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MARKETS

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ABSTRACT

First generation models of speculative attacks show that apparently random speculative attacks on policy regimes can be fully consistent with rational and well-informed speculative behavior. Unfortunately, models driven by a conflict between exchange rate policy and other macroeconomic objectives do not seem consistent with important empirical regularities surrounding recent crises in emerging markets. This has generated considerable interest in models that associate crises with self-fulfilling shifts in private expectations.

In this paper we develop a first generation model based on an alternative policy conflict. Credit constrained governments accumulate reserve assets in order to self-insure against shocks to national consumption. Governments also insure poorly regulated domestic financial markets. Given this policy regime, a variety of internal and external shocks generate capital inflows to emerging markets followed by successful and anticipated speculative attacks.

We argue that a common external shock generated capital inflows to emerging markets in Asia and Latin America after 1989. Country specific factors determined the timing of speculative attacks. Lending policies of industrial country governments and international organizations account for contagion, that is, a bunching of attacks over time.

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Introduction

Exchange market and banking crises in Latin America and, more recently, in Asia have renewed interest in the economics of speculative attacks. Two types of models have dominated formal analysis. First generation models, reviewed in Agenor et al. (1992) interpret speculative attacks as the natural and anticipated demise of an inconsistent policy regime. Proponents of this approach emphasize the conflict between objectives for nominal exchange rate stability and a monetary/fiscal policy that is inconsistent with this objective.

Confidence in these models as complete explanations of speculative attacks has been eroded by the observation that, in many cases, the underlying policy conflict seems to be missing¹. The ERM crises in 1992 and the Mexican crisis of 1994 have been cited as examples of crises not preceded by policy conflicts. Moreover, an important empirical regularity associated with recent crises in emerging markets is that speculative attacks are preceded by very large private capital inflows into the country. This seems to suggest that bullish market sentiment collapsed at the time of the attack.

These observations have inspired models that identify conditions under

¹Krugman (1996) argues that first generation models are useful in understanding recent crises. He emphasizes the fact that a range of policy conflicts can trigger an attack. For example, an extended period of high unemployment can conflict with the government's commitment to a fixed exchange rate and the associated constraint on monetary policy. Moreover, he argues that in some models multiple equilibria are ruled out because an attack will occur on the first day it could occur. Kehoe (1996) Obstfeld (1996b) argue that the multiple equilibria are possible in a wide variety of theoretical models

which a regime is vulnerable to shifts in private expectations. Second generation models, reviewed in Eichengreen et al. (1996b), explain speculative attacks in terms of the fundamentals identified in first generation models, but the fundamentals are themselves sensitive to shifts in private expectations about the future. While a shift in market expectations about future policies could trigger an attack in first generation models, the spirit of the approach would demand that they have a good reason to change their minds in terms of perhaps unobservable fundamentals.²

The objective of this paper is to set out a first generation model based on an alternative set of fundamentals. The general structure of the model is drawn from Dooley (1994), (1996a). An appealing feature of the model is that an anticipated crisis need not be preceded by the exchange rate-policy conflict or by expectations that such a conflict will occur. Moreover, in contrast to existing first generation models, private capital inflows always precede the crisis and are an integral part of a sequence that ends in an anticipated speculative attack against the government's reserves.

The model explains the size and duration of the capital inflow and the anticipated sequence of yield differentials that make the inflow and the attack optimal for rational speculators. Finally, the model suggests that exchange rate regimes and changes in regimes might be associated with crises but play no role in

² Garber (1996) points out that first and second generation models are observationally equivalent if expectations for fundamentals change for good reasons not observed by the econometrician.

causing the crises. It follows that interest differentials across currencies are not always associated with anticipated speculative attacks.³

The primary accomplishment of first generation models is that they relate fundamentals that evolve smoothly to discreet changes in regimes and asset holdings. The mechanism that accomplishes this is an anticipated sequence of yields on real or financial assets that shapes the behavior of competitive and rational investors. The earliest version of the model by Hotelling (1931) considers a situation in which the government distorts the real interest rate earned on stocks of commodities by fixing their nominal price. As long as the return on holding the commodity is below the risk-free alternative, private investors are happy to let the government hold the buffer stock. But investors know that if a speculative attack exhausts the buffer stock, the price of the commodity will henceforth rise at the real interest rate. At this time private investors will buy the entire stock of government holdings in a speculative attack. Salant and Henderson (1978) applied a similar argument to explain attacks on government gold stocks. Krugman (1979) adapted the idea to a fixed exchange rate system.

In Krugman's model the driving force is a conflict between the government's exchange rate commitment and its fiscal policy. As long as the fixed exchange rate regime survives a deficit is financed by gradual reductions in the

³ Sachs et al. (1996) for example argue that the attack against the Mexican Peso could not have been anticipated because interest differentials in favor of the peso were much too small to compensate investors that expected peso depreciation. In our framework the attack on the government's reserves was anticipated but the devaluation may not have been.

government's reserves. On the day the attack occurs the government's reserves fall discreetly to zero and the exchange rate is allowed to float. There is nothing apparently special about that day in terms of the fiscal deficit but there is something special about yields on assets, in this case on money balances.

Because the exchange rate regime ends when reserves go to zero, subsequent deficits are financed by money creation. The associated increase in expected inflation and nominal interest rates reduces the real return on, and demand for, real money balances and this is accommodated by the discreet sale of international reserves (the foreign part of the monetary base) to the private sector. Like its antecedents, this model teaches the important lesson that rational economic behavior driven by fundamentals that evolve smoothly over time can involve dramatic attacks (asset exchanges between the government and the private sector) and changes in regimes that seem to be unrelated to contemporaneous changes in the fundamentals.

The model developed in this paper is in this tradition. The policy conflict in the background in our model is between the desire of a credit-constrained government to hold reserve assets as a form of self-insurance and the government's desire to insure financial liabilities of residents. The first objective is met by the accumulation of foreign exchange reserves. The second objective generates incentives for investors to acquire the government's reserves when yield differentials make this optimal.

These ingredients provide a plausible capital inflow/crisis sequence. The

availability of free insurance raises the market yield on a set of liabilities issued by residents for a predictable time period. This yield differential generates a private gross capital inflow (a sale of domestic liabilities to nonresidents) that continues until the day of attack. The private inflow is necessarily associated with some combination of an increase in the government's international reserve assets, a current account deficit and a gross private capital outflow. But the distribution among these offsetting transactions is unimportant. When the government's reserves are exactly matched by its contingent insurance liabilities, the yield on domestic liabilities falls below market rates and investors sell the insured assets to the government, exhausting its reserves. The speculative attack is fully anticipated and at the time of the attack nothing special happens to the fundamentals or expectations about the fundamentals.

Changes in exchange rate regimes might follow the attack, but expectations about such regime changes are not necessary features of the capital inflow-attack sequence. Finally, introduction of a very simple sort of uncertainty makes speculative attacks inherently contagious. This model has important implications for policy and for "early warning" indicators for speculative attacks. These issues are addressed in concluding remarks.

The evidence

In searching for empirical verification of traditional balance of payments attack models, a recurrent theme is that regularities are difficult to find. Frankel and

Rose (1996) find that crises, defined by dramatic increases in the rate of change in nominal exchange rates, are associated with the composition of capital flows, reserve levels, domestic credit growth, international interest rates, and real exchange rates. They also find that the fundamentals emphasized in Krugman's model, current account deficits and fiscal deficits, seem not to be associated with crises.

Several papers have examined individual crises and concluded that shifts in private expectations are important elements in an attack sequence. Calvo and Mendoza (1995) and Cole and Kehoe (1996) argue that the crisis in Mexico in 1994 is consistent with the idea that the government's short term debt made it vulnerable to a shift in private expectations. Sachs et al. (1996) examine characteristics of 20 countries that seem to contribute to their vulnerability to speculative attacks following the Mexican crisis in 1994. They find that prior lending booms, overvalued exchange rates and low levels of reserves relative to M2 explain a large part of this experience. They also find that fiscal and current account deficits seem to be unrelated to a country's vulnerability to attack. This evidence is widely interpreted as favoring multiple equilibria models of speculative attacks.

In this paper we argue that there is no clear relationship between crises typical of emerging markets and "the" fundamentals because first generation models focus on the wrong set of fundamentals when trying to understand crises in emerging markets. The need for an alternative approach is suggested by the

failure of these models to explain the dominant empirical regularity associated with recent speculative attacks in emerging markets. That regularity is very large gross private capital inflows into these markets prior to the crash. This inflow, the size of which has been systematically understated in literature⁴, is a real problem for models of speculative attacks unless one is prepared to accept the view that private investors change their minds in very special and convenient ways.

Proponents of multiple equilibria models are correct in pointing out that prior capital inflows are inconsistent with first generation models. First generation models predict that a steady private capital outflow (or trade deficit) precedes a speculative attack. But even second generation models suggest that increases in international reserves associated with large private capital inflows reduce the country's vulnerability to a shift in private expectations. The interpretation of domestic lending booms fueled by capital inflows in Sachs et al. (1996) is an ingenious attempt to match the data and the model. In their words: "Presumably, the prior bank lending boom indicates greater weakness in bank balance sheets and, therefore, more vulnerability to reversals of investor confidence." (p. 150) This suggests that a prior burst of arbitrary confidence in the emerging markets is likely to be followed by a collapse of confidence. While such views of speculative behavior are very old, very popular and possibly correct it would be reassuring if a

⁴Following the seminal paper by Calvo et al. (1993) the literature has focused on net private capital flows. The model developed in this paper suggests that gross private capital outflows precede a speculative attack. Gross private inflows to emerging markets have been two to three times as large as net private inflows since 1989.

common analytical framework could account for both the inflows and crises in a model where investors are informed and rational.

The insurance model

The model developed in this section meets this challenge. In our framework a capital inflow and boom in domestic financial intermediation are an integral part of a fully anticipated attack on the government's reserves. In a nutshell the idea is that government insurance of private financial liabilities generates changes in the stock of government contingent liabilities and insured private assets that, if not regulated, will eventually exhaust the resources of the insurer. It is not surprising that moral hazard inherent in free government insurance can generate crises. What is surprising is that such crises are associated with a sequence of yield differentials and international capital flows that fits the data for recent crises in emerging markets.

Elements of the model can be found in several discussions of recent crises in emerging markets. Sachs et al. (1996) provide a clear analysis of how domestic financial liberalization and weak regulatory systems have generated lending booms in emerging markets. "Financial liberalization typically is accompanied by aggressive behavior on the part of banks. In order to raise deposits, banks increase interest rates and fund more risky projects. Given the existence of deposit insurance (implicit or explicit) depositors find it profitable to move to these banks. Although the purpose of prudential regulation is to impede this tendency, during the

early years of liberalization the capacity for oversight is usually poor. Consequently when significant capital inflows take place in early stages of financial liberalization, the lending boom that follows is likely to be associated with an increase in the riskiness and vulnerability of bank portfolios.....The weaknesses of the banking system do not surface until capital inflows reverse." (p. 191).

The empirical association between banking and currency crises is well established. Gavin and Hausmann (1995) document the relationship between lending booms and financial crises in Latin America. Kaminsky and Reinhart (1996) show, in a sample of 76 balance of payments crises and 26 banking crises in 20 developing countries from 1970 to 1995, that about one-quarter of the banking crises occur within one year of a balance of payments crisis. Their interpretation of the evidence is that balance of payments crises were unrelated to banking crises during the 1970s when financial markets within these countries were highly regulated. Following liberalization of domestic financial markets in the 1980s, banking and balance of payments crises were closely linked and banking crises preceded balance of payments crises.

Goldfajn and Valdes (1997) examine four recent examples of banking/ balance of payments crises in Finland, Mexico, Sweden and Chile. In each case capital inflows preceded the crises by three to six years and lending booms occurred in domestic banking markets over the same intervals. The crises were followed, except in the case of Sweden, by substantial capital outflows and in all cases by a sharp reduction in bank credit. Their model suggests that intermediation

involving maturity transformation is likely to increase capital inflows relative to equilibria in which there is no intermediation but at the cost of increasing the probability of a run on the banking system. Since the run on the banking system depletes reserves it also increases the chances that a fixed exchange rate regime is abandoned.

This literature has clarified two important points. First, the government's net reserves support two policy regimes: the banking/financial system and the exchange rate regime. An attack on either regime that exhausts reserves will necessarily have important implications for the other regime. This will make identification of the causes of a crisis difficult.⁵ Second, rapid growth in the stock of bank credit may be an early warning that potential losses in the financial system and the associated contingent government insurance liability are approaching a crisis level.

The model proposed in this paper carries the argument a step further. We do not argue that capital inflows and associated growth in credit increases the vulnerability of the regime to shifts in private expectations or that liberalization per se is likely to trigger a crisis. Dornbusch (1997) sets out this view clearly : "a political reversal could break a pattern of continuity and credibility and lead to a sell off; a bout of easy money would hasten a crisis, a fragile banking system with

⁵The two objective/one policy tool problem is well known. Wigmore (1987), for example, argues that the choice of the new Federal Reserve system to protect its gold reserves in order to maintain the fixed exchange rate forced them to accept the bank failures that may have triggered the 1930s depression. For a discussion of the conflict in the context of currency boards see Caprio et al. (1996).

currency exposure would magnify the collapse, and a liquid debt structure would accelerate and magnify the collapse. Financial considerations are all important in interpreting specific events, but must not be misconstrued as the primary or sole source of a collapse." (pp. 383-84). In the model developed below financial considerations are the primary and sole source of an anticipated collapse.

The fundamentals of an attack

Three "insurance fundamentals" must be present in order to generate a private capital inflow followed by a speculative attack. The first is that the government must have positive-net international reserves. Net reserves in this model are defined to include contingent assets and liabilities. Second, the government's commitment to exhaust these net reserves to pay off an implicit or explicit insurance contract must be credible. That is, it must be consistent with the government's incentives and ability to mobilize and exhaust its net worth after the attack begins. Third, private investors must have access to transactions that produce insured losses.

All three factors must be present to trigger a capital inflow and subsequent attack. One or more of these fundamentals are found in most countries most of the time. But as long as one ingredient is missing there will be no capital inflow and no crisis. Crisis episodes are associated with the relaxation of a binding constraint. It follows that there is no simple temporal ordering of changes in insurance fundamentals and crises. It also follows that an important change in the

international environment might relax a binding constraint in many countries at the same time.

Examples of changes in binding constraints

A government with open financial markets, weak regulatory systems and a credible commitment to insure a well-defined set of residents' liabilities will not experience a sequence of capital inflows followed by an insurance attack unless it has net reserve assets to expend during the attack.⁶ For middle income developing countries with substantial stocks of external debt the missing fundamental from 1982 through 1989 was a stock of assets to support a credible insurance commitment. For this group of countries an important source of changes in the value of governments' net reserves have been changes in the market value of governments' liabilities caused by changes in international interest rates. The fall in international interest rates after 1989 generated a capital gain on external debt that turned developing countries into "emerging markets". This effect was not limited by geography or by the macroeconomic structures of individual developing countries. Asian developing countries had external debt equal to 22.5 percent of GDP at the end of 1989. For Western Hemisphere countries the ratio was 37.9 percent, for all developing countries the ratio was 25.4 percent.

Since the international interest rate relevant for all these countries is the

⁶ There have been, as far as we know, no speculative attacks in very low income countries.

same we would expect to see a capital inflow-crisis sequence start at the same time for many middle-income debtor countries⁷. The decline in international interest rates that preceded the capital inflow to emerging markets in 1989 generated an insurance fund. The capital inflows were not motivated by a simple interest differential but by a much more powerful insurance incentive.

The dynamics of the model can be illustrated by the behavior of key variables following a shock to the government's net assets. Some care must be taken in defining net assets in this model. For simplicity we assume there are no unsecured and incentive compatible debt contracts for the government. Thus, the government cannot borrow against future tax receipts. It is also assumed that the government can credibly offer assets as collateral against liabilities. This collateral consists primarily of international reserve assets and lines of credit from other governments and international organizations. Credible pledges of collateral are generally associated with liabilities to residents but could apply also to foreign debt. Finally, it is assumed that it is optimal for the government to self insure against shocks to national consumption by holding a stock of net assets. There is no market in which the private sector can neutralize the government's decision to accumulate net assets.

In order to mimic the recent experience of many emerging markets the initial

⁷Dooley et al. (1996) show that changes in international interest rates are sufficient to explain all of the changes in the market valuation of these governments' external debt. They also argue that the elimination of discounts on existing debt was a precondition for new capital inflows.

position is one in which the governments have inherited external debt.⁸ The government accumulates international assets over time in a number of ways discussed below in order to smooth domestic consumption. The assets accumulated cannot provide the basis for credible new government liabilities until existing debt is fully collateralized. A decline in the market value of existing liabilities, not matched by a decline in the market value of assets, allows the issue of additional secured liabilities.

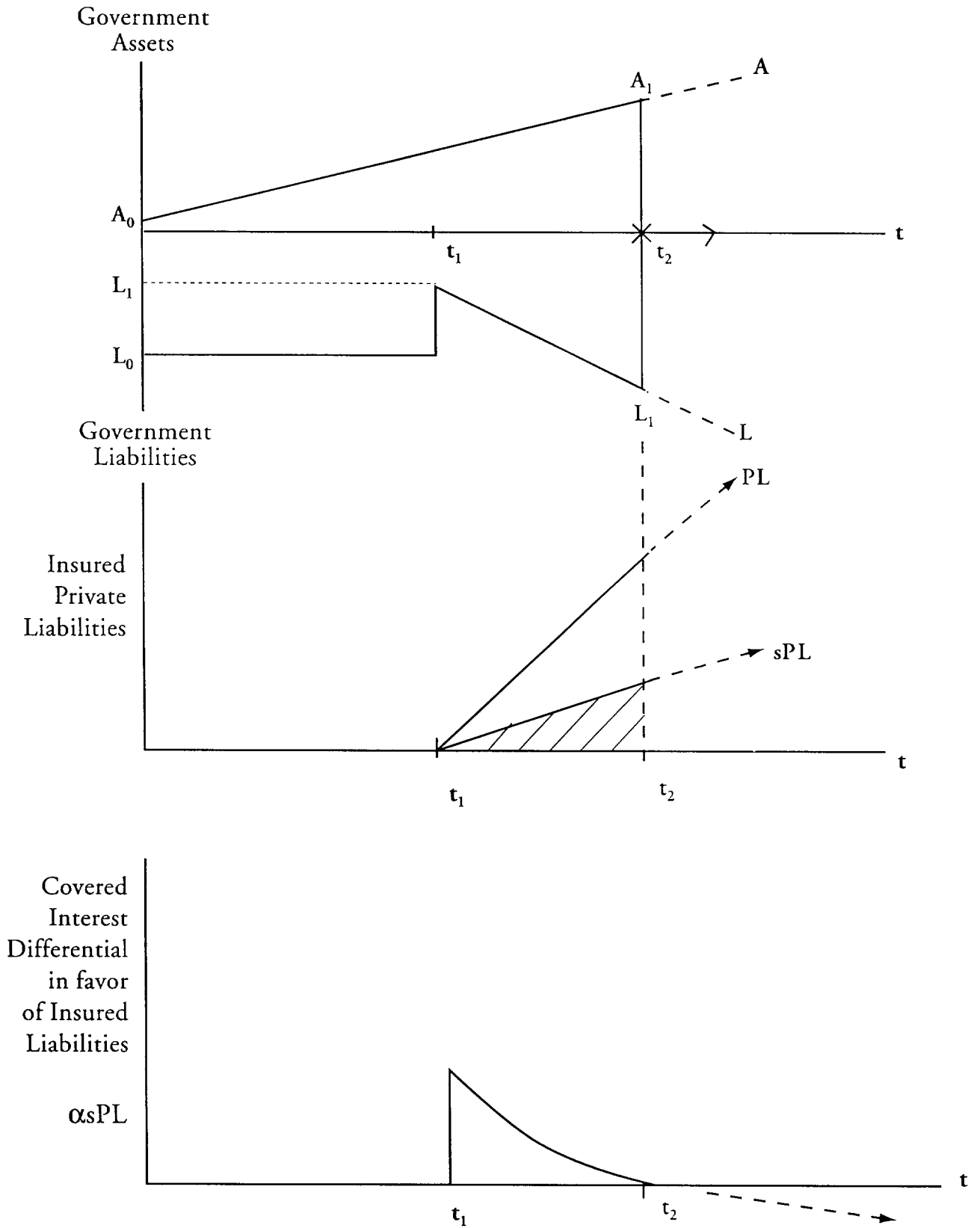
This sequence of events is illustrated in Figure 1. The positive vertical axis in the top panel measures the stock of assets the government could liquidate in order to redeem liabilities to the private sector. The negative vertical axis measures the government's total stock of contingent and noncontingent liabilities. We start from a situation in which the value of assets, A_0 , is growing but is less than L_0 the value of debt.⁹ A fall in international interest rates at t_1 reduces the value of government's long term liabilities from L_0 to L_1 , but does not affect the contractual value of short term assets. A part of the government's assets can now support additional liabilities.

In the middle panel we show the stock of insured private liabilities. At t_1 any resident that can issue an insured liability will now offer to do so in order to

⁸A consistent story for how this debt was acquired before 1982 is that credit lines provided by creditor country governments to guarantee the debt evaporated because of political changes in industrial countries. See Dooley (1995).

⁹The market value of the debt would be equal to the collateral value. That is there would be a secondary market price discount. See Dooley et al. (1996) for a model and evidence.

Figure 1



appropriate share “s” of the proceeds¹⁰. Sellers of such liabilities are residents simply because only residents' liabilities are eligible for insurance. The government's contingent liability is the same fraction of new insured liabilities (the shaded area in the middle panel).

The value of s is specific to the country and is small in a well regulated market and large in a poorly regulated market. The time derivative of the flow of new issues (the slope of PL) is also specific to each country and is also a function of the supervisory system in place. Relatively poorly regulated financial markets will see a relatively rapid increase in insured liabilities.

Investors are willing to buy residents' liabilities because they are insured and because competition among (resident) sellers will force them to share a part of their appropriation with (nonresident) creditors. This will take the form of above market expected yields on residents' liabilities¹¹. Yields will be the same for both domestic

¹⁰A more realistic form of appropriation is state contingent. That is, insured residents exploit insurance by reaching for risk. They share returns earned in good states of the world and default in bad states of the world.

¹¹The accounting is straightforward if we abstract from financial intermediation. Suppose a resident household can issue a \$10 liability to a foreign investor. The household plans on repaying \$5. The household shares its gain by paying the investor \$2.50 and keeping \$2.50. The investor expects the government to purchase the liability for \$10 in one year. The government's contingent liability is \$5.00. More realistic examples will involve one or more financial intermediaries in this process. The distribution of the rents among the participants will depend on their relative bargaining power. If investors' demand for claims on residents are very elastic, residents will capture most of the rents. This seems to us the most likely outcome. It is difficult to interpret historical evidence for deposit rates. As insurance became credible after 1989 deposit rates should have fallen as default risk was absorbed by the government. In Mexico real ex post rates on domestic deposits (adjusted for actual changes in dollar exchange rates) fell from about 15

currency and foreign currency liabilities of residents as long as the insurance is expected to cover both types of domestic liabilities.¹²

As long as the "foreign" investors earn above market yields there is a disincentive for an attack on the government's assets. Investors will prefer to hold the growing stock of high yield insured liabilities of residents and allow the government to hold reserves that earn the risk free rate. Private profits are realized before the attack. The attack itself is generated by competition to avoid losses. When the contingent liabilities of the government are just equal to the initial windfall, competition among investors will insure that all will call the insurance option. The bottom panel of Figure 1 shows the covered premium declining smoothly toward zero on the day of attack. From that date forward their share of the insurance pool will begin to shrink and expected yields will fall below market rates. Recall that resident borrowers will continue to appropriate a part of the loans and this will force expected yields below honest alternatives.

Following an attack the regime returns to its initial equilibrium in which the

percent above US rates in 1990 to equality with US rates in late 1994. While this pattern in returns is consistent with our model, Mexico's stabilization program may have had important implications for this history of yield differentials. See Kaminsky and Leiderman (1996) for a discussion of stabilization plans and real interest rates.

¹²If the insurance is only available on domestic (foreign currency) liabilities an equilibrium covered interest differential will emerge in favor of domestic (foreign currency) liabilities. A fixed exchange rate regime is not crucial for the argument. Under floating exchange rates the nonresident investor plans to liquidate her position at the time of the anticipated attack. It follows that any spot foreign exchange transactions will be offset by a matching forward exchange transaction. Private interest arbitrage will ensure that there is no net change in spot or forward rates.

government's net international reserves have returned to zero. The loss of reserves might force the government to abandon its commitment to manage the exchange rate.

Insurance crises and the exchange rate regime

A fixed exchange rate is a helpful but not a necessary part of this sequence. Fixed exchange rates are helpful because they give residents an easy way to generate insured losses. For example, a bank can offer dollar-denominated deposits at above market rates and make dollar-denominated loans at even higher rates. The bank shares the spread with depositors as long as the inflow lasts and the customer defaults on the loan if the speculative attack triggers a devaluation. The devaluation provides debtors with a plausible story as to why default is unavoidable.

Perhaps more important a fixed exchange rate indicates that the government is likely to exhaust its assets once the attack begins. That is, the government is more likely to choose to honor its contingent liabilities rather than utilizing inflation or default to reduce their value. Governments that are expected to resort to default, either through inflation or outright default, do not fulfill one of the fundamentals for an insurance attack and therefore there will be no capital inflow. It follows that governments that have used an exchange rate anchor to increase the credibility of their commitment not to inflate are more likely to be targets for an insurance crisis.

An important insight from this example is that the exchange rate devaluation is not a necessary part of the story. Nevertheless as Kaminsky and Reinhart (1996) find, a balance of payments crisis is likely to follow an insurance crisis. The idea that the government's stock of international reserves is one policy tool with two objectives is well known. Reserves in our model are lost because the government has a strong incentive to act as a lender of last resort. But once exhausted the reserves cannot help stabilize the nominal exchange rate. Even a tiny negative shock might then convince the government to devalue.¹³ But the initial shock might be positive and there need be no change at all in the regime following the attack. This may explain the fact that returns on domestic currency denominated positions did not indicate that investors anticipated a devaluation prior to recent attacks in Mexico and Thailand.

Assets and contagion

In many developing countries factors other than changes in international interest rates have generated changes in the government's net assets. Fiscal reform has been impressive in many countries; debt restructuring has been put in place; privatization, in fact as well as intentions, has been remarkably successful in adding to governments' net assets. All these factors have contributed to war chests that can be emptied by a crisis.

¹³An alternative reason to devalue might be because this is a condition for official credits.

Equally important, the widespread move toward market economies has opened substantial credit lines from governments and international organizations. A large share of the resources made available to the private investors following the Mexican crisis came from loans from the US government and the International Monetary Fund. IMF loans to Argentina following the Mexican crisis and more recently to Thailand suggest that such credit is now an established part of the resources available to governments of emerging markets.

This important source of net reserve assets helps explain why insurance crises are likely to be contagious. As argued above, a number of country specific factors will determine the size and duration of a capital inflow-attack sequence. In a perfect foresight world insurance crises would be independently distributed over time. Eichengreen et al. (1996b), and Calvo and Reinhart (1996) show, however, that the crises have been much more concentrated over time than independent draws would suggest. While other explanations of contagion have been offered¹⁴, the insurance model offers a relatively simple and compelling explanation.

When an attack occurs investors receive new information about the size of official credits available to cover insurance commitments and perhaps their distribution across countries. Following the crisis in Mexico, for example, there were considerable differences of opinion concerning the willingness or ability of the US government to support additional loan programs in the face of considerable

¹⁴See Calvo and Mendoza (1997) for an excellent review of the literature and a new result that suggests that growth in international markets might increase the tendency for herd behavior to destabilize markets.

congressional opposition. This may have reduced the expected value of official loans to other countries, perhaps to levels that made immediate attacks optimal.

Size, composition and duration of capital inflows and timing of crises

If there were no adjustment costs for private portfolios the relaxation of a binding constraint would generate an immediate capital inflow followed by an immediate crisis that exhausted the government's net assets. A prolonged capital inflow, however, seems likely as residents, nonresidents and financial intermediaries learn how to best take advantage of the newly credible or newly accessible insurance offered by the government.

Although a capital inflow crisis sequence is likely to begin at about the same time for many indebted developing countries following a decline in international interest rates, the duration of the inflow and the timing of the expected crisis can vary widely. In fact, a crisis might never occur if the government reacts properly. The duration of the capital inflow will depend on the rate at which banks, households and firms can sell insured liabilities. In part this will depend on their ability to do so without attracting the attention of the authorities.

It is possible that a regulatory response could stop the process before a crisis occurs. In this case a new equilibrium is established without a crisis. The yield differential in favor of domestic liabilities is eliminated when, at the margin, the cost of avoiding prudential regulation matches the rate of appropriation. At this

point the regulatory constraint again becomes binding and the regime will be characterized by a weakened but viable financial system¹⁵.

The class of investments that are expected to be protected will vary from country to country and over time. But it is easy to think of some general rules. Commercial bank deposits at "large" banks are obvious candidates since a failure of such an institution threatens the payments mechanism. In emerging markets free deposit insurance extended to banks in newly liberalized financial markets has long been cited as a source of instability in financial markets (McKinnon and Mathieson (1981), Hanson and de Melo (1983), Diaz Alejandro (1985), Corbo et al. (1986), Baliño (1991), McKinnon (1991), Velasco (1991)). Akerlof and Romer (1993) and Kane (1995) argue that a deadly brew of insurance, undercapitalized banks, unrestricted competition for deposits and poor prudential regulation has induced banks to reach for risk and generated losses for governments.

The distinguishing feature of recent private capital inflows to developing countries is that they are comprised of a wide range of instruments in addition to bank deposits. These include equities, direct investments, corporate bonds, and government securities (Calvo et al. (1993) and Claessens and Gooptu (1993)). It is not obvious that the government of the borrowing country has provided a guarantee for all these liabilities. But even the liabilities of domestic nonfinancial

¹⁵An important difference between this sequence and problems with domestic markets in industrial countries is that the governments in industrial countries close the domestic intermediaries before the government's net worth is exhausted. Thus, in the US savings and loan debacle there was no run on the government's reserves. Instead a binding constraint was reestablished by reregulating the financial system.

corporations might carry a strong government backup. Nonresident creditors can liquidate these investments without loss if firms can be expected to ask for and receive credit from the domestic banks. To refuse to do so would depress the market value of the banks' existing claims on the domestic firms and call into question the solvency of the domestic banking system. Groups of financial and nonfinancial firms with cross holdings of ownership are common in emerging markets and this blurs the distinction among their liabilities.

The argument is close to the spirit of that offered by Diaz Alejandro (1985). Although he emphasized the role of deposit insurance in generating crises in the Southern Cone he made the much more general point that banks' customers are also implicitly guaranteed. "Southern Cone domestic financial systems of the late 1970s and early 1980s ended up with a pessimum 'middle way': de facto public guarantees to depositors, lenders and borrowers, and no effective supervision and control (until it was too late) of the practices of financial intermediaries...as illustrated in the recent Chilean experience, foreign financial agents will not accept a separation of private and public debts when a crisis arrives." Another way to put this point is that the composition of the private capital inflow may not be informative in evaluating the motivation of the investor. Our conjecture is that all investors rely on the lender of last resort.

Why are inflows to insured intermediaries international capital flows?

The distinction between private residents and nonresidents is not important

for this analysis. All private investors are assumed to face the same incentives and to behave in the same manner. There is, however, an interesting distinction between financial wealth held in the domestic market and wealth held in international capital markets.

In most emerging markets financial repression has meant that domestic intermediation is subject to a variety of restrictions. As a result residents of the country often hold a large part of their wealth in international markets. The flow of financial assets out of these countries is generally not captured in their balance of payments statistics. After all, it is moving out to avoid regulation. But "flight capital" as it is often called has been measured using alternative data sources. We know that for many developing countries the stock of such assets is large relative to the stock of domestic assets.

In contrast, the flow of residents' capital from international capital markets to their home country markets is likely to be captured in their balance of payments accounts. Recent inflows to emerging markets could reflect a decline in the "home bias" of industrial country portfolios but a more plausible story is that "home bias" of residents of developing countries is being reestablished as flight capital has returned to emerging markets. Estimates of unrecorded capital outflows from emerging markets through 1989 suggest that all the inflow since then could have been a return of flight capital (Cuddington (1986), Dooley (1988), Rojas-Suarez (1991)). Recent capital inflows may simply be the reopening of domestic financial markets under the umbrella of a solvent lender of last resort.

Liberalization

Another plausible sequence of events that would trigger an inflow-crisis sequence is that a country with substantial net assets and a credible insurance policy might liberalize access to insured positions. This opening would involve both domestic financial markets and access to international financial markets.

Liberalization might relax two constraints. First it might make domestic liabilities available to foreign investors. Second, liberalization might make the existing regulatory framework less effective.

In a tightly controlled financial system government guarantees are difficult to exploit. In developing countries, for example, controls on deposit interest rates have been common and competition from nonbank intermediaries has been discouraged. Domestic financial liberalization usually involves relaxation or elimination of such controls. This allows residents to find new and better ways to take advantage of explicit or implicit government guarantees.

The sequence of capital inflows and crisis will be as discussed above. Unlike the sequence started by a change in international interest rates, changes in regulatory structure are likely to be country specific. Moreover, the effects of domestic financial liberalization are likely to be gradual and difficult to measure. While such a sequence might be relevant for developing countries in Asia it should be noted that these governments had large external debt stocks in 1989 when world interest rates fell.

Solutions?

Since credit constrained governments have good reasons to hold assets and lines of credit, and since they will continue to act as lenders of last resort, the obvious way to stop insurance crises is to limit the private sector's ability to exploit insurance. Open capital markets and wealthy governments require effective supervision and regulation of domestic credit markets.

If prudential regulation takes time to put in place it might be optimal to delay or reverse liberalization of international capital flows. Effective regulation of capital inflows starves an insurance crisis of the fuel that sustains it. In Dooley (1996b) it is argued that a Tobin, or transactions, tax on capital flows is unlikely to be welfare improving because holding periods have not been convincingly related to speculative behavior. But the insurance model developed in this paper does provide a clear rationale for this type of tax. The key is that the insurance model provides a good reason to believe that holding periods of investors exploiting insurance are different, and probably shorter, as compared to normal (honest) investors. The capital inflow-attack sequence has an expected duration. If regulation is weak the duration is short and a transactions tax would probably fall disproportionately on this type of capital flow. The right transactions tax would eliminate the incentive to exploit the insurance but interfere less with normal investors.

International organizations that supply credit to countries in crisis should consider a different kind of conditionality than is usually required for lending. Recall that first generation models focus on fiscal and trade deficits as the

fundamental causes of crises. It is not surprising, therefore, that conditionality also has focused on reductions in fiscal deficits and exchange rate adjustments. But these policy initiatives will do little or nothing to head off an insurance crisis. As more countries satisfy the three fundamentals for an insurance crisis -- assets, credibility and liberalized financial markets -- a stable international monetary system will require more careful attention to the distortions inherent in insured domestic financial systems.

Finally, the implications of the model for early warning systems are straightforward. Rapid growth in any type of domestic credit creates a presumption that a binding constraint on an insurance attack may have been relaxed. If the credit boom is fed by capital inflows this is an additional warning that trouble may be brewing. The constraints themselves are easily evaluated. Does the government have net assets including lines of credit? Will the government exhaust those assets to honor its explicit and implicit liabilities? Is there a vehicle for residents to issue insured liabilities that is not subject to prudential regulation? An affirmative answer to all three questions suggests that the regime may be headed for a crash.

Agénor, Pierre-Richard, Jagdeep S. Bhandari, and Robert P. Flood, (1992) "Speculative Attacks and Models of Balance of Payments Crises," Staff Papers (International Monetary Fund), Vol. 39 , pp. 357-94.

Akerlof, George A., and Paul M. Romer, (1993) "Looting: The Economic Underworld of Bankruptcy for Profit," Brookings Papers on Economic Activity, 2 (Washington: The Brookings Institution) pp. 1-60 and 70-74.

Baliño, T. (1991), "The Argentine Banking Crisis of 1980," in Banking Crisis: Cases and Issues ed. by V. Sundararajan and T. Balino, (Washington: International Monetary Fund).

Calvo, Guillermo A., (1995) "Varieties of Capital-Market Crises," Working Paper, University of Maryland.

_____, (1996), "Capital Flows and Macroeconomic Management: Tequila Lessons," unpublished manuscript, University of Maryland .

Calvo, Guillermo and Enrique Mendoza, (1995) "Reflections on Mexico's Balance-of-Payments Crisis: A Chronicle of Death Foretold," (unpublished; College Park: University of Maryland, 1995).

_____, (1997), "Rational Herd Behavior and the Globalization of Securities Markets," Federal Reserve Bank of Minneapolis, Working Paper 120, (August).

Calvo, Guillermo, Leonardo Leiderman, and Carmen Reinhart, (1993)"Capital Inflows to Latin America: The Role of External Factors," Staff Papers (Washington: International Monetary Fund), Vol. 40, pp. 108-51.

Calve, Sara and Carmen M. Reinhart, (1996), "Capital Flows to Latin America: Is There Evidence of Contagion Effects?", in Private Capital Flows to Emerging

Markets After the Mexican Crisis, ed by Guillermo Calve, Morris Goldstein and Eduard Hochreiter (Washington: Institute for International Economics 1996), pp. 151-171.

Caprio, Gerald, Michael P. Dooley, Danny Leipziger and Carl Walsh, (1996), "The Lender of Last Resort Function Under a Currency Board: The Case of Argentina," Open Economies Review Vol 7. 625-650.

Claessens, Stijn and Sudarshan Gooptu, (1993), editors, Portfolio Investment in Developing Countries, World Bank Discussion Papers, No. 228 (Washington: The World Bank, December).

Cole, Harold and Timothy Kehoe, (1996) " A Self-fulfilling Model of Mexico's 1994-5 Debt Crisis," Federal Reserve Bank of Minneapolis, Staff Report 210.

Corbo, Vittorio, Jaime de Melo, and James Tybout, (1986), "What Went Wrong with the Recent Reforms in the Southern Cone," Economic Development and Cultural Change, Vol. 34 (April), pp. 607-40.

Cuddington, John T., (1986), Capital Flight: Estimates, Issues, and Explanations, Princeton Studies in International Finance, No. 58 (Princeton, New Jersey: Princeton University).

Diaz Alejandro, Carlos F., (1985), "Good-bye Financial Repression, Hello Financial Crash," , Journal of Development Economics, Vol. 19 (September-October), pp. 1-24.

Dooley, Michael P., (1988), "Capital Flight: A Response to Differences in Financial Risks," Staff Papers, (Washington: International Monetary Fund), Vol. 35, No. 3 September.

_____, "Are Recent Capital Inflows to Developing Countries a Vote For or Against Economic Policy Reforms?" (1994), Working Paper #295, Department of Economics, University of California, Santa Cruz.

_____, "A Retrospective on the Debt Crisis," (1995), in P. Kenen, ed., Understanding Interdependence: The Macroeconomics of the Open Economy (Princeton, N.J.: Princeton University Press).

_____, "Capital Controls and Emerging Markets, (1996a)" International Journal of Finance and Economics, Vol 1, pp. 197-205.

_____, (1996 b), "The Tobin Tax: Good Theory, Weak Evidence, Questionable Policy" in The Tobin Tax: Coping with Financial Volatility, Mahbub ul Haq, Inge

Kaul and Isabelle Grunberg (eds) Oxford University Press pp. 83-108.

Dooley, Michael P., Eduardo Fernandez-Arias, and Kenneth Kletzer, (1996), "Is the Debt Crisis History? Recent Capital Inflows to Developing Countries," World Bank Economic Review, Vol 10, No. 1, pp. 27-50.

Dornbusch, Rudiger, (1997), "Brazil's Incomplete Stabilization and Reform" Brookings Papers on Economic Activity Vol 1, pp. 367-404.

Eichengreen, Barry, Andrew Rose, and Charles Wyplosz , (1996a), "Contagious Currency Crises," NBER Working Paper NO. 5681, July.

_____, (1996b), "Speculative Attacks: Fundamentals and Self-Fulfilling Prophecies," NBER Working Paper 5789.

Frankel, Jeffery and Andrew Rose, (1996), "Currency Crashes in Emerging Markets: An Empirical Treatment," Board of Governors of the Federal Reserve System, IFDP 534, (January).

Garber, Peter, (1996), "Discussion," NBER Macroeconomics Annual, Vol.11.

Gavin, Michael and Ricardo Hausman, (1995), "The Roots of Banking Crises: The Macroeconomic Context," Interamerican Development Bank.

Goldfajn, Ilan and Rodrigo Valdes, (1997), "Balance of Payments Crises and Capital Flows: The Role of Liquidity," unpublished manuscript, MIT.

Goldsterin, Morris, (1996), " Presumptive Indicators/Early Warning Signals of Vulnerability to Financial Crises in Emerging Markets," Washington: Institute for International Economics.

Hanson, James and Jaime de Melo, (1983), "The Uruguayan Experience with Liberalization and Stabilization," Journal of Inter-American and World Affairs, Vol. 25, pp. 477-508.

Hotelling, Harold , (1931), "The Economics of Exhaustable Resources," Journal of Political Economy 39, pp. 137-75.

Kaminsky, Graciela and Leonardo Leiderman, (1996), " High Real Interest Rates in the Aftermath of Disinflation: Credit Crunch or Credibility Crisis?," Board of Governors of the Federal Reserve System IFDP #543 (March).

Kaminsky, Graciela, Saul Lizando and Carmen M. Reinhart, (1997), "Leading

Indicators of Currency Crises," WP /97/79, International Monetary Fund.

Kaminsky, Graciela and Carmen Reinhart, (1996), "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems," International Finance Discussion Paper No. 544 , Board of Governors of the Federal Reserve, (March).

Kane, Edward J. (1995), The Gathering Crisis in Federal Deposit Insurance (Cambridge: The MIT Press) pp. 119-128.

Kehoe, Timothy, "Comment," (1996), NBER Macroeconomics Annual, Vol.11.

Krugman, Paul, "A Model of Balance-of-Payments Crises," (1979) Journal of Money, Credit, and Banking, Vol. 11, No. 3 , pp. 311-325.

_____, (1996), "Are Currency Crises Self-Fulfilling?" NBER Macroeconomics Annual, Vol.11.

McKinnon, Ronald I. (1991), The Order of Economic Liberalization: Financial Control in the Transition to a Market Economy (Baltimore: Johns Hopkins University Press).

McKinnon, Ronald I., and Donald J. Mathieson, (1981), "How to Manage a Repressed Economy," Princeton Essays in International Finance, No. 145 (December).

Obstfeld, M., "Rational and Self-Fulfilling Balance-of-Payments Crises,"(1986), American Economic Review, Vol. 76, p. 72-81.

_____, "Models of Currency Crises with Self-Fulfilling Features," (1996a) European Economic Review .

_____, "Comment," (1996b), NBER Macroeconomics Annual, Vol.11.

Rojas-Suarez, Liliana (1991), "Risk and Capital Flight in Developing Countries" in Determinants and Systemic Consequences of International Capital Flows, IMF Occasional Paper No. 77 (Washington: International Monetary Fund, March).

Sachs, Jeffrey, Aaron Tornell and Andres Velasco, (1996), "Financial Crises in Emerging Markets: The Lessons From 1995," Brookings Papers on Economic Activity, No. 16, pp.147-215.

Salant, Stephen and Dale Henderson (1978), "Market Anticipation of Government Policy and the Price of Gold," Journal of Political Economy 86, pp. 627-48.

Valdes, Rodrigo O. (1997), "Emerging Market Contagion: Evidence and Theory," unpublished manuscript, MIT.

Velasco, Andrés, (1991), "Liberalization, Crisis, Intervention: The Chilean Financial System, 1975-85," in Banking Crises: Cases and Issues, ed. by V. Sundararajan and Tomás J.T. Baliño (Washington: International Monetary Fund).

Wigmore, Barrie, (1987), "Was the Bank Holiday of 1933 Caused by a Run on the Dollar?" Journal of Economic History, 47(3) pp. 739-55.