concerns that its exchange rate policy is much less sustainable than, for example, Chile's.

Eichengreen, Rose, and Wyplosz (1995) study the historical record of sudden exchange rate changes in twenty industrialized countries, between 1959 and 1993. They

[19] Eichengreen and Wyplosz (1993).

[20] Eichengreen, Rose and Wyplosz (1995) review this newer literature, along with the older literature.

[21] E.g., Obstfeld (1994).

find some systematic patterns leading up to devaluations: steady loss of foreign exchange reserves for the eight preceding quarters, a fall in the dollar value of exports, a large current account deficit, large and growing budget deficits in the eight preceding quarters, expansion of domestic credit and money, high inflation, high short-term and long-term interest rates and low equity prices, rising wages, low growth in employment and output.

Eichengreen, Rose, and Wyplosz then look at speculative attacks defined more broadly, to include cases where the authorities managed to withstand sudden adverse shifts in investor sentiment *without* ultimately devaluing. (The criterion for telling when a speculative attack has occurred is a weighted average of a fall in the exchange rate, fall in reserves, and increase in the interest rate.) They find that the most important indicators leading up to speculative attacks are current account deficits, rates of growth of money and domestic credit (particularly M2, for crises that do not necessary result in devaluations) and rapid growth in imports. Budget deficits and unemployment do not seem to be as important for speculative attacks in general as for those specific crises that end in devaluation. High wage and price inflation, current account deficits, and rapid reserve losses apparently make for attacks that governments are unable to ward off. Money growth and inflation rates seem to be the variables that are most important in predicting a crisis in a multi-variate analysis that holds constant other factors.

With this background, four of the macroeconomic indicators on which we focus the most are: the rate of growth of domestic credit, the government deficit as a fraction of GDP, the ratio of reserves to imports, and the current account deficit as a percentage of GDP [though this could also be classed as a measure of borrowing]. At times we have also looked at other variables, such as the rate of change of reserves, but decided that most of the information in them was already captured by our base-case list of

variables.

One macroeconomic indicator requires special emphasis, the real overvaluation of the currency. We define real overvaluation simply as the deviation from Purchasing Power Parity. (We measure the average of real exchange rate relative to its average over the period in question.[22]) A simple but persuasive diagnosis of the Mexican crisis is that it was the result of overvaluation. Specifically, the argument is that the policy of pegging the peso is not so effective a device as to bring inflation all the way down to U.S. levels. The inertia that exists in inflation implies that the peso becomes steadily more overvalued with each passing year. The result is a widening trade deficit, and the genesis of investor perceptions that the situation is unsustainable, culminating eventually in rapid reserve loss and a forced devaluation. The argument that overvaluation in a PPP sense was the central factor (almost to the exclusion of other variables) was made ex ante by Dornbusch and Werner (1994) and ex post by Dornbusch, Goldfajn, and Valdes (1995). The mistake made by the Mexicans is said to have been precisely the same as the one that led to Chile's crisis in 1982.

Our Results

Any study of devaluations must take note of the great difficulties and uncertainties preventing a definitive analysis. It is difficult to explain devaluations even after the fact, let alone to predict them *ex ante*. Many exchange rate movements may be self-fulfilling prophecies, driven by "market psychology" rather than economic fundamentals. Nevertheless, considering the size of the stakes for those undertaking trade or financial

[22] For purposes of prediction, one would have to obtain a sufficiently long time series on the real exchange rate prior to the year in question, which we have not yet done.

transactions with these countries and for the countries themselves, it is better to attempt some systematic analysis than not to.

We begin with some univariate analysis, focusing on one variable at a time, whether graphically or econometrically. We do this as a means of becoming acquainted with the data, though we shall also argue below that rules of thumb based on univariate analysis can be useful.

A first look at the data set

Most of our data set was extracted from the 1994 *World Data* CD-ROM. It consists of annual observations from 1971 through 1992 for one hundred and five countries.[23] The sample was selected (with respect to choice of both country and time) to maximize data availability. However, numerous observations are missing for individual variables. We checked the data via both simple descriptive statistics and graphical techniques. The exact variable definitions (along with *World Data* mnemonics) are included in an appendix. We have also used exchange rates and interest rates from

[23] The countries we include are: Algeria; Argentina; Bangladesh; Barbados; Belize; Benin; Bhutan; Bolivia; Botswana; Brazil; Burkina Faso; Burundi; Cameroon; Cape Verde; Central African Republic; Chad; Chile; China; Colombia; Comoros; Congo; Costa Rica; Cote d'Ivoire; Djibouti; Dominican Republic; Ecuador; Arab Republic of Egypt; El Salvador; Equatorial Guinea; Ethiopia; Fiji; Gabon; The Gambia; Ghana; Grenada; Guatemala; Guinea; Guinea-Bissau; Guyana; Haiti; Honduras; Hungary; India; Indonesia; Islamic Republic of Iran; Jamaica; Jordan; Kenya; Republic of Korea; Lao People's Democratic Republic; Lebanon; Lesotho; Liberia; Madagascar; Malawi; Malaysia; Maldives; Mali; Malta; Mauritania; Mauritius; Mexico; Morocco; Myanmar; Nepal; Nicaragua; Niger; Nigeria; Oman; Pakistan; Panama; Papua New Guinea; Paraguay; Peru; Philippines; Portugal; Romania; Rwanda; St. Vincent and the Grenadines; Sao Tome and Principe; Senegal; Seychelles; Sierra Leone; Solomon Islands; Somalia; Sri Lanka; Sudan; Swaziland; Syrian Arab Republic; Tanzania; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Uganda; Uruguay; Vanuatu; Venezuela; Western Samoa; Republic of Yemen; Federal Republic of Yugoslavia; Zaire; Zambia; and Zimbabwe.

International Financial Statistics.

Histograms of sixteen of our most important variables are provided in Figure 1. As is also generally true in the analysis below, both the scales and the sample sizes are not comparable across individual panels.

The first two rows portray eight different characteristics of the *composition* of capital inflows. Each is expressed as a percentage of the total stock of external debt. The variables are: 1) the amount of debt lent by commercial banks; 2) the amount which is concessional, 3) the amount which is variable-rate; 4) the amount which is public sector, 5) the amount which is short-term; 6) the amount lent by multilateral development banks (this includes the World Bank and regional banks, but not the International Monetary Fund; 7) the flow of Foreign Direct Investment (FDI) expressed as a percentage of the debt stock; and 8) the flow of portfolio investment, again expressed as a percentage of the debt stock.

The last two rows portray more traditional indebtedness measures and other macroeconomic factors in exchange rate crises, again expressed in percentage terms. They are: 1) the ratio of total debt to GNP; 2) the ratio of interest payments to GNP; 3) the ratio of reserves to monthly import values; 4) the growth rate of international reserves; 5) the current account surplus (+) or deficit (-), 6) the total government surplus (+) or deficit (-); 7) the domestic credit growth rate; and 8) the growth rate of real GDP per capita.

One of the variables in which we are most interested is the effect of exposure to world interest rates. Figure 2 has histograms for average interest rates and average private-sector interest rates. ~~[Definitions?]~~ There is also a histogram for the ?foreign interest rate?. We construct the latter as the weighted average of short-term rates for the United States, Germany, Japan, France, the United Kingdom and Switzerland; the weights are proportional to the fractions of debt denominated in the relevant

currencies.[24] (Unfortunately, much debt is not classified as being denominated in one of these currencies, a fact to which we shall return.) Finally, Figure 2 also contains the foreign interest rate observations plotted by year (so that for each year, each country?s foreign interest rate series is marked). While there is a good deal of heterogeneity by country (within-year), foreign interest rates generally move together, rising in the mid-1970s, the early 1980s and the early 1990s.

Event Study

We begin our investigation by characterizing the behavior of countries suffering from an exchange rate ?attack?. Our methodology is that used by Eichengreen, Rose, and Wyplosz (1995) and Rose (1995).

As noted, we begin by defining an attack as an observation where the nominal dollar exchange rate increases by at least 25% in a year and has increased by at least 10% more than it did in the previous year. We also exclude attacks which occurred within three years of each other to avoid counting the same attack twice. The exact thresholds we use are of course arbitrary; we use sensitivity analysis to ensure that our results are insensitive to small perturbations of our basic methodology. Non-attack observations which are not within three years of an attack constitute our sample of ?tranquil? observations. Many of these observations occur in countries that never had an attack throughout the sample under study. We use these as a control sample, and typically compare behavior around attack episodes with behavior during periods of tranquillity.

Our definition of an exchange rate attack suffers from an important limitation above and beyond the arbitrary threshold figures. It makes no allowance for the fact that

[24] We use IFS line 60b, money market interest rates. Using lending rates (IFS line 60l) does not change any results.

a number of exchange rate attacks are successfully warded off by central banks via some combination of: 1) restrictive monetary policy (the traditional ?interest rate defense?); 2) expenditure of international reserves (?sterilized intervention?); and 3) tightening of capital controls. However, it is extremely difficult to obtain consistent market-driven interest rate series for developing countries. It is perhaps even more difficult to obtain accurate measures of international reserves or the efficacy of capital controls. In any case, for some purposes we may be interested in knowing what causes those crises which are not successfully warded off.

Our definition of an exchange rate attack yields 117 different events. (74 attacks are deleted because of the three-year ?windowing.) These are spread over a large number of countries, but have a slight tendency to be clustered in the early-to-mid 1980s. Thus the observations probably should not be treated as independent observations.[25]

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[25] The actual list is: Argentina 1975; Argentina 1981; Argentina 1987; Burundi 1984; Benin 1981; Burkina Faso 1981; Bangladesh 1975; Bolivia 1973; Bolivia 1982; Brazil 1979; Brazil 1983; Brazil 1987; Brazil 1992; Bhutan 1991; Botswana 1985; Central African Republic 1981; Chile 1973; Chile 1982; Cote d'Ivoire 1981; Cameroon 1981; Congo 1981; Comoros 1981; Costa Rica 1981; Costa Rica 1991; Dominican Republic 1985; Dominican Republic 1990; Algeria 1991; Ecuador 1983; Egypt 1979; Egypt 1990; Ethiopia 1992; Gabon 1981; Ghana 1978; Ghana 1983; Guinea 1986; Gambia, The 1984; Guinea-Bissau 1984; Guinea-Bissau 1991; Equatorial Guinea 1981; Guatemala 1986; Guatemala 1990; Guyana 1987; Guyana 1991; Honduras 1990; Indonesia 1979; Indonesia 1983; India 1991; Jamaica 1978; Jamaica 1984; Jamaica 1991; Jordan 1989; Laos 1976; Laos 1980; Laos 1985; Lebanon 1984; Lebanon 1990; Sri Lanka 1978; Lesotho 1984; Morocco 1981; Madagascar 1981; Madagascar 1987; Maldives 1975; Maldives 1987; Mexico 1977; Mexico 1982; Mexico 1986; Mali 1981; Myanmar 1975; Malawi 1992; Niger 1981; Nigeria 1986; Nigeria 1992; Nicaragua 1979; Nicaragua 1985; Peru 1976; Peru 1981; Peru 1985; Philippines 1983; Paraguay 1984; Romania 1973; Romania 1990; Rwanda 1991; Sudan 1982; Sudan 1988; Senegal 1981; Sierra Leone 1983; Sierra Leone 1989; El Salvador 1986; El Salvador 1990; Somalia 1982; Somalia 1988; Sao Tome and Principe 1987; Sao Tome and Principe 1991; Swaziland 1984; Syrian Arab Republic 1988; Chad 1981; Togo 1981; Trinidad & Tobago 1986; Turkey 1978; Turkey 1984; Turkey 1988; Tanzania 1984; Tanzania 1992; Uganda 1981; Uruguay 1975; Uruguay 1983; Uruguay 1990; Venezuela 1984; Vanuatu 1981; Zaire 1976; Zaire 1983; Zaire 1987; Zaire 1991; Zambia 1983; Zambia 1989; Zimbabwe

Figure 3 is a set of sixteen ?small multiple? graphics, each resembling an ?event study? of the sort used in finance. Each of the graphics corresponds to a panel in Figure 1 and portrays the movement in a variable of interest beginning three years before the crisis and continuing through the crisis (marked by a vertical bar) until three years afterwards. Thus, the ?seeds? of a variety of different crises can be examined, along with behavior in the aftermath of a crisis. All variables are expressed as deviations from periods of tranquillity, so that a value of say 5% means ?5 percent higher than during a typical period of tranquillity.? Average values are provided, along with a band delimiting plus and minus two standard deviations. The scales of individual panels are not comparable across variables, nor is the sample size (because of data availability problems). A horizontal line through the ordinate?s origin is provided, making it easy to compare behavior around periods of crisis to the behavior of the same variable during more ?typical? periods of tranquillity.

Graphical approaches like these have disadvantages. They are informal. They are intrinsically *univariate*: they encourage readers to examine individual variables by themselves, whereas the norm in econometrics is to look at the marginal contribution of each variable conditional on the others.

Graphical methods also have advantages. They impose no parametric structure on the data, and impose few of the assumptions which are sometimes necessary for statistical inference or estimation but are frequently untenable. This is especially appropriate in a non-structural exploration of the data. They are often more accessible and informative than tables of coefficient estimates. Univariate results lend themselves to simple rules of thumb that can be very useful in practice. For these reasons, we use our graphs extensively but cautiously. We perform two types of sensitivity analysis. First,

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1983; and Zimbabwe 1991.

we check the robustness of our graphics. Second, we verify our ocular analysis with more rigorous statistical techniques, using probit models estimated with maximum likelihood to check our results.

The results in Figure 3 are as hypothesized. Countries experiencing exchange rate crises tend to have: high proportions of their debt lent by commercial banks (compared, as always, to tranquil observations), high proportions of their debt on variable-rate terms and in short maturities; and relatively low fractions of debt that are concessional, lent by the multilateral organizations or lent to the public sector. Crisis countries tend to experience disproportionately small inflows of FDI and relatively high ?hot money? portfolio flows. Their debt and interest burdens are high and rising, reserves are low and falling, the current account and budgets are in deficit, and domestic credit growth is high.

Most variables tend to move very sluggishly in the years surrounding exchange rate crises. This leads one to expect that it will be difficult to predict exchange rate crises with any precision. The notable exception is the growth rate of real output per capita, which dips dramatically (in both the economic and statistical senses) below the tranquil norm in the year of the crisis. Of course, the direction of causality is unclear (especially at the annual frequency) since the crisis may be precipitated in part by slow growth, but may also itself induce recession.

Figure 4 is an analogue to Figure 3 in that it is a series of ?event study? graphics. However, the three definitions of interest rates covered in Figure 2 are analyzed instead of the wide array of variables in Figures 1 and 3. Interest rates are higher than in tranquil times in the years before exchange rate crises, by amounts that are economically and statistically significant.[26]

[26] The variable in the lower right corner of Figure 4 is the foreign interest rate (portrayed in the lower left corner), but only for the sample of observations where at least 80% of the debt is denominated in

Finally, Figure 5 is a comparable event study for a variable of particular interest to us: the degree to which the real exchange rate is over-valued. We measure the real exchange rate by adjusting the nominal exchange rate for domestic and foreign GDP price *levels*, and then normalizing the level of the resulting ratio on a country by country basis.[27] The degree of over-valuation is portrayed in the graph, an increase in the variable indicating increased over-valuation. Clearly the degree of over-valuation (as always, compared to tranquil values) peaks dramatically in the year before currency crises. (The timing of the peak is probably an artifact of the coarse frequency of our data. Clearly a currency crisis that is defined to be a nominal depreciation [as ours is] will typically entail a real depreciation as well.) This is consistent with received wisdom, although we will find it more difficult to corroborate this fact as starkly using statistical procedures.

Regression analysis

The ?event study? analysis is both naive and intrinsically univariate. More confirmation can be provided by simple regression work.

We estimated a large number of regressions linking our binary event measure to a variety of variables. The latter include: 1) a set of five debt composition characteristics; 2) a set of five macroeconomic factors; 3) the debt burden, measured as the ratio of debt to output; 4) the foreign interest rate; and 5) the degree of over-valuation. We do not include all of our macroeconomic and debt-composition variables for two reasons. First, we wish to reduce multicollinearity problems. Second, we wish also to conserve degrees

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the six currencies we use to construct the foreign interest rate variable. This variable moves less dramatically than the full-sample foreign interest rate variable. Since it is probably more reliable, the exact movements of the foreign interest rate variable should not be over-interpreted.

[27] That is, the real exchange rate for a given country in a given year is compared to the values for that country over the entire sample.

of freedom, especially given the problems associated with missing data. The five debt-composition variables that we focus on include the following, each expressed as proportions of total debt: 1) commercial bank debt; 2) concessional debt; 3) variable-rate debt; 4) short-term debt; and 5) FDI. The five macroeconomic variables on which we concentrate are: 1) the reserve to import ratio; 2) the current account as a percentage of GDP; 3) the budget as a percentage of GDP; 4) the growth rate of domestic credit; and 5) the growth rate of real output per capita.

We estimated the linkages variable by variable, using a bivariate approach. We also use a multivariate model where all the variables are employed simultaneously in a multivariate regression (which reduces the number of available observations considerably). Throughout, we pool all the available data across both countries and time periods, and estimate probit models using maximum likelihood.

Results are tabulated in Table 1. Multivariate coefficients and their standard errors are tabulated to the left side of the table; univariate results, including coefficient, standard errors and sample sizes are to the right. Diagnostic statistics for the multivariate model follow at the bottom of the table. These include joint hypothesis tests for the debt composition and macroeconomic coefficients.

Univariate Results

The univariate results are almost all very sensible. An increase in the proportion of debt which is issued by commercial banks, variable rate, or short-term in nature, makes the country more vulnerable to currency crises. Similarly, countries are ?safer? when a higher proportion of their debt is concessional, issued by multilateral institutions, or made up by FDI flows. (While these results are all reasonable, the statistical significance is perhaps surprisingly low in some cases, given the sample sizes and the simple nature of the models.)

The macroeconomic univariate results are almost as good. More reserves (relative to imports) decrease the likelihood of a currency crisis, as do bigger current account or budget surpluses. However, the latter two effects are statistically insignificant. An increase in the growth rate of domestic credit is strongly associated with an increase in the likelihood of a crisis, as is a recession. Increases in either the foreign interest rate or the debt burden also lead to a sharp increase in the probability of a currency crisis. Finally, over-valuation is associated with an increased probability of a crisis, though not at a particularly high level of statistical significance.

To sum up, the univariate results seem sensible and encouraging. The results are easily interpretable, though perhaps not always as statistical sharp as one might like.

Multivariate regression results

The multivariate results are also sensible. Combining the effects of the variables together into a single model reduces the sample size dramatically. The statistical precision is also affected by the multivariate nature of the estimation. Thus, most of the debt composition variables no longer have statistically significant coefficients, though some like the concessional variable are close to significant. The coefficients for commercial bank and public sector proportions of debt switch signs.[28] The most dramatic effects are on the macroeconomic coefficients. Neither the current account nor the budget deficit has the predicted sign (witnessed in the univariate estimation), though neither is statistically significant. But the effects of reserves, domestic credit growth and output growth all remain strong and sensible. The effects of the debt burden, foreign interest rate, and degree of over-valuation remain sensible but are much reduced in statistical precision (though the latter two effects increase in magnitude).

28 The proportions of public debt and multilateral debt are included as a regressor in Table 1b, but are dropped from Table 1 as their theoretical rationale is less clear than the others.

We have pursued many extensions of the analysis. A few of them will be described here, without reporting the tables of results.

We added a variable to reflect the exposure of debtors to fluctuations in the exchange rates among the dollar, yen, franc and other major currencies. We defined the currency exposure variable for a given debtor to be a weighted average of the changes in the dollar exchange rates of the major currencies, where the weights were the shares of that debtor's liabilities denominated in the currencies in question. Thus a country with a heavy share of yen-denominated debt would show a high vulnerability in a year when the yen appreciated sharply against the dollar. Our currency exposure variable turned out to enter the regressions with high statistical significance, but the wrong sign. We believe that this result was dominated by the yen/dollar exchange rate: countries with a lot of debt in the ever-appreciating yen did better in the sample than others. It is the East Asian countries, of course, that have the heavy share of yen debt. We believe that the East Asian countries have done well for other reasons, so that our finding of the wrong sign is spurious. [We did try including dummy variables for the various continents. They are highly significant statistically, e.g., the Asian countries are indeed less prone to currency crises, even holding constant for our other variables. The coefficient on the currency exposure variable goes down some, but does not disappear.]

As another extension, we tested for interactive effects between the level of foreign interest rates and such domestic variables as the debt/output ratio, the variable-rate proportion of debt, and the short-term proportion of debt. All three interactive terms had the hypothesized signs: the combination of high interest rates with a lot of short-term or variable-rate debt raises the probability of crisis. Only the product of the interest rate with the debt/GDP ratio is generally statistically significant, however. There seems to be no reason to believe that the multiplicative form suits the data better than additively separate effects for interest rates and the other variables.

As another extension, we have tested for lagged effects in univariate and multivariate regressions on the variables discussed here. That exploration did not add much to the picture already presented. These results, and others, could be reported in future revisions of this paper, if warranted. [An application of factor analysis is relegated to Appendix 4.]

An attempt to distill some new rules of thumb

In light of the breadth of experience that is reflected in our statistics, it may be useful to try to develop some simple guidelines to judge when a country is vulnerable to a currency crisis. These may be updates of traditional rules of thumb, or may be new guidelines based on indicators such as debt composition that have not previously received as much attention.

The simplest sort of rule of thumb looks only at one single indicator at a time, corresponding to our univariate results. Looking at more information is always better than less, but the financial and policy-making community is much more likely to remember and use such guidelines if they are easy to remember, and easy to apply. We take some encouragement from the knowledge that there is no agreed upon "correct" model to which we are doing violence by focusing on one variable at a time, as well as from the knowledge that many of these variables will speak not only for themselves but also for other variables with which they are correlated.

A more sophisticated guideline would take a weighted average of variables, corresponding to our multivariate regressions [but grouped into factors for ready comprehension]. This will have to await further research.

We tried the following "rule of thumb for constructing rules of thumb": the critical threshold for a given variable (we are considering them one at a time) is where

the probability of currency crisis implied by our probit model exceeds 50 per cent in a given year. Our logic was that, because such variables as the debt/GDP ratio change only slowly over time, a country that exceeds the threshold will probably experience a currency crisis eventually, even though the probability that it will be lucky enough to make it through the first year is as high as 50 per cent. In the calculations we have done so far, however, it appears that to predict a devaluation risk even of 50 per cent required extraordinarily aberrant values of our indicator variables, typically to levels worse than they ever obtained in our data set. These calculations suggest that there is not that much information in any single indicator variable considered alone. A very bad current account balance, for example, is nothing much to worry about if it is the only variable that is known to be out of line.

There is another way to proceed, which is even simpler and more direct, and gives the sort of answer we are looking for. This is to ask what are the average levels of our indicator variables for those countries that do have a currency crisis, compared to those that do not. In other words, we simply read our thresholds off the graphs in Figure 3. The ocular method leads to the following rough conclusions as to composition-related danger signs for risk of currency crisis, *measured relative to non-crisis countries*: as much as 5 per cent of debt at variable rates above, 2 per cent short-term debt above, or 2 per cent portfolio. A country is also at risk if it level of FDI is as much as 3 per cent below that of the other countries. Among non-composition-related variables, the following rules are suggested: debt/GDP as high as 40 per cent above others, interest payments/GDP over 1 1/2 per cent above, reserves/monthly imports more than 75 below, domestic credit growth above 15 per cent, and output growth as low as 4 per cent below. These conclusions need to be refined. To begin with, it would be useful to express the danger levels in absolute terms, rather than merely relative to the group of tranquil observations.

Appendix 1: Brief case studies of eight Latin American and East Asian countries

To flesh out the statistics, this appendix will concentrate on a "reference group" of eight emerging-market countries in Latin American and East Asia: Argentina, Brazil, Chile, Mexico, the Philippines, Indonesia, Malaysia and Thailand. Figures A1.1 and A1.2 show the exchange rates of our eight countries over the last 25 years. We present a brief review of the devaluations of these countries over the past 25 years. Then we consider what answers the traditional rules of thumb gave in their cases.

Major devaluations among the four East Asian reference countries since 1970

We begin with the countries that have managed to maintain the greatest exchange stability, and progress to those with higher magnitudes of depreciation and devaluation.

As the figure shows, Malaysia has not experienced any substantial devaluations. Thailand has also had a fairly stable exchange rate, with two relatively small devaluations in the 1980s.

Of the eight, Indonesia most fits the classic model: a highly stable exchange rate during most of this period, punctuated by three large devaluations. Overall, Indonesia's macroeconomic management has been relatively good. Its three large devaluations can in part be explained by developments in world oil markets.[29] In the late 1970s, with world oil markets booming, Indonesia experienced rising inflation. In a deliberate effort to avoid the real overvaluation that has led to trouble for other commodity-exporters, specifically, a crowding out of manufactured exports (the famous "Dutch disease"), the Indonesians devalued in 1978. In the 1980s, the combination of high world interest rates and declining oil prices led to large current account deficits in Indonesia, and

29 Woo and Nasution (1989), and Caves, Frankel and Jones (1993, p.430).

prompted the other two large devaluations, in 1983 and 1986, respectively.

The record of macroeconomic and exchange rate stability in the fourth of the Southeast Asian countries, the Philippines, has not been as good as the others. Nevertheless, there have only been two years, 1983 and 1984, when the fall in the Philippine peso exceeded 25 per cent.

Major devaluations among the four Latin American reference countries since 1970

The Latin American currencies have been far more prone to depreciation than the East Asians. Chile's depreciations exceeded 25 per cent every year from 1971 to 1977. In June 1979, it fixed the value of its currency in terms of the dollar, in a dramatic attempt to provide an anchor to expectations of monetary stability, and thereby eliminate inflation. Although the inflation fell, it did not disappear. The result was progressively greater real overvaluation and trade deficit, the same pattern that Mexico was to repeat ten years later. Meanwhile, copper prices were declining.[30] By June 1982, unemployment had already risen to 23 per cent. The peg began to unravel. When the international debt crisis surfaced in Mexico in August, and banks all but cut off lending throughout Latin America, the Chilean currency abruptly collapsed. A serious economic and financial crisis resulted.[31] Further large devaluations were also necessary in 1984 and 1985. Since that time, however, depreciation has been gradual and mild. Alone in South America, Chile is now considered a paragon of macroeconomic stability, free-market virtue, and near-miracle growth.

Of the four Latin American reference currencies, the Mexican peso is the one that comes closest to fitting the classic pattern of exchange rate stability punctuated by occasional discrete devaluations.[32] The first large devaluation took place in 1976,

30 Chile's terms of trade in 1982 were only 40 per cent of what they averaged during the period 1965-74 (Cline, 1995a, p.286-87).

31 Corbo (1985), Dornbusch (1985), Edwards (1985), Cline (1995a).

32 One econometric study is Blanco and Garber (1986).

shattering a twenty-year old peg to the dollar. By 1981 the primary fiscal deficit had reached 8 per cent of GDP. The large amount of domestic and international borrowing left Mexico vulnerable to international financial shocks. There was another large devaluation in 1982, when the debt crisis hit Mexico, followed by annual depreciations in excess of 25 per cent in every year until 1987. A *pacto* in that year, together with a large primary fiscal surplus, brought down inflation. The exchange rate was tied to the dollar in late 1987. A gradual slide was built into the target zone for the peso. The rate of slide was itself gradually diminished over the subsequent six years, and for awhile the policy looked very successful.

The most recent peso crisis merits special consideration.[33] Although the exchange-rate-based stabilization program was effective in bringing down inflation after 1989, problems eventually developed. As usual, the inertia in inflation insured that the peso would become progressively overvalued over time, as Dornbusch and others warned.[34] That this happened at the same time as import liberalization meant a large trade deficit. The current account deficit went from balance in the late 1980s to a deficit of 7.8 per cent of GDP in 1994.

As long as capital was flooding in, the exchange rate strategy could be defended. But, at least in retrospect, the reversal in capital flows and in Mexican interest rates around March 1994, and the rapid reserve loss, should then have triggered a devaluation (or accelerated crawl). Authorities could, with justification, have saved face by pointing to U.S. interest rates (which the Federal Reserve began to raise in February) and the Colosio assassination as the cause of the problem, and sought a new *pacto* at that time.

Much-discussed as a contributing factor to the subsequent crisis has been the

33 "Instant analyses" include Frankel (1995), Sachs, Tornell and Velasco (1995). and the epilogue in Cline (1995a,b).

34 Dornbusch and Werner (1994).

structure of the Mexican domestic debt (short-term, and heavily dollar-denominated). Ex ante, this is precisely the sort of "credible commitment mechanism" that some economists are always urging. The point is that such commitments are not sustainable, no matter how sincere the leaders who make them, if the unemployment rate and the ultimate political fundamentals do not allow interest rates to be maintained at extremely high levels. It did allow a camouflaging and postponement of the problem, and bit it worsened the crisis once it came in December. The composition problem was really just another facet of the mistaken decision not to devalue. If the Mexican government had chosen in the spring to respond to the investors clamoring to trade peso assets for dollar assets by continuing to run down their reserves, instead of issuing huge new quantities of tesobonos as it did, it would not have prevented the devaluation crisis.

On the other hand, one can say that foreign direct investment (FDI) is a more stable form of capital inflow than borrowing. FDI appears to have held up relatively well in the present episode. Some have pointed out that Asian countries like China, with far more FDI than most Latin American countries, were less affected by the crisis.

The "Nigel Lawson" thesis, that international borrowing is not a cause for public concern if it goes to finance private sector borrowing rather than public borrowing, failed on two grounds. First, it turns out that the Mexicans, apparently, were rapidly building up credit from a state-owned development bank in the 1994 election year (even if it was no more than sterilization of outflows), which did not appear in the official budget statistics. Second, and more importantly, private borrowing for consumption is almost as unlikely to facilitate future servicing of the debt as public borrowing. While private consumption is in theory better than government consumption, the more important distinction is between consumption and investment.

Another lesson of the recent crisis is that, even a country with good macro policy-making, if it relies too heavily on international borrowing, can be a crisis victim in the

event of bad luck. Huge flows from capital-rich to capital-poor countries, while economically efficient in theory, in practice are subject to periodic crises in which both borrowers and lenders lose. The bad luck in the case of Mexico in 1994 was: (1) the increases in U.S. interest rates that began in February 1994 (as Calvo, Reinhart, and others had warned[35]), and (2) Mexican assassinations and politics. These events are illustrated in Figure A1.3. The average event raised interest rates an estimated 200 basis points.[36]

Of the four Latin American countries, Brazil most regularized the crawling peg. During most of the last 25 years, the cruzeiro has undergone frequent mini-devaluations, in line with a rising inflation rate. In 1976, the depreciation exceeded 25 per cent per annum, and it has done so in every year since.[37] A particularly large devaluation marked 1983, after the international debt crisis had spread from Mexico to Brazil. The rate of depreciation accelerated rather steadily, notwithstanding a series of short-lived attempted stabilization programs. (New currencies were introduced in 1986, 1989, and 1990.)[38] In mid-1994, however, Brazil undertook a serious stabilization program, known as the *real* plan, which was spectacularly successful. It put a floor on the dollar value of the Brazilian currency, now called the real. Indeed, the new currency appreciated above its floor in its early months. Some depreciation was deemed necessary in early 1995, however, as the Mexican crisis spilled over to other debtors (the so-called "tequila effect").

Argentina has experienced the greatest extent of instability of the reference countries. Between 1974 and 1991, the value of the Argentine currency declined by

35 Calvo, Leiderman, and Reinhart (1993, 1995).

36 Frankel and Okongwu (1995).

37 In 1977 and 1978, the percentage devaluations fell just short of 25 per cent if calculated as the change in the exchange rate measured in dollars per cruzeiro, but exceeded 25 per cent if measured either logarithmically or (especially) in cruzeiros per dollar. The logarithmic measure is preferable for most analytic purposes.

38Cardoso (1991).

more than 25 per cent -- usually a lot more -- in every year but one.[39] Repeated efforts to stabilize the exchange rate failed, producing extreme degrees of overvaluation by the PPP criterion in such years as 1976 and 1989. The Austral Plan of 1985 halted the depreciation only briefly.[40] Argentina's monetary instability reached its apogee in the hyperinflation of 1989. Its cumulative depreciation during the 1980s was far in excess even of Bolivia's (which experienced its own hyperinflation in 1984-85). Measures taken in 1989 by the new President, Carlos Menem, again worked only briefly. It was left to a new Finance Minister in 1991, Domingo Cavallo, to introduce the Convertibility Plan, which successfully guaranteed a 1-to-1 parity with the dollar, with the peso fully backed by international reserves. This *currency board* arrangement has generated much interest recently.[41]

To summarize the preceding history, the number of currency crashes was relatively limited, if one defines a currency crash as a sharp departure (> 25 per cent) from the trend that preceded it. There were five in the 1970s (Chile 1971, Argentina 1974, Brazil and Mexico 1976, and Indonesia 1978). There were five more in 1982-83 (Indonesia, Philippines, Mexico, Chile and Brazil), in response to the international debt crisis. Further large devaluations followed for many of these countries, but (with the exception of the third devaluation in Indonesia in 1986) they cannot be viewed as an abrupt departure from the trend of depreciation that had by then been established in the country in question. The collapse of the Mexican peso in 1994 rounds out the dozen clear cases of currency crash.

The rules-of-thumb for dangerous levels of indebtedness

39 One econometric study is Cumby and van Wijnbergen (1989).

40 Dornbusch and Carlos de Pablo (1989).

41 Connolly (1994).

As noted, one traditional warning signal is Net debt/exports > 200 %. Argentina, Brazil, Chile and Mexico and the Philippines had all reached net debt/export ratios of 250 % in 1982. (Mexico had an even higher level at the time of its devaluation in 1976, while Brazil's was almost 200 %.) Indonesia never had debt levels that were this high, until 1986. It may be worth pointing out again a point that was made in the text. The Asian countries persistently do much better than the Latin American countries with ratios where the denominator is exports rather than GDP (while the performance is more equal when the denominator is GDP), for the simple reason that the Asian economies tend to be far more open, as measured by the ratio of exports to GDP. Their high export base makes them less vulnerable than the Latin American countries to currency and debt crises.

How have the eight reference countries fared by other criteria recently? Argentina, Brazil, and Mexico have brought their debt/export ratios down from the high levels of the 1980s, but not quite below the 200 % threshold. The Philippines, Indonesia, and -- most dramatically -- Chile, have brought their debt levels below this threshold. Thailand and Malaysia never had debt levels this high [even at their mid-1985 peaks]; Malaysia's debt in 1993 actually fell below the level of its foreign exchange reserves.

The net interest payment ratio fell below 15 per cent in Argentina in 1993, Brazil and Chile in 1991, Mexico and the Philippines in 1990. In the three other Southeast Asian countries it had never reached that threshold in the 1980s.

The overall debt service ratio has been below 50% in Argentina and Brazil ever since 1991. Mexico's debt service ratio was 39 per cent in 1988, and it has been declining gradually ever since. The others (Chile, the Philippines, Indonesia, Malaysia and Thailand) have done even better by this measure.

Reserve to import ratios have been healthy in Argentina since 1990, Brazil since

1992, Chile and Thailand since 1989, Indonesia and Malaysia since 1991. The Philippines, despite a higher level of reserves than at the lowpoint in 1990, has hovered in the danger zone (below 3 months of imports) for years. Mexico plunged into the danger zone in 1994. Reserves are clearly an important short-term warning indicator for devaluation. (In Mexico's case, however, one who looked at reserves might have thought that the situation had stabilized during May-October, 1994, if one had not also looked at the volume of *tesobonos* issued or the quantity of domestic credit).

None of these traditional rules-of-thumb could have forecasted trouble in Mexico a year ahead of time. The indicator that was most salient for Mexico was its current account deficit. As already noted, several economists have suggested a rule of thumb that a country can rarely sustain a current account deficit of more than 3 per cent of GDP, or at most 4 per cent for a rapidly growing country, before risking trouble. Mexico's current account deficit was an alarming 6.5 % of GDP in 1993, and it rose further in 1994. Argentina's was a manageable 2.9 %, Brazil's a negligible (though rising) 0.2 %, the Philippines a dangerous and rising 5.9 %, Indonesia a safe (though rising) 1.8 per cent, Malaysia a more worrying (and rising) 3.9 %, and Thailand a quite worrisome (and rising) 5.4 %.

One feels much better about a current account deficit when the net capital inflow that it represents is going to finance investment rather than consumption. In Mexico in 1993, the capital inflow was 2/3 the level of gross national saving, an alarmingly high ratio. In Thailand, the Philippines, and Argentina it was a much better 1/5 to 1/4, and in Malaysia a still better 1/8.

Appendix 2: Short-term warning indicators

The discussion in the paper focussed primarily on fundamental economic indicators that suggest a country may be vulnerable to crisis. Many are collected only with a lag of one year or more, as noted. Moreover, some of our reference countries have gone through many years of apparently excessive indebtedness without a crisis. Are there short-term indicators that might give an early warning of an impending crisis on a more timely basis?

We have been able to think of five candidates. The first three are obvious: local interest rates, the spread in the parallel or black market where one exists,[42] and the level of foreign exchange reserves. (We observe below that when a country stops reporting its reserves, as Mexico did from August to December of 1994, that fact itself is valuable information.) The other two are much less well-known: country fund discounts, and exchange rate forecast survey data.

Securities prices are of course sensitive barometers of investor opinion, and are available on a daily basis. Secondary debt prices, including the prices of Brady Bonds, have been watched carefully. [Figure A2.1 illustrates secondary debt prices from 1986 to 1995 for our four Latin American countries.] The problem is that, although these are sensitive *coincident* indicators of crises, they are not leading indicators. Secondary debt prices for Mexico and the rest of our debtor countries rose throughout the early 1990s, signalling rising investor confidence, including through mid-1994. There was little sign of trouble before December 19. Until they fell off the cliff, Mexican prices in December 1994 had been on the same high plateau that they had first attained in 1992.

42 Edwards (1994) tries the parallel market premium as one of the variables in an equation to determine the real exchange rate, in a sample of 12 countries that includes Brazil, Malaysia, the Philippines and Thailand.

The same problem applies to equity market indices.

It is worth investigating whether *country fund discounts and premiums* are a potential leading indicator. This idea requires some explanation. An interesting possible hypothesis regarding the capital inflows of 1990-94 is that foreign residents were more optimistic about domestic assets than are domestic residents. A widely-held interpretation of the massive capital flight from Latin America that took place in 1982 and the years immediately preceding it is that residents of these countries correctly perceived dangers ahead, at a time when foreign banks were foolish enough to be still lending eagerly. Anyone who is concerned about a possible replay of 1982 wants to be vigilant to any future signs that the locals are again losing confidence. Unfortunately, capital flight can only be estimated with a lag of several quarters (and, even then, very imperfectly).

One place where it might be useful to look instead are the prices of country funds that invest in the emerging stock markets of Latin American and Asian countries. Over 40 of such funds have been opened on the New York Stock Exchange in recent years. They are closed-end funds, and their price in New York seldom equals the value of the constituent equities on the home-country markets. Fluctuations in the premium of the U.S. price of the fund over the net asset value could be a measure of fluctuations in the difference in expectations of U.S. versus local investors regarding the economic prospects of the country in question.

For most of these funds this premium was higher (or the discount was lower) during the period 1990-1992 than during the preceding three years, suggesting bullish sentiment on the part of foreign investors. In Frankel (1993, p.181), it was observed that Mexico and Brazil showed a clearly higher level of relative U.S. investor confidence in 1991-1993 than in 1989-1990, but the reverse for two East Asian

countries. That paper concluded, "If our interpretation of the data is correct, that they represent the confidence of U.S. investors relative to local investors, these four graphs suggest a possible replay of the period leading up to 1982: booms based relatively firmly on the ground in the case of East Asia, but based excessively on the enthusiasm of U.S. investors in the case of Latin America." Figure A2.2, borrowed from Frankel (1994, 1995a) shows the country fund data for the period of net capital inflows.

In light of the subsequent Mexican crisis, the look at the country fund prices bears updating. The available data in fact show little evidence of a further rise during the course of 1994 in the optimism of foreign investors relative to locals. However there was a very sharp change, indeed a switching from discount to premium, in all three closed-end Mexico funds *in the middle week of December 1994*. Under the hypothesis that the premium measures the valuation that local residents place on local equities relative to the valuation that U.S. investors place on them, the opening of a large premium suggests that Mexicans suddenly became more pessimistic than Americans. This would seem to be a good potential piece of evidence in support of the claim by some that the speculative attack, when it came in December, was led by Mexican residents rather than foreign investors.[43] Figure A2.3, borrowed from Kramer and Smith (1995)[44], shows data from before and after the Mexico crisis (with data from the three funds shown in three graphs). The conclusion for our purposes seems to be that the country fund prices could perhaps have been useful for forecasting a crisis at either a one-day horizon or a two-year horizon. The data bear further investigation.

A final short-term indicator that might potentially warn of devaluation is the exchange rate forecasts of market participants, as captured by survey data. Currency

43 Notably, the International Monetary Fund Capital Markets Report, 1995.

44 They argue against the interpretation that the discount or premium captures relative optimism.

Forecasters' Digest (recently acquired by the *Financial Times Group*), collects monthly forecasts of future exchange rates from multinational companies and forecasting services. Among developing countries, Argentina, Brazil and Mexico are covered monthly; Malaysia and the Philippines, are covered bi-monthly; Indonesia, Thailand and Chile are covered three times a year. The data for Mexico are graphed in [Figure 3 / A2.3 (the data points are represented by little triangles).] They show that expectations of devaluation shot up after the assassination of presidential candidate Colosio in March 1994, and again after the Ruiz Massieu assassination and second Chiapas uprising, i.e., shortly before the December devaluation. One cannot say that the forecasters saw a definite devaluation coming, let alone that they could have forecast the magnitude of the crisis. Indeed, the most pessimistic of the respondents in the Currency Forecasters Digest survey called for a peso/dollar rate of 4.0, which turned out to be far too optimistic. But these data too bear further investigation.[45]

It has been widely noted lately that lack of information can itself constitute information. Mexico's failure to report some key central banking statistics in the Fall of 1994 should have been a tip-off to trouble. The *Economist Intelligence Unit* recently rated 24 emerging-market countries by the quality of their statistics as of March 1994. Chile gets an *A*, Argentina a *B+* (although Argentina ranks 2nd in the timeliness of its statistics, it does not report GDP on a quarterly basis), Mexico also a *B*, Malaysia, the Philippines and Thailand *B-*, and Indonesia a *C+* (ahead only of China, Russia, and Venezuela).[46] This issue has received a lot of attention in the aftermath of the 1994 Mexican crisis. Where other reforms proposed in the aftermath of 1994 have foundered on various rocks of impracticality or political opposition, the International Monetary

45As in Frankel and Okongwu (1995) or Chinn and Frankel (1995).

46The Economist, March 4, 1995, p.72.

Fund is likely to implement proposals that debtors and other member countries be required to report data on a more complete and timely basis than in the past. The primary sanctions are likely to consist of public release of the fact of inadequate reporting, so that the financial markets can apply their own penalties.

Appendix 3: Variable Definitions

Commercial Bank Debt: (*World Data* mnemonic ?DT DOD DCBK CD?)
Concessional Debt: (*World Data* mnemonic ?DT DOD ALLC CD?)
Variable Rate Debt: (*World Data* mnemonic ?DT DOD VTOT CD?)
Public Sector Debt: (*World Data* mnemonic ?DT DOD PUBC CD?)
Total Debt: (*World Data* mnemonic ?DT DOD DECT CD?)
Short Term/Total Debt: (*World Data* mnemonic ?DT DOD DSTC ZS?)
Multilateral/Total Debt: (*World Data* mnemonic ?DT DOD MLAT ZS?)
Foreign Direct Investment: (*World Data* mnemonic ?BN KLT DINV CD?)
Portfolio Investment: (*World Data* mnemonic ?BN KLT PORT CD?)
Debt/Annual Exports: (*World Data* mnemonic ?DT DOD DECT BX?)
Debt/GNP: (*World Data* mnemonic ?DT DOD DECT GN?)
Interest Payments/GNP: (*World Data* mnemonic ?DT INT DECT GN?)
Reserves/Monthly Imports: (*World Data* mnemonic ?FI RES TOTL BM?)
International Reserves: (*World Data* mnemonic ?FI RES TOTL CD WB?)
Current Account/GNP: (*World Data* mnemonic ?BN CAB XOTR ZS?)
Government Deficit/Surplus: (*World Data* mnemonic ?GV BAL OVRL CN?)
Gross National Product: (*World Data* mnemonic ?NY GNP MKTP CN?)
Domestic Credit: (*World Data* mnemonic ?FM AST DOMS CN?)
GNP per capita: (*World Data* mnemonic ?NY GNP MKTP KD 87?)
Net Long Term Capital Flow: (*World Data* mnemonic ?BN KLT XRSL CD?)
Net Short Term Capital Flow: (*World Data* mnemonic ?BN KST XRSL CD?)
Average Interest Rate: (*World Data* mnemonic ?DT INR DPPG?)
Average Private Interest Rate: (*World Data* mnemonic ?DT INR PRVT?)
Lending Rate: (*World Data* mnemonic ?FR INR LEND?)
Debt Denominated in Dollars: (*World Data* mnemonic ?DT COM USDL ZS?)
Debt Denominated in Deutschemark: (*World Data* mnemonic ?DT COM DMAK ZS?)
Debt Denominated in Yen: (*World Data* mnemonic ?DT COM JYEN ZS?)
Debt Denominated in French Francs: (*World Data* mnemonic ?DT COM FFRC ZS?)
Debt Denominated in Pound Sterling: (*World Data* mnemonic ?DT COM UKPS ZS?)
Debt Denominated in Swiss Francs: (*World Data* mnemonic ?DT COM SWFR ZS?)

Appendix 4: Factor analysis

We have repeatedly described the variables as falling into four categories: indebtedness, composition, other domestic macroeconomic indicators, and world financial conditions. One might wonder whether these categories like these four fall out of the data naturally. Factor analysis is a natural way to answer this question.

We applied factor analysis to a list of variables, corresponding generally to those mentioned above. The results are not reported here. There is some basis for judging these results as pointing to the importance of what we would [a priori] have identified as the important factors. [One judges support for these groupings by looking within a given factor loading for large coefficients (of the correct sign) on each of the variables in question.] In the table, factor 1 seems to correspond to our composition variables, and so forth. These results could be expanded.

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Table 1b

	Multivariate Results		Univariate Results		
	Coefficient	*(se)*	*Coefficient*	*(se)*	*Sample Size*
Comm?l Bank/Debt	-.005	.013	.003	.002	1642
Concessional	-.010	.006	-.006	.002	1642
Variable Rate	.001	.013	.006	.002	1642
Short Term	.004	.012	.005	.003	1687
FDI/Debt	-.031	.011	-.035	.008	1255
Public Sector/Debt	.011	.008	-.004	.002	1642
Multilateral/Debt	-.003	.007	-.006	.003	1687
Reserves/Imports	-.0007	.0003	-.0004	.0002	1441
Current Account	.011	.010	-.001	.005	1370
Gov?t Deficit	.027	.014	-.004	.007	1084
Domestic Credit	.013	.003	.011	.002	1332
Growth Rate	-.037	.012	-.043	.007	1412
Debt/GNP	.003	.002	.004	.001	1526
Foreign Interest	.115	.025	.083	.016	1609
Over-Valuation	.468	.300	.303	.201	1305

All estimates are probit coefficients with a constant included, estimated by maximum likelihood.

Multivariate Results: $N = 803$; $)^2(15) = 93$; McFadden?s $R^2 = .19$.
Ho: All Debt Composition Coefficients $= 0$; $)^2(5) = 13.8$.
Ho: All Macroeconomic Coefficients $= 0$; $)^2(6) = 35.4$.

Notes