Lecture Note on Asian Flu

Fall 1997

1. Introduction

Asian flu is the disease characterized by the contagious spreading of outflows of capital in emerging market economies. It is the successor to the Tequila effect. When Mexico devalued the peso in December 1994 there were strong adverse reactions in other countries such as Argentina, Brazil, and the Philippines. But other countries seemed to escape, for example, Chile and Columbia. This experience raised the issue of how contagious are these crises and what causes them to spread. This question has become all the more important in the wake of the Asia flu, because the contagion appears, in this case, to be world-wide.

Indeed, Dornbusch has argued that contagion is *always* the issue. The reason is that "if every crisis were exactly as the preceding one, they would all happen much earlier." If currency crises all had the same characteristics it would be easier to discern the warning signs. But this phenomena evolves: there is always something new that dispels an old myth. For example, it used to be thought that large reserves were an effective antidote; but this was proved wrong in the UK case in 1992. After the Thai case there is much more attention to currency forward contracts. Another myth that seems to have gone by the way is that borrowing is not a problem if it goes to investment.

A closely related, and perhaps even more important, question relates to the cause of such currency crises. Are these due to declining fundamentals or speculative attacks. Mexico had a growing current account deficit in 1994 that seemed a looming danger. But other countries (Malaysia and Thailand) ran comparably larger deficits and emerged (then) unscathed in 1994. In that case, then, it seemed that fundamentals may have something to do with who gets hit. Yet the Asian flu struck countries that appeared to be have strong fundamentals. There were few voices raising alarms about Asia. A cursory look at the Thai situation, where

it all started, is informative. In table 1 we have some data for Thailand which indicates the extent to which fundamentals, with the exception of the current account, were rather strong.

This raises the question of how important are fundamentals, and can fundamentals explain the magnitude of adjustments that take place. And the two questions are related: Whether or not the crisis spreads may have something to do with how strong are fundamentals in other countries.

Table 1: Thai Macro Performance

	1981-90	*1991-95*	*1995*	*1996*
Growth	7.9	8.5	8.7	6.7
Inflation	4.4	4.8	5.8	5.9
Saving	26.2	34.8	35.0	35.3
Budget		3.4	1.5	1.5
Current Account		-6.9	-7.6	-7.5
External Debt		48.1	68.1	78.1

There are several interesting features of the current wave of currency crises that are especially noteworthy. It is useful to collect these *stylized facts* of currency crises here for future reference.[1]

1. *Government misbehavior does not seem to be the proximate cause.* This is evident in the Thai case from the budget surpluses. Similar stories could be told for Mexico and the rest of Asia, though less for Russia certainly. This fact raises the relevance of "first-generation" models of currency crises.

2. *A wide variety of macroeconomic circumstances are observed.* There appears to be no unique pattern of buildup to these crises. This is what makes them so hard to forecast. This raises some questions about the relevance of "second generation" models.

3. *The same macroeconomic circumstances do not seem to always cause crisis.* In 1994 Malaysia and Thailand had large current account deficits. Why did they not get drunk from Tequila, but fell victim to the flu? Why were Brazil, Chile, Columbia and Peru immune in 1996?

[1] This particular list is due to [2].

4. *Exchange rate and banking crises appear highly associated.* Currencies seem to crash along with financial systems. Financial variables appear more highly correlated with currency crises than real variables.

5. *Punishment appears to be much larger than the crime.* The real consequences of these crises are quite large. Chile's GDP contracted by 14% in 1982, Mexico's by 7% in 1995. Asia has also seen huge turnarounds in GDP growth. These seem large given the magnitude of current account deficits in these countries.

The current Asian flu is spreading rapidly. South Korea is in therapy already, and Russia has caught a full dose. Now Brazil appears about to get ill. What is common about these cases is that the financial crises are associated with large capital flows. The countries that have been struck first had large capital inflows. This is a response to financial liberalization which was taken to be a great success.. Capital inflows are an important feature of the development process, but sudden bursts of panic that lead to massive capital outflows can be quite disruptive. The question that arises is whether this is due to caprice or cause?

2. Background

The flow of private capital to developing economies is not new. Such flows were very important in the 19th century. European investments, especially British, financed US railroad expansion, and France and Germany were major lenders to Russia in the late 19th century. During the latter half of the century Britain was running current account surpluses on the order of 3-7% of GNP.

Debt crises were also not uncommon. Consider Taussig's description:

> The loans from the creditor country...begin with a modest amount, then increase and proceed crescendo. They are likely to be made in exceptionally large amounts toward the culminating stage of a period of activity and speculative upswing...With the advent of crisis, they are at once cut down sharply, even cease entirely. The interest payments on the old loans thereupon are no longer offset by any new loans; they became instantly a net charge to be met by the borrowing country [10, 120].

And as now, countries that were hit by such crises eventually made their way back to the international capital markets. Taussig was thinking of the US and Argentina, but similar cycles occurred in Latin America in the 1920's followed by crisis in the 1930's, and again in the period 1978-81 followed by the debt crises of the 1980's. So it should not be too surprising that after the debt crisis of the 1980's, this past decade has seen massive capital flows.

2.1. The Resurgence in Capital Flows

Capital flows to developing countries increased dramatically in the 1990's. Between 1990 and 1994 some $670 billion flowed to developing countries in Asia and Latin America, compared with about $133 billion in the previous five years. This increase was generally attributed to sound economic policies and marketization, and was seen as market support of economic policies in these countries. Of course, the fact that this was a global phenomenon suggests that maybe it had as much to do with general and cyclical phenomena as with specific country characteristics.

2.1.1. Causes

The causes of the large inflows in the 1990's are several.

First, is the sustained decline in world interest rates. Short-term interest rates fell dramatically in the late 1980's and early 1990's, so that by 1992 they were at their lowest level since the early 1960's. Investors sought out developing countries in an effort to earn higher returns. And lower interest rates reduced the debt burden of many debtor countries, increasing their creditworthiness. Of course, this does raise the question of whether these low rates were a temporary phenomenon.

Second, an increasing trend towards international diversification of investment in major countries and growing integration of capital markets. Mutual funds and insurance companies greatly increased their activities in foreign countries.

Third, many previously indebted countries made significant progress on improving their relations with creditors. Debt-equity swaps also improved the situation. This reduced the perception of risk in such lending.

Fourth, several countries made progress in reforming their domestic economies. Bolivia, Chile, and Mexico implemented major disinflation programs in the 1980's and Argentina, Brazil, and Peru in the early 1990's. Such programs can reduce the risk associated with lending to these countries and so stimulate capital flows. Even if the reforms are not credible they can lead to capital flows due to the effect

on real interest rates of stabilization. Other reforms, such as trade liberalization and financial reform, can also stimulate capital flows.

Finally, we may point to the *contagion* effect. Lending to some countries in a region can stimulate lending to neighbors as investors learn about the region. Investment in Mexico and Chile may have had positive spillovers in other parts of Latin America. Of course, this can happen in reverse as well, and is an important aspect of the Tequila effect and the Asian Flu.

Of these various causes, external factors seem to play a large role.

2.1.2. Consequences

The effects of the inflows are also several.

First, inflows led to a large increase in foreign exchange reserves. Over 35% of the capital inflows to Asia and Latin America during 1990-94 went to foreign exchange holdings. Towards the end of the period inflows started to go into larger current account deficits, which is the second effect. This is due both to an increase in national investment and a decline in savings.[2] Higher investment and consumption also led to higher economic growth. Real GDP grew at an annual average rate of 6.8% in Indonesia, 8.7% in Malaysia, 10.0% in Thailand, 7.7% in Argentina and 6.4% in Chile during the period of high capital inflows (1990-94).

A third effect is a rise in consumption spending. This appears in the form of increasing imports of durable goods, which is common in exchange-rate based stabilizations. It appears to be more of a factor in Latin America than Asia.

Fourth, there is a rapid growth in the domestic money supply, in both real and nominal terms. This can be thought of as a natural result of more rapid growth, and also as a consequence of lower interest rates. It is possible, however, to offset the monetary effects of capital inflows. This can be accomplished in two ways. First, by letting the currency appreciate. This eliminates the increase in reserves, and hence in the monetary base. Second, the central bank can conduct contractionary open market operations by selling bonds to offset the inflow; i.e., sterilization.

A fifth effect, that is coming to roost, is the rapid acceleration of domestic asset prices. Stock markets in emerging markets saw massive increases in their levels during this period. Similar effects on real estate. Many countries saw annual returns of more than 100%. This led, no doubt, to the wild lending sprees that

[2] Recent behavior in developing countries seems to suggest against the Feldstein-Horioka effect.

play an important role in the current crisis.

A final effect is on the real exchange rate. In most Latin American countries the real exchange rate appreciated, while in most of Asia this did not occur. This may be due to fiscal contractions that accompanied inflows in Asia but not in Latin America.[3]

2.2. Implications

One might assume that capital inflows are an unmitigated benefit. It certainly reflects an increase in opportunities that face a country. But there are policy issues. If the country lets the currency appreciate then competitiveness will be eroded by real appreciation. Alternatively, a fixed exchange rate poses the problem of domestic money expansion or the technical difficulties of sterilization.[4] Indeed, sterilization may not even suffice in the long run. If capital inflows are sterilized, then interest rate differentials fail to narrow, and the inflows continue. If sterilization takes place via bond sales then public debt increases. This can have its own adverse consequences, not least on the creditworthiness of the borrower.

There may also be difficulties if the domestic banking system is unable to handle large capital flows. And, of course, what comes in can flow out, as is becoming apparent now.

3. Currency Crises and Speculative Attacks.

To understand the Asian Flu we need to examine currency crises. One of the main controversies in this literature is whether speculative attacks are successful only when fundamentals are out of line, or whether currency crises can arise from self-fulfilling attacks. Officials in many countries know the answer of course. Dr. Mahatir's tirade against George Soros does not differ dramatically from sentiments expressed by people in the Bank of England in 1992. The alternative argument is that currency crises are due to deteriorating fundamentals, and that the responsible agents are the governments of the respective countries.

The key debate is then over the issue of whether currency crises are self-fulfilling or whether they are due to deteriorating fundamentals. This is ultimately an empirical question, but there are also important theoretical considerations.

[3] In Chile and Mexico fiscal contractions preceded the surge in inflows.

[4] Which Russia seemed unable to deal with in 1994.

3.1. The Fragility of Fixed Exchange Rates

It is often argued that the increase in global capital flows makes it difficult to peg exchange rates. The argument is often heard that global capital flows exceed reserves of any central bank, thus rendering fixed exchange rates impossible. The daily volume of foreign exchange transactions is typically greater than $1 trillion. The Quantum Fund may have resources as high as $12 billion. A group of hedge funds may have assets sufficient to defeat any currency they focus on, given the typical size of foreign reserves.

This argument is incorrect, however. To defend a peg all a central bank has to do is buy back the monetary base. Most countries have foreign reserves that are at least as high as the monetary base.[5] As an example, in September 1994 Mexico had total reserves of $4.7 billion compared with a monetary base of $3.9 billion. In practice, a determined central bank would not need to buy back all the monetary base; once attackers recognize that the central bank is willing to subordinate all other goals to defending the peg the attack will cease.

Here is the crux of the problem: to repel an attack a central bank must subordinate other goals. It is the conflict between defending the currency and other goals that make currencies subject to attack. To fully combat an attack means letting domestic interest rates spike dramatically. In the short run this may have deleterious effects on the banking system because banks borrow short and lend long. In the longer term, higher interest rates will have adverse effects on the economy. A government pledge to fight at any cost is thus unlikely to be credible.

This argument suggests that central banks face a tradeoff between defending the currency and domestic objectives. Given this tradeoff, it is argued, speculative attacks can be self-fulfilling. This argument points to multiple equilibria. The value of this argument is that the currency may come under crisis long before the markets display panic. In many cases interest differentials prior to depreciation do not signal a time of trouble.[6] Models with multiple equilibria, it is argued, are better able to explain this.

[5] Not the US or Japan, however. These countries have little need to hold reserves given that their currencies float, and given the ease of borrowing.

[6] This is apparent in the 1992 ERM crisis. Interest differentials showed little evidence of any erosion of confidence in the months leading up to the crisis.

3.1.1. Speculative Attacks

Krugman [5] takes issue with the new class of models that suggest that currency crises can be self-fulfilling. To understand this we first examine a simple model that develops the relationship between currency crises and fundamentals.

Standard models Consider an economy that attempts to peg the exchange rate. Assume full employment, PPP, and interest rate parity. Further assume that the rest of the world price level is fixed at unity. We will show how multiple equilibria can appear to be present, and then how a unique timing for a speculative attack can be established.

In the standard model the focus is on loss of reserves. Let the domestic money supply be given as the sum of domestic credit and foreign reserves $M = D + R$. The demand for domestic money is given by $L(\pi)$, where π is the expected rate of depreciation (which is also the expected inflation rate). Then money market equilibrium, when the peg holds, can be written as

$$M = eL(0). \tag{3.1}$$

We further assume that the government is running a deficit that is financed by expanding D. Now we take a snap-shot of the economy. Suppose that

$$0 < R \leq M - eL(\pi) \tag{3.2}$$

We can think about the economy in two ways. If agents expect that the exchange rate will hold, then they expect $\pi = 0$. In that case money demand is sufficiently large so that $R = M - eL(0)$; hence, reserves are adequate and no depreciation takes place. If, on the other hand, agents expect depreciation then money demand will fall and reserves will be inadequate. Since the flow of reserves depends on the excess demand for money (i.e., $\dot{R} = -[M - eL(\pi)]$, with expectations of depreciation reserves must run out eventually. So it appears that we have multiple equilibria. The economy is in a crisis zone, and whether there is a currency crisis or not depends can depend on whether or not there is a speculative attack.

The standard analysis suggests that this is incomplete. The reason is backward induction. Recall that fundamentals are deteriorating; reserves are falling, so eventually the exchange rate will have to give way. But if the rate must give way at time t, then it would be prudent to get out of the currency at time $t-1$. But then the attack must come at $t-1$. However, it is now prudent to attack at $t-2$. We can proceed with this argument until we reach a point where it is not longer

prudent to attack. In other words, backward induction implies that the attack occurs when it is first *feasible* to attack. This is defined by

$$R = eL(0) - eL(\pi) = M - eL(\pi). \tag{3.3}$$

Notice the argument. It is not that there is no possibility of a speculative attack; indeed the argument depends on it. Nor does it imply the absence of a crisis zone. The argument is rather that we will not *observe* the economy lingering in the crisis zone, because the currency will collapse as soon as it enters the zone.

One of the appeals of this model is that it implies gradual loss of reserves until the critical point is reached; then a large loss of reserves as the currency collapses. The problem with the model for recent currency crises is that the driving force is the public deficit which causes the gradual decline in reserves. This did not happen in many recent crises; notably in ERM and Mexico.

Self-fulfilling Models A new class of models argues that self-fulfilling attacks are possible when countries face trade-offs in their objectives. In these models the government must decide whether or not to defend the currency. A simple way to see this is to incorporate a loss function that the government minimizes. Three characteristics of the situation are important. First, that there is some reason whey the government would benefit from depreciation, perhaps to reduce unemployment with fixed wages, or to reduce the real value of debt. Second, the cost of maintaining the peg is directly related to expected depreciation.[7] Third, there is a reputational loss that occurs from abandoning the peg. This makes the government prefer not to see depreciation.

Write the loss function of the government as:

$$H = [a(e^* - e) + b\epsilon]^2 + R(\Delta e) \tag{3.4}$$

where e is the log of the exchange rate, e^* is the rate that the government would depreciate to if there were no cost to this, ϵ ($\equiv e^E - e$) is the expected rate of depreciation, and $R(\Delta e)$ is the reputation cost, which is equal to 0 if no depreciation takes place, and equals C if the currency depreciates.

Assume that the government can choose the exchange rate so we do not have to model monetary policy. Let $\overline{e}$ be the current parity to which the government has staked its reputation. Then if the government chooses to allow depreciation it

[7] This would follow for various reasons; for example, expected depreciation causes interest rates to increase.

will choose $e = e^*$ immediately since this eliminates the first two terms in 3.4. If the government does not depreciate then we have two possibilities. Either agents expect depreciation next period so that $e^E = e^*$ or they expect no depreciation $e^E = \overline{e}$. Then to see what the government does we must compare the loss from staying with the peg with the cost of depreciation, C, i.e., whether

$$[a(e^* - \overline{e}) + b(e^E - \overline{e})]^2 \lesseqgtr C. \tag{3.5}$$

Now suppose that agents do not expect depreciation. The second term in 3.5 will vanish. Then these expectations will be fulfilled if

$$[a(e^* - \overline{e})]^2 < C \tag{3.6}$$

Now suppose that agents expect the peg will be abandoned. These expectations are ratified if

$$[(a + b)(e^* - \overline{e})]^2 > C \tag{3.7}$$

We thus have multiple equilibria if parameters are such that

$$[a(e^* - \overline{e})]^2 < C < [(a + b)(e^* - \overline{e})]^2. \tag{3.8}$$

Expression 3.8 thus establishes a range for which a currency crisis can occur if expectations are appropriate. Again we have a crisis zone.[8] Notice that if the cost of depreciation is high enough, or if the current rate is close to the equilibrium rate then the conditions that make an attack possible will not be present.

Notice that this argument so far lacks the element which allowed us to pin down the date of the attack in the standard model: deteriorating fundamentals. We can augment the model, however. There are a variety of reasons why we might expect this. Inertial inflation could make the current peg increasingly unsustainable. Or external debt may be accumulating which makes the peg less credible over time. Any number of such factors would be expected to make e^* increase over time.

Thus let us suppose that it is *known* that at some date T the exchange rate $e^*(T)$ must be such that the peg will be abandoned even without an attack; i.e.,

$$[a(e^*(T) - \overline{e})]^2 > C \tag{3.9}$$

Now move back one period. The currency will collapse if

$$[a(e^*(T-1) - \overline{e}) + b(e^*(T) - \overline{e})]^2 > C.$$

[8] Notice that this does not establish that any fixed exchange rate can be attacked, but rather that it can be attacked if fundamentals are such that expression 3.8 is satisfied.

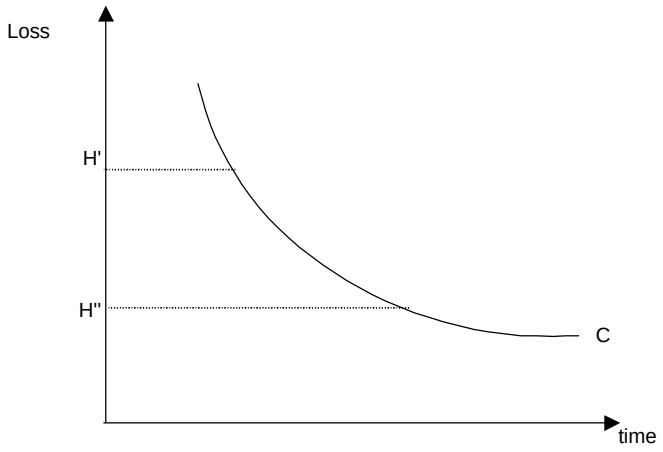

Figure 3.1:

Continuing backwards we can find the *latest* date, t, at which the currency must collapse:

$$[a(e^*(t) - \overline{e}) + b(e^*(t+1) - \overline{e})]^2 > C. \tag{3.10}$$

Now let the time periods get small so that $e^*(t+1) \rightarrow e^*(t)$. Then we can approximate 3.10 by:

$$[(a+b)(e^*(t) - \overline{e}))]^2 > C \tag{3.11}$$

Now compare 3.11 with 3.8. It is apparent that the gap between the time when the currency *can* collapse and when it *must* collapse has been eliminated. Once a currency can be attacked it will be attacked. The possibility of multiple equilibria has been eliminated by the presence of deteriorating fundamentals.

One might wonder where the phenomenon of "throwing good money after bad" has gone if speculative attacks occur as soon as feasible. It would seem that this can occur only if there are multiple equilibria. The central bank sell foreign exchange in the hopes of bringing about the good equilibrium, but it fails and the bad one occurs. But this is not necessarily the case.

Suppose that fundamentals are deteriorating but that we have not yet reached the point where $[(a+b)(e^*(t) - \overline{e}))]^2 > C$. Investors are selling domestic currency but we are not yet at the point where a speculative attack will succeed. There is an excess supply of domestic currency, however, and this is causing the central

bank to intervene. Now typically it practices sterilized intervention. To prevent the domestic money supply from contracting it expands domestic credit (though an open market operation). This does not change fundamentals, however, so whatever is deteriorating continues to deteriorate. Eventually we reach the zone. At that point the currency does collapse, and it appears that good money has, indeed, been thrown after bad.

The point from this is that the switch from the standard mechanical seignorage and reserve-exhaustion models to models based on multiple objectives does not, per se, alter the conclusions about the timing of speculative attacks, or multiple equilibria. As long as there are declining fundamentals multiple equilibria disappear.

Of course this analysis is based on strong assumptions: for example, that there is certainty about the path of fundamentals. These can change and reverse themselves. There may also be uncertainty over the loss function. Investors may not know how large C actually is. Notice that pronouncements about this are meaningless. All finance ministers attach total national will to the peg; any lack of resolve would destroy all hope of preventing depreciation. One only finds out the true magnitude of C in the wake of an episode. This suggests that uncertainty over C can lead to probes of the central bank's willingness to defend.[9]

Lack of Warning One argument that is made in favor of the multiple equilibrium-type models is the frequent absence of warnings, in terms of interest differentials, in many major crises. Many crises, such as the Mexican crisis, seems to come out of the blue, with little warning. This is what causes the shock. This is taken as evidence that the crises are self-fulfilling rather than due to fundamentals.[10]

This argument is not, however, all that convincing. Consider that if it is known that a currency is likely to be subject to a speculative attack, investors must attach some probability to a discrete devaluation. But this possibility should be reflected in markets just as weakening fundamentals. Even if the attack does not occur, the risk should be reflected in market prices, so the absence of warning seems to be evidence against both approaches.

[9] Assume that there is some likelihood (p) that the cost of depreciation is low, C_L, and thus with $1-p$ the cost of depreciation is high, $C_H > C_L$. Then if the currency enters a zone defined by C_L speculators will attack. If the true cost is C_H, however, then the central bank will fight it off until C_H is reached, at which point collapse occurs.

[10] It is not clear how the fundamentals argument is affected by the absence of warning, although many see this as direct evidence against. Recall, that once the currency is "attackable" it is attacked, so suddenness is not a surprise in these models.

Obstfeld and Rogoff [7] provide an ingenious was out of this dilemma for the multiple equilibria story. Their point is that the fact that speculative attacks have led to large depreciations means that large profit-making opportunities exist. Since they were not reflected in prices, this means that the *ex ante* probability of such events were very low. But it is hard to find such large shocks that were highly uncertain yet severe enough to cause large depreciations. Obstfeld and Rogoff then argue that if sunspots cause self-fulfilling attacks we would not have to look for large changes in the environment.

Of course one could argue that financial markets are simply ineffective at forecasting the importance of political events. The uprising in Chiapas and the assassination of Collosio should have revealed a troubled political environment in Mexico. The fact that this was not reflected in prices suggests that markets do not correctly process such events. In fact, people did discuss deteriorating fundamentals in Mexico during 1994. What was surprising was how severe the crisis became.

4. Lending Booms and Currency Crises

There is a strong empirical association between lending booms and currency crises [3].[11] Sachs, et al., [9] demonstrate that countries which had experienced lending booms were more likely to suffer currency crises were more likely to suffer from the Tequila effect. Lending booms also seem to be associated with financial liberalization. After all, when the financial system is repressed lending is curtailed.

It is useful to start with the connection between financial liberalization and financial fragility.

4.1. Financial Liberalization and Financial Fragility

There appears to be a connection between financial liberalization and financial fragility.

[11] Rapid growth in the ratio of bank credit to GDP preceded financial troubles in Argentina (1981), Chile (1981-82), Colombia (1982-83), Uruguay (1982), Norway (1987), Finland (1991-92), Japan (1992-93), and Sweden (1991). Of course, we could add Mexico (1994), and currently Thailand and South Korea as well.

4.2. Lending Booms

The link between bank crises and currency crises is not hard to discern. A sudden banking crisis involves an abrupt change in the demand for money, and a sharp decrease in deposits. In a fractional reserve banking system banks will have insufficient cash to meet demands. Either a bank panic will occur or the government must inject liquidity into the system.[12] The expansion of liquidity generated by a bank panic can then speed an attack on the reserves of the central bank.

It is possible that bank crises occur due to exogenous shocks. But it seems clear that in the wake of a lending boom the likelihood of such a crisis is enhanced. A lending boom results in weaker banks as riskier projects are approved. Bank assets thus become more illiquid as a lending boom proceeds. Note that it is not a high ratio of credit to GDP that is alarming; this is a sign of financial deepening. What is alarming is a rapidly *increasing* ratio.

The form in which debt is held is also important. DFI is less likely to cause problems than short-term debt. In countries that have experienced crises, the ratio of short-term debt to foreign reserves has been quite high.[13] A comparison of economies that experienced crises with those that have not indicates that the ratio of short-term foreign obligations to reserves is 1.82 in the crisis countries as opposed to 0.99 in the non-crisis countries [8, 46].[14] Short-term debt makes a country much more susceptible to sudden changes in investor sentiment. Illiquidity can cause a crisis even when the country is solvent (see Mexico below). Short-term foreign debt is also special because there is no satisfactory domestic lender of last resort. Instruments that can prevent bank runs due to illiquid domestic debt are of little use with illiquid foreign debt.

4.3. Causes of Lending Booms

What causes lending booms?

[12] This implies that the monetary base is *not* the only claim on the central bank that can be called in a crisis. If commercial bank liabilities carry implicit government guarantees (or explicit if there is deposit insurance), then all of M2 is essentially a government liability. Does this necessarily invalidate the argument that any government can sustain a peg? No: one can think of saving the banking system as the *competing* goal to the peg.

[13] Interestingly, [8] find no relationship between total debt and crises, even when short-term debt is not included in the probit equation.

[14] It is interesting to note that in their sample Russia is *not* a crisis country, yet its ratio is 3.33; hence, it is one of the biggets outliers.

A frequently mentioned culprit is liberalization of the capital account. The argument is that this induces large capital inflows, which are then intermediated by the banking system. The problem with this explanation is timing. Many economies liberalized the capital account long before the trouble arose. More important, there does not appear to be a correlation between capital inflows and subsequent expansion in bank credit. Malaysia, Chile, and Colombia experienced large capital inflows without an obvious effect on bank behavior. It could be argued [1], however, that what matters is the type of capital inflow: foreign direct investment may be much less problematic than portfolio investment, as the former is not channeled through the banking system. This is probably an important point.

A more likely culprit is domestic financial liberalization. Especially when this is not accompanied by appropriate prudential regulation, liberalization can lead to rapid expansions in deposits. This can be especially troublesome if accompanied by capital inflows. These flow to banks whose on-lending results in portfolios that deteriorate in quality.

4.3.1. Mexico

What is interesting about the Mexican case is that fundamentals were not that bad. The public sector was in balance and inflation was low. The real exchange rate had appreciated and there was a large external deficit that was a cause of alarm. But overall the fundamentals were in much better shape than in previous election cycles.[15] Given that some depreciation did take place in the last half of 1994 why did Mexico crash so precipitously?

Calvo and Mendoza argue that the peso became vulnerable because of the large imbalance between liquid financial assets and the stock of reserves. The focus is thus on *stock* imbalance rather than a flow imbalance (though there was that negative current account). This is due to bank fragility. The potential for panic runs against financial assets which are a multiple of reserves is the setting for crisis. Thus when Mexico devalued at the end of 1994 a run against dollar-denominated public debt (*tesobonos*) began.

This is clearly a case where short-term, foreign denominated debt played a role. The Mexican government had to roll over about $28 billion in short-term debt. This is was not a large amount relative to GDP (10% at the pre-crisis level). Hence, the burden was not overwhelming. The problem is that foreign creditors

[15] Mexico has historically sufferred from currency crises brought on by expansionary fiscal policy and external shocks, timed almost perfectly to the election cycles.

no longer wished to lend. The crisis was brought on by the currency mismatch and the fact that the loans were short-term and fell due simultaneously. This is not an insolvency problem. Moreover, we know that after the US arranged the emergency international loan to Mexico it was able to pay off the loan ahead of schedule. So this is a case where illiquidity, rather than insolvency created a crisis.

Notice that as long as international investors expected the exchange rate to remain fixed they had little incentive to worry about currency risk. This was assumed by the central bank. As domestic banks weakened, however, the central bank faced a conflict between defending the peg and acting as lender of last resort. It is precisely this conflict which comes to a head as the crisis emerges. If the central bank acts to defend the peg by tightening monetary policy it risks pushing the banking system into collapse. Again the lending boom creates a policy conflict which can make defending the peg impossible.

What makes Mexico particularly interesting is that after the devaluation the crisis was not over.[16] The argument here is that "herd" behavior of international financial markets contributes to the process.[17] The argument is that as the market grows in depth the incentives to agents to gather information decreases, and investors are more likely to move in herds. The idea is that investors who have larger opportunities (think here of countries) for investment are less likely to invest in information about a particular investment than those with fewer opportunities. This also means that the effect of news on investment decisions is likely to be larger; an investor with lots of potential investments will move funds in response to small differences. Note that if funds put little in information gathering they also become more identical in the sense that they respond to the *same* information. This increases the likelihood that they will respond in a "herd" fashion.

Two types of financial imbalances emerged in 1994. First there was the imbalance between the dollar value of M2 and foreign reserves. This grew dramatically in 1994. A large ratio may not be scary, but the ratio grew from perhaps 3:1 in 1992 to about 8:1 in 1994. This implies large risk if there is a sudden shock to money demand.

The second imbalance is that between short-term public debt and reserves. Here it is important to note the increasing proportion of *dollar*-denominated debt

[16] This clearly applies to the Asian flu as well.

[17] One piece of evidence of herd behavior is the increased correlation in world stock markets during periods of increased price volatility. A hedging motive should lead to decreased correlation. There is no reason to believe that increased information should lead to more volatile prices. But if there is herd behavior it could make correlations stronger.

in the form of tesobonos during 1994. Dollar-denominated debt is more risky because it cannot be reduced via devaluation. One might also argue that debt held by foreigners is more elastic due to the lack of liquidity motives for holding it. Notice also that the debt became increasingly short-term during 1994.

One reason why public debt became shorter term and dollar denominated in 1994 was the political shocks the economy was subject to.

5. Illiquidity versus Insolvency

A firm can be illiquid without being insolvent. Lack of liquidity can be just as harmful. The same is true with countries. Fundamentals can be sound but transitory phenomena can render a country illiquid, and force it to depreciate its currency.

An important feature of banking and currency crises has been foreign debt of short maturities. The most notorious example are the *Tesobonos* of Mexican fame, but this has also been a feature of Asian and Russian problems. The key problem with short-term debt occurs when foreign bondholders choose not to roll it over. Maturity is critical when the problem is *illiquidity*.

It is also important to note the role of banks in these crises. Bank lending dominated the capital flows in these economies, despite the development of the emerging market. Bank are maturity transformers: typically short-term liabilities and longer-term assets. This is their function. But when the liabilities are denominated in foreign currencies, the ability of the central bank to intervene to stop runs is much limited. Notice that if markets are complete there is little need for banks: complete security markets can mimic most of their activities. But developing countries are precisely where there is limited participation in security markets, so it is not surprising that banks are relatively more important.

5.1. Bank Runs and Multiple Equilibria

We can think of the multiple equilibrium story as similar to the argument of illiquidity. A sudden inability to borrow, due to bad expectations, results in a self-fulfilling crisis. Observationally equivalent is the insolvency argument, that the currency collapses because of deterioration in fundamentals. Garber has noted that in the period leading to the devaluation the major dumping of pesos was by domestic agents, particularly banks, rather than foreign investors. Of course, the banks were more likely to have full information.

It is straightforward to develop a simple model where illiquidity results in insolvency, due to multiple equilibria. Suppose that a borrower owes D on a project that will pay off Q_2 in the second of two periods. Debt service this period is θD, and in the subsequent period the debtor will owe $(1+r)(1-\theta)D$. Assume that the present value of the project is greater than the present value of debt service: $\frac{Q_2}{1+r} > \theta D + \frac{(1+r)(1-\theta)D}{1+r} = D$. If the debtor defaults, the loan repayments are accelerated and the project is scrapped, with salvage value, $Q_1 < D$.

If this borrower is illiquid, he could typically borrow cash, L, in the first period to repay θD, and then service $(1-\theta)D + L$ in the second period. So if $L = \theta D$, the total repayment is

$$(1+r)\theta D + (1+r)(1-\theta)D = (1+r)D < Q_2$$

hence, the loan is repayable. Now suppose that no creditor can lend more than λ, where $\lambda << D$. A first-period loan thus requires $n_1 = \frac{\theta D}{\lambda}$ lenders, since if no other lenders lend, I will lose everything if I lend.

Clearly, there are multiple equilibria here. If there are (at least) n_1 lenders then there is no problem. The project is financed, and returns are sufficient to service debt. If other creditors choose not to finance, then it is rational for me not to finance either. And we are all correct. So with the same fundamentals we can have a self-fulfilling financial crisis.

5.2. Bank Runs: Chang-Velasco Model

The essential idea is to embed the Diamond-Dybvig framework in an open economy framework. As in the D-D model banks take short term deposits and make loans that are relatively illiquid. Hasty liquidation of these assets results in value loss that can cause self-fulfilling bank runs.

5.2.1. Basic Environment

We have a small open economy with a large number of *ex ante* identical agents. There are three periods, indexed $t = 0, 1, 2$. There is one good which is freely traded globally and be consumed and invested. Let the world market price of the good be fixed, and normalize it to one unit (of say dollars). Let $e > 0$ be the domestic agents endowment of the good (worth e dollars).

Agents have access to an investment project with a constant returns technology that yields $R > 1$ if an investment is held to maturity (two periods). Early

liquidation, however, results in $r < 1$ in period 1 (for an investment in period 0). The investment is thus illiquid in the sense that early liquidation results in a net loss of $(1-r) > 0$ per dollar invested. Only domestic residents have access to this technology.

It is assumed that agents can invest in the world capital market and earn a safe return (normalized to unity) in each year. They can also borrow in this market, at the same rate, but only up to the limit $f > 0$. The nature of this restriction is unexplained but can be rationalized in various ways.

Notice that domestic consumption is increasing in both e and f; the latter because the domestic investment earns more than the return on the foreign investment. Suppose an agent in period 0 borrows up to the full credit ceiling and invests this and his endowment in the illiquid technology. Then the resources available for period 2 consumption would be $eR + f(R-1) > 0$.

To make the problem interesting, following D-D, assume that there are two types of agents: patient and impatient. The latter derives utility only from first period consumption, while the former derives utility only form second-period consumption. Let λ be the probability that an agent is impatient (and, normalizing the population to unity, λ is also the measure of impatient agents. Type realizations are i.i.d. across agents, and there is no aggregate uncertainty. The realization of agents' types is private information.

Let x and y be the typical agent's consumption in periods 1 and 2 respectively. Then expected utility of the representative agent is given by:

$$\lambda u(x) + (1-\lambda)u(y) \tag{5.1}$$

where $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$.

Clearly agents that must act in isolation face idiosyncratic risk. They would like to borrow in the world market and invest domestically, but if they turn out to be impatient they will need to liquidate which is costly. This raises the possibility of improving allocations through pooling. A coalition of agents, called a commercial bank, allows agents to provide insurance against early liquidation. This is straightforward because of the absence of aggregate uncertainty. Essentially the bank offers consumption streams contingent on the realization of the agent's type, consistent with the resource constraints of the coalition. Notice, however, that because information about types is private, these contracts must satisfy incentive constraints as well.

The revelation principle allows attention to be restricted to feasible type-contingent allocations that give no agent incentive to misrepresent. We can then

examine the bank's problem as that of maximizing (5.1) subject to:

$$k \leq d + e \tag{5.2}$$

$$\lambda x \leq b + rl \tag{5.3}$$

$$(1-\lambda)y + d + b \leq R(k-l) \tag{5.4}$$

$$d + b \leq f \tag{5.5}$$

$$y \geq x \tag{5.6}$$

$$x, y, b, k, l \geq 0 \tag{5.7}$$

where d and b denote net foreign borrowing in periods 0 and 1, respectively, k is the amount invested in the illiquid project, and l is liquidation of the domestic asset in period 1.

These constraints are straightforward. 5.2 restricts investment to be no larger than the endowment plus first-period foreign borrowing. Constraint 5.3 is the feasibility constraint in period 1, constraint 5.4 is the feasibility constraint for period 2, while constraint 5.5 is the external credit ceiling. Constraint 5.6 is the *incentive compatibility* constraint. The misrepresentation to guard against is a patient agent masquerading as an impatient one. Given that a liquidated investment can be invested in the world market with the safe return (unity), constraint 5.6 insures that consumption will be no greater from misrepresenting than if the truth be told.

Solution It is quite obvious that the optimal solution will have $\widetilde{l} = 0$; that is, no liquidation in period 1 of the long-term investment. This follows from the absence of aggregate uncertainty. With large numbers the bank can calculate what $\lambda\widetilde{x}$ will be, and then set $\widetilde{b}$ equal to that.

It must also be the case that the value of consumption must be equal to total income:

$$R\lambda\widetilde{x} + (1-\lambda)\widetilde{y} = eR + (R-1)f \equiv Rw \tag{5.8}$$

where $w = e + \frac{R-1}{R}f$ can be thought of as social wealth. Because R is the rate at which consumption can be transformed, optimality requires that the social indifference curve be tangent to the transformation curve, 5.8:

$$\left(\frac{\widetilde{x}}{\widetilde{y}}\right)^{-\sigma} = R \tag{5.9}$$

Combining 5.8 and 5.9 we have:

$$(1-\lambda)\widetilde{y} = (1-\theta)Rw \tag{5.10}$$

$$\lambda\widetilde{x} = \theta w \tag{5.11}$$

where $\theta = \frac{\lambda R^{\frac{\sigma-1}{\sigma}}}{\lambda R^{\frac{\sigma-1}{\sigma}} + (1-\lambda)}$. Notice that if $\sigma = 1$ (log utility) we have $\theta = \lambda$, and thus $\widetilde{y} = Rw$ and $\widetilde{x} = \theta w$; in other words, each set of consumers receives their technological return. If $\sigma > 1$ then $\theta > \lambda$, which means that patient consumers subsidize impatient consumers.

We can now see that the optimal level of first-period borrowing will be $\widetilde{b} = \theta w$.

Demand Deposits To implement the social optimum we can consider demand deposits. These are contracts which have the agents surrendering their endowment to the bank in period 0, in exchange for the option to withdraw $\widetilde{x}$ in period 1 or $\widetilde{y}$ in period 2. The bank invests $\widetilde{k}$ in the long term technology and borrows $\widetilde{b}$ in period 1.

Two constraints are imposed. First, the sequential service constraint. This requires the bank to meet the requests of depositors on a first-come first-serve basis. Second, for the time being, we assume that the bank commits to repay any foreign debt under all circumstances. This means that the bank cannot liquidate more in the first period than what is needed to repay second-period loans.[18] This maximum level of period 1 liquidation is given by:

$$\widetilde{l}^{+} = \frac{R\widetilde{k} - f}{R} \tag{5.12}$$

Taken together these assumptions mean that as depositors arrive at the bank in period 1 they can withdraw $\widetilde{x}$ as long as the bank remains open. The bank meets these requests by borrowing from abroad and then by liquidating the long-term investment, until the constraint 5.12 is met. At that point the bank closes. If the bank does not close, then in period 2 agents can withdraw $\widetilde{y}$ plus any profits if available.

Notice that we have a strategic situation. Agents are playing a game, in that their returns will depend on the strategies of other agents. The bank is an

[18] This rules out foreign creditor panics. It will be dropped later.

automaton, but the other depositors decisions count. So the outcomes of the demand deposit system are equilibria of this game.

It can easily be seen that the demand deposit system can implement the social optimum. We know this because the game has an *honest* equilibrium in which all players truthfully reveal their types. But this is not the only equilibrium. To see this, note that the socially optimal allocation requires the bank to hold less liquid assets than its liabilities. Hence, the bank is subject to a *run*. If all agents decide to withdraw their deposits in period 1 this is an equilibrium, and such behavior will be collectively optimal because the bank will be closed in period 2. This occurs when the withdrawals in period 1 exceed the total first-period assets:

$$\widetilde{z}^{+} \equiv \widetilde{x} - (\widetilde{b} + r\widetilde{l}^{+}) > 0 \tag{5.13}$$

where $\widetilde{l}^{+}$ is the maximum liquidation consistent with paying off second period debt. This condition means that the potential short-term obligations of the bank exceed its liquidation value. It is thus the condition for the existence of a bank run, and it is a measure of the bank's illiquidity.

Notice that the presence of multiple equilibria means that whether or not a run occurs depends on extraneous factors.[19] This is not so bad in our case because financial crises are hard to forecast, and are always not anticipated by market participants. But the model also implies that runs do not occur if the bank is not illiquid. That is also an interesting feature of the model, for it means that bad expectations, by themselves, are not enough.

5.2.2. Foreign Borrowing

How does the size of foreign borrowing enter our story? Notice that if the bank never liquidates more than $\widetilde{l}^{+}$ foreign creditors will continue to lend even if there is a period 1 run. The reason is that this condition allows the bank to meet its second-period obligations, which include repayment of period 1 debt, $\widetilde{b}$. Notice that we can substitute from 5.13 into 5.12 to obtain:

$$\widetilde{z}^{+} = \widetilde{x} - \left\{ r\widetilde{k} + \left(\frac{R-r}{R}\right)\widetilde{b} - \left(\frac{r}{R}\right)\widetilde{d} \right\} > 0 \tag{5.14}$$

[19] There is one unsatisfying feature of this setup. Note that the social planning problem does not take into account the probability of a run, which means that rational expectations would require that the probability of a run be zero. We can rely on sunspots but that is unsatisfying. Or we can just take demand deposits as an institutional datum: then the probability of a run is arbitrary.

Now consider what happens if ongoing lending of this sort does *not* take place in the event of a run. This means that the bank would owe less in the second period because it would do no borrowing in period 1. Hence, the maximum liquidation level would be larger than before:

$$\widetilde{l}^{++} = \widetilde{k} - \frac{\widetilde{d}}{R} \tag{5.15}$$

which is clearly greater than $\widetilde{l}^{+}$.

That is, without ongoing lending the bank can liquidate more assets in period one and still meet its period-two commitments. But without ongoing lending, i.e., $\widetilde{b} = 0$, the bank has less to service period one withdrawals. Hence, the bank is unable to service depositors if:

$$\widetilde{z}^{++} \equiv \widetilde{x} - r\widetilde{l}^{++} = \widetilde{x} - \left\{ r\widetilde{k} - \left(\frac{r}{R}\right)\widetilde{d} \right\} > 0 \tag{5.16}$$

and if we compare 5.16 with 5.15 it is apparent that:

$$\widetilde{z}^{++} - \widetilde{z}^{+} = \left(\frac{R-r}{R}\right)\widetilde{b} > 0 \tag{5.17}$$

which means that the run condition *without* ongoing lending is more stringent than with. In other words, if foreign creditors refuse to engage in ongoing lending in the event of a run the bank is more vulnerable than otherwise. This is just the effect of reduced liquidity.

The question is whether or not it is rational for foreign creditors to refuse ongoing lending. Suppose that there are a large number of foreign lenders so that each one considers her own decision as atomic for the financing of the bank. Suppose that 5.16 holds. If all other creditors choose not to on-lend, and if the depositors panic, then it is optimal for me to refuse to on-lend. Why? Because in this case the bank will have to liquidate all of the long term asset except what is needed to pay the initial debt $\widetilde{d}$ in period 2. Any additional debt incurred would not be repaid. Hence, I would not want to lend under these conditions. This is clearly the case for all lenders.

This result suggests that the behavior of international lenders can by itself cause a run. Suppose that parameters are such that 5.16 holds but 5.14 does not. There are enough funds to prevent a run if foreign creditors on-lend. But if they choose not to, funds are insufficient, and a run occurs.

Two points about this result are interesting. First, as C-V note, if the bank could borrow the full amount, f, in the first period, and then use some of it to purchase international reserves to meet $\widetilde{b}$ in period 1, then the bank would be immune to creditor behavior. But it is not clear that foreigners would actually lend for that purpose.

Second, note that it has been assumed that the bank liquidates all the way to $\widetilde{l}^{++}$ rather than stopping at the stricter limit, $\widetilde{l}^{+} < \widetilde{l}^{++}$. Notice that if the bank could precommit to liquidate only up to the smaller amount, $\widetilde{l}^{+}$, then resources would be available to repay creditors who lend in period 1, in addition to the period 0 lenders. This means that no on-lending would not be an equilibrium. This suggests that lack of commitment is an important part of the bank run story.

Short term debt What about the maturity of the debt? So far, the debt incurred in period 0 is rolled over until period 2. But short-term debt is an important issue. So now assume that the initial debt consists of one-period loans. What happens if foreign creditors refuse to rollover the debt in period 1?

With no rollover in period 1 there is no debt to repay in period 2. This means that the bank can liquidate the full amount of the long-term investment if need be:

$$\widetilde{l}^{+++} = \widetilde{k} \tag{5.18}$$

Now the bank will become bankrupt if its short-term obligations, which include depositor withdrawals and short-term external debt, exceed the liquidation value of the full amount of the long-term investment, $r\widetilde{k}$:

$$\widetilde{z}^{+++} \equiv \widetilde{x} + \widetilde{d} - r\widetilde{l}^{+++} = \widetilde{x} + \widetilde{d} - r\widetilde{k} > 0. \tag{5.19}$$

If we compare 5.19 with 5.16

$$\widetilde{z}^{+++} - \widetilde{z}^{++} = \left(\frac{R-r}{R}\right)\widetilde{d} \tag{5.20}$$

which is clearly positive if $\widetilde{d} > 0$. It is thus clear that the financial system is even more fragile when lenders refuse to rollover debts in the case of a run. And it is clear that creditors may refuse to rollover short-term debts if 5.19 holds, for in that case there will not be enough left over to repay short term debt in period 2. Small lenders would once again be justified in refusing to lend in this situation.

Just as in the case of no on-lending, fear on the part of creditors that short-term debt will not be repaid can become a self-fulfilling prophecy. This occurs if 5.19 holds but 5.14 does not. Creditor panic can become a self-fulfilling prophecy.

Can fragility be reduced by implementing policies that bar short term debt? Suppose that the short-term debt is barred. That is, the bank cannot borrow from the world market for less than two periods. Then the bank will have to borrow f in period 0 and hold $\widetilde{b}$ of reserves. To do this it may have to pay a premium; it is likely that the cost of borrowing abroad may exceed the interest that can be earned on the reserves. If the bank behaves this way there is no possibility of a creditor panic because there is no short-term debt to rollover in the first period. Of course there can still be domestic depositor led bank runs.

5.2.3. Financial liberalization

It is rather amazing the extent to which financial liberalization and financial crises are linked. According to Kaminsky and Reinhart [4]:

- Of 26 banking crises they studied, 18 were preceded by financial sector liberalization within a five year interval.
- Financial liberalizations accurately signalled 71% of all balance of payments crises and 67% of all banking crises.
- The M2 multiplier rose steadily in the periods leading up to the banking crises.
- Growth in the ratio of domestic credit to nominal GDP was high and increasing as crises approached.

Why does liberalization lead to increased fragility? One answer has to do with transparency. If financial liberalization is insufficiently supervised, and if behavior is not transparent, it is possible that banks will take greater risks than prudent. We will turn to this below.

Lowering Reserve Requirements One aspect of financial liberalization that is easy to analyze is a reduction in reserve requirements. Reserve requirements are a form of regulation. They are, under certain circumstances, inefficient. Reducing them can increase welfare. It can also increase bank fragility.

It is easiest to consider the polar case of narrow (100% reserve) banking. This means that the bank must hold liquid reserves equal to potential liquid liabilities:

$$x \leq b \tag{5.21}$$

This is in contrast to the constraint in the benchmark case, where $x\lambda \leq b$. Because this constraint is more strict, the solution will not be efficient compared with the benchmark case.

It is obvious that in the case of narrow banking runs cannot occur. This follows because the bank always has sufficient reserves to meet all withdrawals in the first period. This produces exactly the tradeoff we seek: liberalization, which is characterized by a reduction in reserve requirements leads to more efficient (because less costly) banking, but it also makes possible bank runs. Social welfare is higher in the good equilibrium with lower reserve requirements, but the possibility of bank runs is also created.

One could also make similar arguments about introducing competition. Monopoly means less efficient banking and somewhat less borrowing. At the same time the bank earns some monopoly profits. These two factors reduce the scope for runs. But again, the tradeoff is with lower financial efficiency.

5.2.4. From Banking Crises to Currency Crises

So far we have only examine features that lead to banking crises. It is easy, however, to extend to currency crises. We need to introduce a domestic currency and an exchange rate mechanism. Assume that promised payments to depositors are denominated in pesos. Foreign loans, however, continue to be denominated in dollars. To get consumption goods, the agents take the pesos to the central bank and exchange them for dollars, if available. Since the central bank cannot print dollars the possibility of a currency crisis is created. But we need an exchange rate mechanism. Two natural candidates: currency board and a central bank with a fixed exchange rate.

Currency Board This is the simplest monetary arrangement, and the simplest to analyze in this framework. The Central Bank simply guarantees to trade one dollar for one peso. No domestic credit is extended by the Central Bank.. This means that the commercial bank's problem is unaffected. It solves the same problem as before, so the same solution will hold.

As the depositors withdraw pesos (either $\widetilde{x}$ or 0 depending on type) in period 1 they go to the Central Bank to redeem them for dollars. As long as there are sufficient dollars the Central Bank remains open. Because this is a currency board there will always be sufficient dollars, but in alternative systems there may not be. In the second period, if the bank survives, it liquidates all remaining investments,

repays its external debt, and sells its remaining dollar proceeds to the Central Bank.. It then pays $\widetilde{y}$ to any patient agents, who then go to the Central Bank to redeem them for dollars.

Notice that the bank's problem has not changed, so the conditions for a run have not changed. There is an honest equilibrium in which agents report their types, and if 5.14 holds, there is a runs equilibrium. The commercial bank is vulnerable to crisis as before, but it cannot lead to a currency crisis because the demand for dollars never exceeds the supply. There are never more pesos in circulation then dollar reserves at the Central Bank; this is the definition of a currency board. Hence, in this system there can be banking crises but not currency crises.

If such a system comes under crisis (as in Argentina in 1995) the banking system may come under threat. But the currency board prevents the Central Bank from intervening. Without a lender of last resort, the commercial bank is on its own in the face of a run. To survive, an external infusion of credit is needed, as happened in that case.

Fixed Exchange Rate with a Lender of Last Resort Now we assume that the Central Bank will act as a lender of last resort to commercial banks. It will also defend the peg (which we continue to set at 1), as long as it has sufficient reserves. Once it can no longer acquire foreign currency we have a balance of payments crisis.

The lender of last resort function means that the Central Bank offers to lend an unlimited amount of pesos to commercial banks in the case of a run. So if more than λ customers show up the Central Bank supplies extra credit. The Central Bank then assumes control over the domestic asset $\widetilde{k}$ and also assumes the debts that the commercial bank had contracted to pay in period 2. The Central Bank then liquidates what it needs, up to the limit for period 2 debt, to meet impatient agents.

What happens if too many depositors show up in period 1? The bank still can borrow $\widetilde{b}$ as before; if this runs out it gets emergency lending from the Central Bank.. Because the amount of emergency credit is unlimited the commercial bank does not close. That is, even if more than λ customers show up they are able to withdraw their deposits because of the emergency credit line. Why then would people crowd at the bank? We have to consider what may happen to the demand for dollars.

People with pesos go the Central Bank to obtain dollars. The Central Bank

can liquidate the domestic asset up to $\widetilde{l}^+$ as before. This means that, as with the currency board, the maximum amount of dollars that can be redeemed in period 1 is $\widetilde{b} + r\widetilde{l}^+$. After this amount is reached the Central Bank can sell no more dollars. If people still have pesos that they want to redeem as dollars, a Balance of Payments crisis has emerged.

As before we can have an honest equilibrium. When the conditions for a run are met (5.14) we do not get a banking crisis, but rather a Balance of Payments crisis.

Now we can see why people may run to the bank in period 1. If they believe that there will be a shortage of dollars at the Central Bank they may wish to get their money out now to redeem for dollars. The run is not at the bank but at the Central Bank.. Notice that the problem is that the financial system *as a whole* is internationally illiquid. The short-term dollar obligations exceed the quantity of dollars available. The move from currency board to central bank alters the *location* of the crisis, but not the conditions for it.

Notice, however, that if the Central Bank had extra reserves of dollars it could stave off the crisis. The question, of course, is where do these come from. But this does explain why Central Bank's in emerging markets may want large war chests (Taiwan comes to mind).

Notice also that if the public did not want dollars the Central Bank could get away with its lender of last resort function. It can always print enough pesos to save the commercial banks. The problem is that the more pesos it prints the greater is the excess demand for dollars. But if people believe that the Central Bank has insufficient reserves, and for this reason they queue up at the commercial banks and withdraw their deposits, they are certainly going to rush out to convert them to dollars immediately. Of course the Central Bank can suspend convertibility; but that is the very definition of a Balance of Payments crisis.

What if exchange rates were flexible? In this case if too many people queue up in period 1 the amount they will get in dollars will decline. The excess supply of pesos means that the domestic currency will depreciate. Hence, there is a cost to excessive withdrawals in the flexible exchange rate regime that is not present in the fixed exchange rate regime. In the latter each depositor is a free rider. In the flexible exchange rate regime, excess withdrawals reduces what you can get; hence you may not want to withdraw too much in the first period.[20]

[20] This is very reminiscent of goods runs.

5.3. Two Caveats

Two caveats are in order here. First, it is necessary to understand the importance of *small* foreign investors and coordinated actions. The problem for the crisis country is the need to rollover short-term notes. If the problem is really liquidity rather than fundamentals it would seem that a private entrepreneur could profit from lending to the illiquid country. That this does not seem to happen could be seen as an argument against the financial fragility hypothesis.

The missing private entrepreneur may be a result of the magnitude of the problem. That is, the size of short-term debt may be too large for any single entrepreneur to fill the gap.[21] If many foreign lenders are needed there may be a coordination problem in getting them to agree (unless they are stuck for the losses, as in the case of Long Term Capital Management). Moreover, if investors expect that the IMF will bail out countries in trouble, the potential gains to the private lender may be too small.

The second caveat has to do with empirical work that related the probability of a crisis to short-term debt. Recall that Radelet and Sachs [8] estimate a probit model of the form:

$$P_i(c) = \beta_1 \left(\frac{SD}{FR}\right)_i + \beta_2 \left(\frac{TD}{FR}\right)_i + \gamma X_i \tag{5.22}$$

where $P_i(c)$ is the probability of a crisis in country i, SD is short term debt and TD is total debt, and X_i is a vector of explanatory variables, such as freedom from corruption, current account deficits, private credit buildup, real exchange rate appreciation, etc. The strong result is that β_1 is statistically significant while β_2 is not. This is compelling evidence.

But a there is a caveat. Lenders would not simply offer credit in unlimited amounts at a given interest rate. Presumably, lenders offer a schedule of interest rates and maturities. Hence, even if rates do not rise it may perceptions of the increased riskiness of a country may manifest in a shortening of maturities. But this means that $\frac{SD}{FR}$ may be an endogenous variable in 5.22. Hence, the strong relationship between short-term debt and crises may not be a *causal* relationship, but rather the natural response to increased risk.[22]

[21] Recall that in June of 1997 George Soros did lend to the Russian government for one week to help with a liquidity crisis.

[22] Of course if the perception is that the problem is short-term debt then the country would presumably prefer to borrow at longer maturities, as Russia tried in the summer of 1998.

6. Krugman's Moral Hazard Model

In the context of financial liberalization and fixed exchange rates financial institutions in emerging market face the issue of what to do with inflows. If foreign investors anticipated that they would be bailed out in the case of a currency crisis the risk of lending to emerging markets was greatly reduced. Because real interest rates tend to be high in countries that have stabilized inflation, investors may have been attracted to these economies. And because of the expectation of bailouts, they might have performed less due diligence than may have been expected. In fact, McKinnon has long argued this to be a fundamental problem in such economies.

Krugman [6] has developed a model based on moral hazard to explain the peculiarities of the Asian flu.[23] In particular, he addresses four key stylized facts:

- the lack of relationship to fundamentals, as in first-generation models;
- no real unemployment or other factor for a conflict of objectives, as in second-generation models (this would be less true for Russia);
- the boom-bust cycle in asset prices that occurred in these economies, especially in stock and land prices;
- the central role of financial intermediaries.

The Krugman model focuses less on currency issues and treats these crises as essentially boom–bust phenomena. The essential idea is that the problem began with financial intermediaries - institutions whose liabilities were perceived as having an implicit government guarantee, but were essentially unregulated and therefore subject to severe moral hazard problems. The idea is that the excessive risky lending of these institutions created inflation - not of goods but of asset prices. The overpricing of assets was sustained in part by a sort of circular process, in which the proliferation of risky lending drove up the prices of risky assets, making the financial condition of the intermediaries seem sounder than it was.

Then the bubble burst. As it did, the fall in asset prices meant that financial institutions were no longer liquid, as intermediaries called in loans asset prices fell further. The cumulative process works in reverse, too. That is why the fall is so large, and so unrelated, seemingly, with fundamentals.

[23] McKinnon and Pill actually precedes Krugman, and Dooley has also discussed this issue.

6.1. Moral hazard and overinvestment

The basic mechanism at work is moral hazard when there is a guarantee of a bailout. Think of the US. savings and loan crisis. Deposit insurance means that the depositors have no reason to police the institution. The owners, meanwhile, put up little of their own money; so there is strong incentive to choose risky investments: it is a game of heads I win, tails the taxpayer loses.

Now it is not crystal clear that explicit insurance existed in Asian countries to the extent it did in the US, but Krugman argues that it is approximately so: "However, press reports do suggest that most of those who provided Thai finance companies, South Korean banks, and so on with funds believed that they would be protected from risk - an impression reinforced by the strong political connections of the owners of most such institutions. In practice, moreover, these beliefs seem to have been for the most part validated by experience (at least at time of writing). For example, depositors in all Thai finance companies were protected; in some cases those who had merely lent them money were not, but these cases were exceptional, so that as a general rule the finance companies did in fact turn out to have guaranteed liabilities. Similarly, while South Korea may have the legal right to declare private bank debts a private issue and let default happen, in practice bank debt was at time of writing well along in the process of being nationalized."

So Krugman is going to argue that as a first approximation, we can think of Asian economies pre-crisis as having in existence a class of financial intermediaries that, like US. thrifts, were able to raise money at safe interest rates but lend that money at premium rates to finance speculative investments. Now in such environments, it is a familiar point that such intermediaries then have an incentive not merely to undertake excessively risky investments, but to pursue investments with low expected returns as long as they have "fat right tails" - that is, the owner of a guaranteed intermediary likes investments that could yield high returns if he gets lucky, even if there is also a strong possibility of heavy losses.

Krugman offers a numerical example (adapted from Milgrom and Roberts) to illustrate. Suppose that a financial intermediary has raised $100 million from guaranteed creditors, without the need to put up any of his own money, and he can walk away, in the case of bankruptcy, at no personal cost. There are two alternative investments. One has a certain yield of $107 million, the other yields $120 million in the good state, $80 million in the bad state; the states being equally likely. We can examine the options in the table:

Table 1: Moral Hazard and Investment Decisions

	Safe Investment	Risky Investment
return in good state	107	120
return in bad state	107	80
expected return	107	100
expected return to owner	7	10

A risk neutral investor should prefer the safe investment, but our financial intermediary will prefer the risky investment. The reason is clear. In the bad state the payoff is 0, while in the good state it is 20. Thus his incentive is to choose the risky investment, even though it has a lower expected return. And this distortion of investment decisions produces a deadweight social loss: the expected net return on the invested capital falls from $7 million to zero.

So far we see how moral hazard can lead to distorted investment. Nothing really new. But we can go on to show how such a system can lead to excessive investment by the economy as a whole.

Consider a two-period economy. In the first period firms purchase capital; in the second they produce using that capital. For the sake of simplicity let me assume that the production function has a quadratic form:

$$Q = (A + u)K - bK^2 \tag{6.1}$$

where u is a random variable. Assume a small open economy, able to borrow at a fixed world interest rate - and that the real interest rate is zero. (It is possible to redefine units so as to make this true in any case).

In this economy capital will earn its marginal product; i.e., the rental per unit of capital will be:

$$R = A + u - 2bK \tag{6.2}$$

and given the absence of distortions, capital will be invested until the rental cost equals the cost of capital, which in this case is unity. Hence,

$$K = \frac{A + E[u]}{2b} \tag{6.3}$$

Now we introduce guaranteed financial intermediaries. As in the example in Table 1, suppose that these intermediaries face a very stark form of moral hazard: their liabilities are guaranteed, but their owners need not put up any capital, and can simply walk away if their institutions fail. Krugman makes two further assumptions. First, that there are many actual or potential intermediaries, so that

they will compete away any economic profits. Second, that intermediaries can directly own capital. In reality, even in Asia banks and bank-like institutions generally lend money rather than buying capital assets outright.[24] However, lending to a very highly leveraged firm engaged in risky investment - especially a firm that is part of an industrial group that has effectively established a controlling interest in the lending institution (see Amsden 1989) - is de facto very much like buying the capital directly.

How would such intermediaries behave? From their point of view, any rate of return on capital in excess of the world safe rate of interest - that is, any $R > 1$ - represents a pure profit. Thus there will be pure profits as long as there is any state of the world - any realization of u - in which $R > 1$. But given our assumption of competition among potential intermediaries any such pure profit will be competed away. The only way this can happen is if:

- All capital ends up being purchased by guaranteed intermediaries. This is an extreme result, but it does capture the tendency of Asian businesses to become extremely leveraged by Western standards.

- Investment is pushed up to the point where R = 1 in the most favorable possible circumstance - that is, given the maximum possible value of u. Again, this is an extreme result, but it does capture the obvious tendency of Asian firms toward over-optimistic investment.

Krugman calls this kind of investment behavior predicted by a model with competition among intermediaries subject to extreme moral hazard, investment according to *Pangloss* values. Normally we think of investors as responding to expected values of the relevant variables. In this model, however, the owners of intermediaries will instead focus on what we might call *Pangloss* values: the values that variables would take on if it turns out that we live in what is (from their point of view) the best of all possible worlds.

Suppose, for example, that $A = 2$, $B = 0.5$, and u has an equal probability of equalling 0 or 1. The undistorted level of investment would set

$$K = \frac{2 + 0.5}{1} = 2.5.$$

[24] But this is not true of Russian FIG's.

However, if there are moral-hazard-prone financial intermediaries, they will drive out equity investment and push up the capital stock to

$$K = \frac{2+1}{1} = 3.$$

This excessive investment will lower expected welfare, because the increased return in the favorable state will not offset the increased losses in the unfavorable state.

It may also be worth noting that this is the sort of distortion whose consequences can easily be made worse by globalization. Suppose that this country did not have access to the world capital market - suppose, for example, that it had to rely on a fixed supply of domestic savings, unresponsive to the interest rate. Then the excessive investment demand generated by the intermediaries would not in fact lead to excessive investment - all that it would do is drive up the interest rate. Offering such an economy access to the world capital market might then, in classic "second-best" fashion, actually make the economy worse off by allowing moral hazard in the financial sector to translate into real excess capital accumulation.

6.1.1. Asset prices

In the previous example moral hazard in investment leads to an excessive volume of investment. That is because the supply of capital goods was assumed to be infinitely elastic. To obtain a boom-bust cycle in asset prices it is necessary to assume a fixed supply of assets. So assume that there is only one asset, land, which is fixed in supply. This means that only prices, rather than volumes, will be affected.

Again the model is two periods. In the first investors bid for land, in the second they receive rents, which are uncertain in period 1.

A numerical example is sufficient to make the point here. Suppose that the rent on a unit of land could be either 25, with a probability of 2/3, or 100, with a probability of 1/3. Risk-neutral investors would then be willing to spend $\frac{2}{3}(25) + \frac{1}{3}(100) = 50$ for the rights to that land.

But now suppose that there are financial intermediaries, once again able to borrow at the world interest rate (again normalized to zero) because they are perceived as being guaranteed. And also as before, we assume that owners need not put any of their own money at risk, but that competition among the intermediaries eliminates any expected economic profit.

The result is obvious: intermediaries will be willing to bid on the land, based not on the expected value of future rent but on the *Pangloss* value - in this case 100. So all land will end up owned by intermediaries, and the price of land will be double what it would be in an undistorted economy.

Does the one-shot nature of this game affect the results? At first it might seem that it does not. Suppose that we turn from a two-period to a three-period economy, again with random land rents of 25 and 100 with probabilities 2/3 and 1/3 in both the second and third periods. And let us continue to assume a zero interest rate (which is now more than a mere normalization, but still makes no essential difference to the results). In an undistorted economy we can solve backwards for the price. The expected rent in period 3, and therefore the price of land purchased at the end of period 2, is 50. The expected return on land purchased in period 1 is therefore the expected rent in period 2 (50) plus the expected price at which it can be sold (also 50), for a first-period price of 100. This is also, of course, the total expected rent over the two periods. (In this example, the price of land declines over time, from 100 to 50, even in the undistorted case. This is merely an artifact of the finite horizon and should simply be regarded as a baseline).

Now suppose that intermediaries are in a position to borrow with guarantees. Again working backward, at the end of period 2 they will be willing to pay the *Pangloss* value of third-period rent, 100. In period 1 they will be willing to pay the most they could hope to realize off a piece of land: the *Pangloss* rent in period 2, plus the *Pangloss* price of land at the end of that period. So the price of land with intermediation will be 200 in period 1 - again, twice the undistorted price.

It seems, then, that the multi-period version of the model, in which part of the return to investment depends on the future prices of assets, makes no real difference to the distortion of those prices imposed by guaranteed intermediaries. However, this result changes in a dramatic way once we allow for the possibility of changes in the financial regime - that is, if we believe that moral hazard may be a sometime thing.

6.1.2. Disintermediation and Crises

We continue to focus on the three-period economy, but now we consider what may happen if agents are not certain that the regime will be unchanged. Suppose that agents believe that liabilities carried over from period 2 may be not be guaranteed anymore. This should be thought of as some exogenous regime shock, or as an

endogenous change. We deal with each in turn. In the first period, however, asset prices are still determined by *Pangloss* values rather than expected returns.

Exogenous change in regime We assume that from the point of view of investors there is simply some probability p that the government will credibly announce during period 2 that henceforth creditors of intermediaries are on their own. (Perhaps this reflects the election of a reformist government that is no longer prepared to tolerate "crony capitalism"; or perhaps the end of moral hazard is imposed by the International Monetary Fund). Maybe it has become apparent that the fiscal situation is such that guarantees can no longer be sustained.

Again, we work backward, and consider the price of land in the second period. If liabilities of intermediaries are not guaranteed, then nobody will lend to them (the moral hazard will remain, but its burden would now fall on investors rather than on the government). So intermediation will collapse, and the price of land will reflect only its expected return of 50. On the other hand, if intermediaries are guaranteed, the price will still be 100.

What about the price of land in the first period? Investors now face two sources of uncertainty: they do not know whether the rent in the second period will be high or low, and they do not know whether the price of land in the second period will reflected expected values or *Pangloss* values. However, as long as there is competition among intermediaries in the first period, the price of land will once again be driven to a level that reflects the most favorable possible outcome: rents of 100 and a price of 100. So even though this is now a multi-period world in which everyone knows that disintermediation and a decline in asset prices is possible, current asset prices are still set as if that possibility does not exist!

Endogenous response In reality, of course, throughout Asia's arc of crisis there has indeed been a major change in financial regime. Finance companies have been closed, banks forced to curtail risky lending at best and close their doors at worst; even if the IMF were not insisting on financial housecleaning as a condition for aid, the days of cheerful implicit guarantees and easy lending for risky investment are clearly over for some time to come. But what provoked this change of regime? Not an exogenous change in economic philosophy: financial intermediaries have been curtailed precisely because they were seen to have lost a lot of money.

This suggests that a more or less realistic way to model the determination of implicit guarantees is to suppose that they are available only until they have

had to be honored (or more generally until honoring them has turned out to be sufficiently expensive - the criterion used in Krugman 1998). In the context of our three-period example, this criterion can be stated alternatively as the proposition that *creditors of financial intermediaries will be bailed out precisely once.*

To see what this means, first suppose that in period 2 rents are disappointing - 25, not 100. Given the structure of our model, in the absence of intermediaries this should have no effect on the price of land at the end of the second period, since it does not change the probability distribution of future rents. But a less-than-*Panglossian* rent in period 2 means that creditors of intermediaries need to be bailed out in that period, and therefore that future creditors can no longer expect the same. So the intermediaries collapse, and the price of land drops from 100 to the expected rent 50.

Notice that this means that there is a magnification effect on the losses of the intermediaries established in the first period. The "real" news about the economy is that rents in period 2 were 25, not the hoped-for 100. But land bought for 200 will now yield only 25 in rents plus 50 in resale value, a loss of 125 rather than merely 75. The magnification effect is caused, of course, by the circular logic of disintermediation: the prospective end to intermediation, driven by the losses of the existing institutions, reduces asset prices and therefore magnifies those losses.

And now we come to the possibility of multiple equilibria. Suppose that in fact intermediaries have been lucky, and that second-period rents do turn out to be 100. Now if everyone then expects that the government will continue to guarantee intermediaries in the future, the land price at the end of the second period will also be 100. In that case no bailout will be needed; and so the government guarantee for intermediation will in fact continue.

But on the other hand, suppose that despite the high rents in the second period potential creditors become convinced that there will be no guarantee on newly incurred liabilities of intermediaries. Then they will not be able to attract funds, and the price of land in the second period will be only 50. That means, however, that intermediaries that borrowed money in the first period based on *Pangloss* values, including the *Pangloss* value of 100 for land sales, will require a bailout - and since the government's willingness to provide for bailouts is now exhausted, investors' pessimism is justified.

In short, our stylized little model appears to generate a story about self-fulfilling financial crises, in which plunging asset prices undermine banks, and the collapse of the banks in turn ratifies the drop in asset prices.

We now have the necessary elements in hand to tell a story about the Asian

crisis. Recall that the crises have seemed baffling because of :

- The absence of the usual sources of currency stress, whether in the form of fiscal deficits or macroeconomic difficulties;
- The pronounced boom-bust cycle in asset prices prior to the currency crisis;
- The severity of the crisis given a lack of strong adverse shocks, and the spread of the initial crisis to countries that seemed to have few economic links with the initial victims.

We now have an admittedly primitive but still illuminating way to make sense of these paradoxes. The reason that traditional measures of vulnerability did not signal a crisis is that the problem was off the government's balance sheet: the underlying policy mistake was, like the guarantees that created the S&L fiasco, not part of the government's visible liabilities until after the fact. The boom-bust cycle created by financial excess preceded the currency crises because the financial crisis was the real driver of the whole process, with the currency fluctuations more a symptom than a cause. And the ability of the crisis to spread without big exogenous shocks or strong economic linkages can be explained by the fact that the afflicted Asian economies were in a sort of "metastable" state in any case - highly vulnerable to self-fulfilling pessimism, which could and did generate a downward spiral of asset deflation and disintermediation.

6.2. Evaluation

This model is quite simple, yet effective. Nonetheless, no simple model can explain everything. Some limitations are inevitable.

One simplification had intermediaries using none of their own capital. With nothing to lose we get the extreme levels of risk-taking. Indeed, competition pushes these intermediaries to the point where they will almost surely require a bailout. In practice, however, intermediaries will have something to lose so the decision problem will be more complex.

Notice that compared with other models (e.g., Chang-Velasco) the moral hazard story affords no useful purpose to intermediation. In practice, however, financial intermediation is productive. When it ceases this is an important cause of the slump. That is missing here. The only effect of the decline in intermediation is a collapse in asset prices, and then back to expected values.

This brings us to a fundamental point. In the Krugman model the crisis is due to speculation that leads to a bubble in asset prices. These cannot be sustained once the forces that drive speculation are weakened. But in a model with multiple equilibria, there are states where the value of the assets can be sustained at the higher values. Not in the simple version of the Krugman model because of the extreme simplification. But we could have a model where the price of the asset is dependent on the ability of the intermediary to channel savings.

Consider how this story interacts with financial intermediation. If illiquid banks are forced to leave plants half-completed, then asset prices will fall. The question is whether this represents a bubble in asset prices or a financial crisis that punctures a healthy economy. One way to approach this issue is to ask whether there is a unique meaning to fundamental prices.

Chang and Velasco analyze this in the context of their bank run model. Suppose that there is some fixed asset, land, that earns a basic rent, $\pi > 0$. If the bank buys a units of land (at the price, p_0) in period 0 the return of the long-term asset is enhanced; i.e., $R'(a) > 0$, $R''(a) < 0$. Now the bank may buy some units of land to enhance the return on the asset. This may be optimal. Notice that by purchasing an additional unit of land the bank obtains $R'(a)k$ units of consumption in period 2. Alternatively, it can invest p_0 in the long term asset and earn $p_0 R(a)$ in period 2. Hence, optimality requires

$$p_0 R(\widehat{a}) = R'(\widehat{a})\widehat{k} \tag{6.4}$$

where $\widehat{a}$ is the optimal choice of land purchase.

Now there are two possibilities for the equilibrium price of land in period 0. If some land is not sold the price will equal the rents that are earned, hence $p_0 = \pi$. Alternatively, if all land is sold then the price will be given by

$$\widehat{p_0} = \frac{R'(a)}{R(a)}\widehat{k} > \pi \tag{6.5}$$

which is possible if π is small enough.

We can now see that the period 0 price of land exceeds its alternative use price if all land is sold. Hence, there are already two values of land that are consistent with some fundamentals. Moreover, note that the price of land rises between period 0 and period 1. Why? Think of how 6.4 must look for p_1. It is too late to invest in the long term asset; so for the bank to be indifferent between holding and selling land we must have: $p_1 = R'(\widehat{a})\widehat{k} > p_0$. This is a socially optimal "price

boom." It is efficient given the productivity of land when used with the capital asset.

Now suppose that the bank uses demand deposits to implement the social optimum. We know that there will be an honest equilibrium and one where there will be runs. Now the run condition will be:

$$\widehat{z} = \widehat{x} - \widehat{b} - r\widehat{l}^{+} - \pi a > 0. \tag{6.6}$$

As before, the bank can meet a run by borrowing to its credit limit and by liquidating capital consistent with period two repayments. The key difference from before is now that the bank can also sell land to obtain liquidity. But once the long-term asset is liquidated, the price of land in period 1 must be equal to its yield in the unused state, π.

Notice that if a run takes place the price of land crashes to its fundamental value, π. But how should this be interpreted. This is the price of land *conditional* on the occurrence of a run. If no run takes place the fundamental value of the land is higher. Notice that this value is consistent with land's productive return. Hence, we have a boom-bust cycle in asset prices, but the source of the problem is not moral hazard but financial fragility.

Empirical predictions The Krugman model suggests that the quality of loans in crisis countries deteriorated as a result of moral hazard. It also suggests that the prices of fixed assets, such as real estate, increased relative to other prices. These predictions are, in principle, testable.

Radelet and Sachs [8] have shown that in the afflicted Asian countries there was a discernible shift in loan composition away from manufacturing and towards real estate. The magnitudes differ across countries: bigger in Indonesia, small in Malaysia. In Korea and Thailand it is very small for commercial banks, but larger for financial institutions. Note, however, that reported loan composition may be biased: borrowers are likely to claim that loan proceeds will be used for productive uses when, in fact, they are intended for speculative purposes. Moreover, the data they use looks at the sectoral distribution of *outstanding* loans in two years. But they hypothesis is that marginal loans are of inferior quality, so what we would really want to know is about new loans.

One might also want to look at the ratio of non-performing loans. Presumably if moral hazard is important we would see an increase in non-performing loans. Again, however, we have a problem. Banks typically under-report non-performing loans. Moreover, in the Krugman model loans only become non-performing when

the crisis occurs. When *Pangloss* values are in effect the loans appear to be proper. An inflationary boom in asset prices would make the banks lending behavior appear quite satisfactory until the bubble bursts.

Another avenue for confirmation would be asset prices. Were stock and real estate prices booming prior to the crisis? There is some evidence for this in Thailand, where real estate prices in Bangkok were steady up till the devaluation of the baht. Less so in Indonesia. The observation that incremental capital-output ratios rose in almost all Asian countries in the 1990's is also suggestive of some deterioration in loans.

Radelet and Sachs argue that the fact that spreads did not rise suggests that foreign investors did not suspect a deterioration in loan quality. This may be true, but the implications are unclear. If everyone believed that *Pangloss* values would persist it is not clear why spreads should rise, especially if investors also expected bailouts.

What is hard to separate is the view that investors would be bailed out from the perception that Asia would just grow out of any problems. It could be that infatuation with the "Asian Tigers" inoculated investors from the fear of what could happen if things turned bad.[25] Certainly it is the case that rapid economic growth can make lots of loans look good. But we need to explain what caused investors to underappreciate risks in the bad state, so we still come down to something like moral hazard, or some other institutional failure.

7. Financial Liberalization and Fragility

The importance of financial institutions in generating financial crises suggests that financial liberalization may have some effect in enhancing the likelihood of crises. Whether this is so is an important question, given the importance that development economists have given to the issue of financial liberalization. Therefore some discussion of this issue is worthwhile..

How might financial liberalization enhance the likelihood of financial crises? One way to see the connection is think about the effects of lifting controls on interest rates. Financial repression often takes the form of interest rate ceilings. This means that bank cannot charge risk-premia to high risk borrowers. Liberalization allows such loans to take place; this is socially beneficial and one of the benefits. Moreover, if the loan-specific risk is hedged by holding a well-diversified portfolio,

[25] This is related to the argument that has recently been made about Long Term Capital Management. The argument is that investors disregard "fat tails."

the system itself may not be any riskier. But this may require a qualified staff that may not be available in emerging markets. Moreover, even a well-diversified portfolio may not protect the system from aggregate shocks, such as recession.

The effects of ceilings are exacerbated when combined with barriers to entry. In this case financial institutions will earn monopoly rents. This increase in franchise value may then reduce moral hazard. The reason is that franchise holders have more to lose if they earn excess profits. Consequently, they may shun more risky loans. When competition is introduced into the banking system the incentive to avoid risk is reduced, unless proper regulation is introduced at the same time.

These considerations suggest that financial liberalization may increase financial fragility, especially when institutions are not conducive to markets. The upshot is that a policy that increases the efficiency of the financial system may also increase the likelihood of financial crises. The question then is how to evaluate the tradeoff. But first we must ask whether there is empirical support for the link between liberalization and fragility.

7.1. Empirical Analysis

Demirguc-Kunt and Detragiache have studied the link between liberalization and fragility. They look at 53 countries during the period 1980-95 and estimate a multinomial logit model to test the hypothesis that financial liberalization increases the probability of a crisis. Basically, the idea is to relate a dummy variable for a banking crisis in a particular year to a financial liberalization dummy and a vector of control variables, including proxies for institutional development.

The findings are rather interesting. Liberalization does lead to increased probability of crisis.

8. The Role of FIG's

The importance of lending booms in generating the crisis atmosphere seems to be recognized. What about the role of FIG's? This seems very important in the Korean case. There are two important issues with regard to FIG's.

First, FIG's get access to cheap credit from the government. Access to cheap credit may lead to investment in activities that have very low returns. Of course, the FIG still wants to maximize profits, but its potential investments may have lower returns than elsewhere. The reason that this is a problem is that the government must borrow at market rates. Still this would not be so bad without the

second issue, moral hazard.

There appears to be significant moral hazard involved with FIG's because they are "too large to let fail." In Korea in the late 70's many *chaebols* ran into severe financial difficulties in the wake of the second oil shock. But they were too large to fail, so the government bailed them out. This has been a recurrent theme. This clearly socialized risk within the group, and reduces the prudence of decisionmakers. The result is that Korean *chaebols* are highly leveraged, with debt-equity ratios that are huge by international standards. Of the 30 top *chaebols*, 25 have debt-equity ratios higher than 3:1, and 10 have ratios greater than 5:1.

What happens then is that capital inflows may finance rather poor and speculative investments, based on implicit government guarantees. Investors may invest in banks or government securities which appear to be low risk. These funds are then lent on to the *chaebols*, which invest in risky projects. This seems to be a recurrence of what happened in Chile in the early 80's, when bad loans in the *grupos* led to problems for the banks.

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