Lecture Note on Crises

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1 Introduction

Why study financial crises? Important for many questions:

- should economies fix exchange rates?
  - with flexible exchange rates, no currency crises, yet there is fear of floating
- fate of globalization
- facilitation of capital flows
- how and whether to reform international financial system?

Why are financial crises bad? Huge losses in GDP and consumption? Much larger than most Harberger triangles. Loss of capital, physical and human. Bad policies.

There are also political costs. Suppose we use the following definition of a currency crisis:

- the devaluation must be at least 25% (on a cumulative 12-month basis)

	6-Months Period Following a Devaluation	All Other 6-Month Periods
Change observed	31	492
	(22.0%)	(11.5 %)
No change observed	110	3,792
	(78.0%)	(88.5%)
Total	141	4,284

Note: "Own turnover"—reference set is only for those developing countries which have experienced currency crash at some point. *P*-value for the difference is **0.002.**

Figure 1: Devaluations and Regime Changes

- it must represent an acceleration of at least 10 percentage points, relative to the rate of depreciation in the 12 months before that.
- it must have been at least three years since the last currency crisis.

By this criterion, Frankel examined a sample of 103 developing countries over the period 1971-2003, and found 188 currency crashes. Suppose we look at the six month window after the devaluation. See figure 1. The chief executive lost office 22.8 % of the time, as opposed to 11.6 % of the time otherwise. In other words, the currency crash doubles the probability of a change in the top leadership within the following 6 months. This difference is statistically significant not only at the 10% or 1% levels, but at the 0.5% level as well.

Why does devaluation carry such big political costs? How is it that a strong ruler like Indonesia's Suharto can easily weather 32 years of political, military, ethnic, and environmental challenges, only to succumb to a currency crisis?

Is it output effects? But devaluation should be expansionary. George Bush wants it. Recall the story of the British Chancellor of the Exchequer "singing in the bath" after the 1992 devaluation of the pound. Developing

countries are different, however. The question is to explain why. We shall see that a major reason is *original sin*.

Old style versus new style crises.

Emerging market crises have changed dramatically in recent times.

2 Old Style Crises

Cycle of overspending and real appreciation that weakens the current account. This eventually causes reserves to decline. Eventually a crisis ensues. Exchange rate is devalued. Not too much else happens. The finance minister is fired, but not a big crisis in the economy. The big issue is the fall of the real wage. Because finance is repressed there is no change for balance sheets to get in bad shape.

In a world with fixed nominal exchange rates and limited capital mobility, excessive domestic credit creation leads to a trade deficit, the depletion of international reserves and, eventually, a devaluation crisis.

2.0.1 A Simple First Generation Collapse Model

In the first generation model the collapse is brought about by the loss of reserves due to excess credit creation. Suppose that the exchange rate is fixed at $\overline{e}$ and that the government prints money to finance a government budget deficit. Let d be the log of domestic credit, and let its growth rate be given by $\dot{d} = \mu > 0$. Then we can define the log of the monetary base as $h = d + R$, where R is the domestic currency value of foreign reserves. Assume PPP and normalize the foreign price level to unity so that $p = e$. Uncovered interest parity implies that $i = i^* + \dot{e}$. For simplicity suppose the money multiplier is unity, so the money supply equals the monetary base. Then money market equilibrium requires that $m^d = d + R$. What is money

demand here? To keep it simple let money demand be given by

$$m^d = p + y - \alpha i,\ \alpha > 0 \tag{1}$$

where $i^* = 0$, so that using PPP, expression (1) becomes

$$m - e = y - \alpha \dot{e}. \tag{2}$$

Thus, if the exchange rate is credible, $\dot{e} = 0$, and thus money demand and money supply must equal $m = \overline{e} + y$, hence the money supply is constant if there exchange rate is fixed.

Now take into account credit creation. Since $m^s = m^d = d + R$, then

$$R = y + \overline{e} - d \tag{3}$$

So if output is constant (again for simplicity) and the exchange rate is fixed, it follows that the growth rate of reserves is the negative of the growth rate of domestic credit.

$$\dot{R} = -\mu \tag{4}$$

In other words, if the exchange rate is fixed and the central bank is financing the budget deficit by printing money at the rate μ, then reserves must be falling at that rate.

Clearly expression (4) implies trouble for a fixed exchange rate regime. Eventually the economy will run out of reserves – they will clearly be exhausted in a finite period of time. Once reserves have reached zero (or some minimum level $R_{\min}$ at which point they can fall no further and $\dot{R} = 0$) the exchange rate can no longer be pegged (unless somehow the budget deficit could be eliminated so $\mu = 0$). At that point the exchange rate will have to float, and will satisfy $\dot{e} = \mu$.

Notice that when the exchange rate peg collapses holders of domestic currency will absorb a capital loss. But if they are rational they can anticipate

this. They clearly will not simply wait till reserves run out to get out of domestic currency. They will anticipate and sell sooner. But this will cause the run on reserves to accelerate and bring the collapse sooner. Can we say something intelligent here?

The answer is yes! We can say exactly when *this* regime will collapse. Absence of arbitrage means that the exchange rate just after the collapse of the peg must be equal to what it was just before the peg. In other words, no jump at the critical date, t_c, when the collapse occurs. How to find this? We need to define the shadow value of the exchange rate, that is what value the exchange rate would take if there were no pegging. Then just set this value to the peg, $\overline{e}$ to find t_c.

We define the shadow rate of the exchange rate as the value it would take if the exchange rate were not fixed. From (2) we can see this must be $e = m + \alpha\dot{e}$ (recall y is not changing). But we also know what is happening to the money supply – it is now growing at the rate of credit creation. Hence we could write the shadow value of the exchange rate as

$$e = d_0 + \mu t + R_{\min} + \alpha\dot{e} \tag{5}$$

where d_0 is the initial value of domestic credit.

Hence, setting $e = \overline{e}$ in (5) and solving for t we get:

$$t_c = \frac{\overline{e} - d_0 - R_{\min}}{\mu} - \alpha \tag{6}$$

where we can see that the time of the attack depends positively on the growth rate of credit creation and negatively on the initial size of the monetary base and the minimum level of reserves. Now it is also possible to show that $\overline{e} - d_0 = R_0$, i.e., the initial level of reserves. So we could write (6) as

$$t_c = \frac{R_0 - R_{\min}}{\mu} - \alpha$$

which shows that the time to collapse depends positively on the initial level of reserves.

We can see this graphically in figure 2. In the upper panel the shadow exchange rate is upward sloping due to the steady depreciation of the currency. The peg is given by $\overline{e}$. In the lower panel we have the time path of reserves, with the minimum level of reserves being $R_{\min}$. Now suppose that the exchange rate collapsed only when $R = R_{\min}$. Then at this point the exchange rate would jump up to the shadow rate, by the amount Δe, causing a capital loss. So investors would not wait till time $\widehat{t}$ to dump the domestic currency. They would sell earlier. Notice that at time t_c there is no capital loss. Reserves jump down at that point (they follow the path R_0AB), but there is no anticipated capital loss.

Would speculators attack before t_c? The answer is also know. Suppose they did. Then they did dump domestic currency at some $t < t_c$. From figure 2 it is clear that the exchange rate would jump down – the domestic currency would *appreciate*. Hence, investors would be selling at $\overline{e}$ and then the domestic currency would rise in value. They would lose this appreciation. Hence, they would want to hold the currency a bit longer to not forego these gains. Only if they sell at t_c would there be no jump in the exchange rate, and hence no arbitrage profits.

This model of collapsing exchange rates is simple and informative. But it has one big flaw – while the agents are rational the government is completely mechanistic – they act like dumb robots losing reserves each period. Shouldn't we model the policymakers as rational as well. Moreover, there is an empirical problem. Countries that suffer a collapse often appear to have plenty of reserves left to purchase all of the outstanding monetary base. In the UK, for example, foreign reserves were 116% of the monetary base, and in Mexico they were 120%. Why didn't the countries simply use all their reserves to purchase the outstanding money base and maintain the peg? To ask the question is almost to answer it. If the central bank purchased all

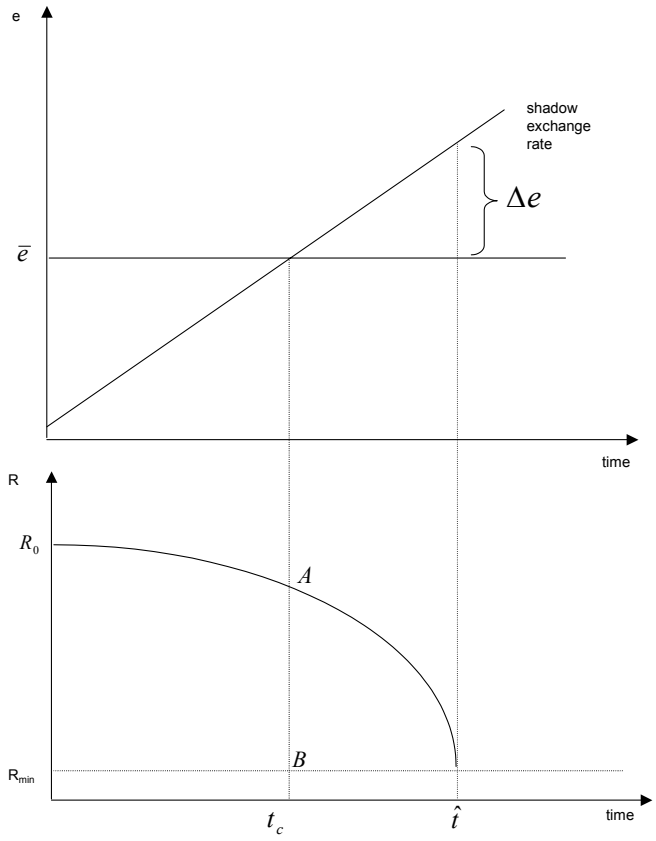

Figure 2: Time to Collapse

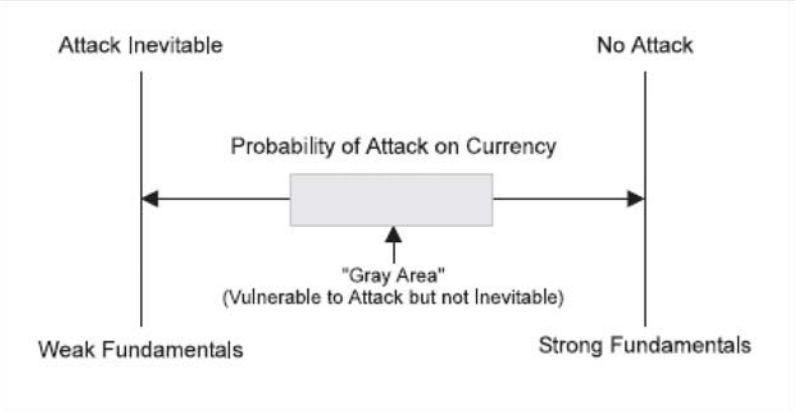

Figure 3: Second Generation Models

its outstanding liabilities the domestic money supply would shrink to zero – this cannot be good for the economy. Hence, it is the conflict of internal and external balance all over again. For this reason we need to look to second generation models.

3 Second Generation

In the second generation type models, whether or not an attack occurs is uncertain. There is a "grey zone" in which an attack can occur, but may not. It depends on whether or not the government is willing to take costly enough actions to deter speculators. We have figure 3, where there is an intermediate zone where a speculative attack may occur.

It is useful to think of the speculative attack is the outcome of a prisoner's dilemma game (as in the example below), where each speculator sells the currency for fear that he will be left "holding the bag" if he is the only one not to sell. A large trader could matter because he affects the probability that the others will undertake a speculative attack, for any given set of fundamentals.[1]

[1] Notice that it is not just information *per se* about the likelihood of a speculative attack.

Example 1

Investor 2 \ *Investor 1*	*Stay in*	*Attack*
Stay in	2, 2	$-2, 2$
Attack	$2, -2$	$0, 0$

Of course, this only matters if the attack is likely to be successful. If not there are better returns from staying in. What causes the likelihood of attack to increase? *It is a rise in the cost of maintaining the peg.* For example, if it becomes too costly for the government to keep raising rates to preserve capital inflows then it may make sense to attack. Notice that if the domestic banking industry is strong (or unemployment low) then raising interest rates may be feasible. If not, however, the cost is high, and investors may believe that governments will not raise rates to protect the capital inflow. But then attacking the currency is likely to be successful.

An important implication of the prisoners' dilemma is that if all investors can be persuaded to stay in everybody benefits. This is where the bail-in idea stems from. But this requires some coordination.

Contagion becomes a big issue. A statement by Mexico's Secretary of the Treasury José Angel Gurría vividly captures and frustrations with financial contagion:

> "Ninety percent of Mexicans have never heard of the Duma, and yet the exchange rate and interest rates that they live with every day were being driven by people with names like Kiriyenko and Chernomydrin and Primakov." (Gurría, 1999)

Capital account plays a key role. In the run-up too much capital flows

What is important is how *common* this information is. Even if agents are informed about fundamentals, they may not be informed about the beliefs of other agents. In that case a speculative attack still may not occur. This reduces the multiplicity of equilibria and can help explain timing. What shifts the expectations so that the attacks occur? Most accounts suggest that there is a window when they could have succeeded, but what explains why they took place when they did?

in. The problem is when it stops. It "is not the speed that kills, it is the sudden stop." 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 [1, 120].

Because they involve national balance sheets these crises have much bigger impacts on the national economy. This is true even if it is just illiquidity rather than insolvency. Matters a lot what type of capital flows in: FDI inflows are less likely to cause crises.

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.[2]

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.

[2]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.

One explanation might be that noisy investors simply extrapolate from the past. In some periods their behavior could dominate rational investors, as in a bubble. Suppose, that an emerging market currency is linked to the dollar. Let ρ be the probability that the exchange rate survives ($\dot{e}^e = 0$) this period, so that $1 - \rho$ is the probability of a collapse ($\dot{e}^e = k$, where k is the value of the exchange rate in a devaluation. Hence, the expected value of the exchange rate is

$$\dot{e}^e = \rho(0) + (1 - \rho)k = (1 - \rho)k$$

and we know that $i - i^{US} = (1 - \rho)k$ from interest parity. Now, suppose that the longer the exchange rate survives the more confident are investors that it will continue. This is a survivor bias, but it could be common. Then, over time $\rho \to 1$ and $i - i^{US}$ shrinks. So the lack of warning could be due to this survivor bias. Of course, rational investors may want to sell the currency short based on fundamentals. But given finite resources they may lose money if the noisy investors are strong enough.

We should also consider the role of private financial institutions. They toot the horn of the emerging economy to reap fees. JP Morgan and Argentina, for example. Conflict of interest of private research and bond sellers. Why can't short sellers win?

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.

3.0.2 Third Generation Models

Like Generals, international finance economists fight the last battles. The first generation models were a response to the typical crises under Bretton

Woods. The second generation models helped us understand the ERM crisis, where fundamentals were suspect but not certain to cause a crisis. Now we have third generation models.

Involves doubt about the credit worthiness of the balance sheet and the exchange rate. No matter how it originates, implied capital flight makes it a question about both. Implied capital flight calls into question reserves.

In a world with high capital mobility, even small adjustments in international portfolio allocations to the emerging economies result in very large swings in capital flows. Sudden reductions in these flows, in turn, amplify exchange rate and/or interest rate adjustments and generate overshooting, further bruising credibility and unleashing a vicious circle.[3]

The Third-Generation is a response to crises in countries where fundamentals did not seem suspect. In the Asian crisis countries that were attracting capital suddenly found their currencies attacked. The currency crises were associated with banking crises, and the economies suffered severe contractions. This led to the third generation models with focus on balance sheet problems. Often these result from moral hazard. Borrowers and lenders are less likely to be careful evaluating the true profitability of investment opportunities if they believe they will be bailed out in the event that the project goes badly.[4] The Third-Generation approach instead interprets recent crises as illustrations of the perils of moral hazard. Borrowers and lenders are less likely to be careful evaluating the true profitability of investment opportuni-

[3]Mendoza begins his discussion by arguing that Sudden Stop (SS) episodes are qualitatively different from standard balance of payments crises. While in the latter the economy experiences a deep collapse – followed by a rather sharp recovery – in a run-of-the-mill BOP crisis the economy suffers a prolonged recession. Mendoza develops a model of an economy subject to excess volatility, which is able to capture the main features of Sudden Stops. In this model, under most states of nature the economy functions in a frictionless fashion. There are some states of nature, however, when the economy becomes subject to a binding credit constraint. More interestingly, the economic frictions and distortions set in motion by this credit constraint can be triggered either by investors' expectations, or by foreign or domestic shocks.

[4]This is especially true with exchange rate pegs and high capital mobility.

ties if they believe they will be bailed out in the event that the project goes badly.

The Third Generation model often start from the assumption that government officials have a pot of resources that can potentially be used to bail out political cronies if they get into financial difficulty. This pot is mainly identified with the central banks' holdings of foreign exchange reserves. Well-connected banks are able to borrow from abroad to finance risky projects – such as real estate development or a new factory in the already-glutted steel industry. They are aware of the risk. But they believe that they will be bailed out by the government if things go badly.

Claim 2 *Guarantees play the critical role of enhancing foreign borrowing*

The timing of the attack is straightforward:

- when the level of liabilities that have a claim on bail-out protection rises to the level of reserves available for the bailing out.

Why does the crisis occur when it does? Asian countries did not suddenly develop critical structural flaws in their financial systems for the first time in 1997. The timing of the attack again comes out of the calculations of speculators who worry that if they wait too long, there will not be enough foreign exchange reserves to go around.

- But there is a key difference from the First Generation models, which watched reserves decline steadily over time, and identified the timing of the attack as the point at which reserves sank to a particular critical level.

- The Third Generation models watch liabilities rise steadily over time, artificially encouraged by moral hazard. They identify the timing of the attack with the point at which the liabilities have climbed to the critical level given by the level of reserves. At that point, speculators

suddenly cash in their investments. If they waited any longer they might not be able to get their money out.

The speculative attack, as usual, then forces the central bank to abandon the exchange rate.

Herding is an especially important problem in globalized markets. Herding occurs when agents are imperfectly informed and when the benefits to an action increase if others also do this. In this situation an agent may learn from the behavior of others. Think of a bank run. It is like a bank run. If nobody panics I am better keeping my money in the bank, but if others run I had better do it too. This can occur in international financial markets when there are informational asymmetries.

The problem here is coordination failure. To see this suppose we analyze it as a 2×2 game, with the two agents being foreign investors (FI) and the government. Of course foreign investors are not one player, but many – this is what makes coordination hard. Let the two actions for the FI be to panic or not panic. And for the government it is to default or not. Then we have:

		Government	
		Default (D)	No default (ND)
FI	Panic (P)	$-x, -x$	$-x, -2x$
	No panic (NP)	$-2x, -x$	x, x

(7)

where the payoffs to the FI are listed first.[5] What is evident from these

[5]Notice that it would be more likely that the payoffs resemble:

		Government	
		Default	No default
FI	Panic	$-x, -x$	$-.75x, -2x$
	No panic	$-2x, -.75x$	x, x

If the FI do not panic the government is better off in the default case than if there is panic. They were able to borrow more before repudiating debt. Not clear, however about the outcome of panic plus no default. Given that there is no default the foreign investors who panicked have lost some extra returns. So one could argue that they are worse off

illustrative payoffs in this payoff matrix (7) is that if the government chooses D, then the payoff to the FI from panicking (write this as $\theta^{FI}(P, D) = -x$) is greater than if they do not panic ($\theta^{FI}(NP, D) = -2x$) Similarly, the payoff to the government of defaulting is greater than that of not defaulting when investors panic, since $\theta^{G}(P, D) = -x > \theta^{G}(P, ND) = -2x$. So the outcome of $[P, D]$ is an equilibrium. Given that foreign investors panic government wants to default, and given that government wants to default investors want to panic. So there are two equilibria: $[P, D]$ and $[NP, ND]$. Of course the latter dominates for everybody. The question is how to get there.

The problem for policy is how to get out of the bad equilibrium and into the good one. This requires government to do something to coordinate investors expectations.

In these models the *original sin* is foreign currency borrowing which constrains the hands of authorities when a crisis occurs.[6] Eichengreen, Hausmann and Panizza (2003a) define original sin as the inability of a country to borrow abroad in its own currency. Traditional monetary and fiscal policy is ineffective in this case. The key point here is that with large foreign borrowing, devaluation will devastate the banking system. Balance sheets worsen. It also hurts investment because of the need for working capital. The currency mismatch then limits the options for policy. The more the domestic currency depreciates, the worse the impact on the balance sheets.

The big question is why do countries suffer from original sin? Although one might think this is due to institutions and the history of policy, it seems that size is the most robust factor explaining original sin. Larger countries find it easier to borrow in their own currencies. Why might this be? One explanation could be that if there are costs to international transactions

now than if there had been a default.

[6] Notice that another implication of original sin is that some countries accumulate large reserves of foreign currency precisely because they fear they will be unable to borrow when they need to. This means that some countries that suffer from original sin will *not* suffer from currency mismatch.

then there are limits to international financial diversification. Hence, smaller countries currencies may not be part of an optimally diversified portfolio.[7] This also means that each country that can borrow in its own currency lowers the chance that another country will be able to. This follows because there are diminishing marginal benefits from holding another country' currency.

One might wonder how Switzerland or the UK can borrow in their own currencies. This is probably just a function of history. At one time the UK was the world's biggest power, and Switzerland has long been a money center. Network externalities giving rise to historical path dependence have worked to lock in their currencies' international status: once the Swiss franc was held in some international portfolios and used in some international transactions, it became advantageous for additional investors and traders to do likewise.

4 Crises of Confidence and Currency Mismatches

Financial crises are bad. They are associated with large drops in income. Capital inflows reverse causing real decreases in consumption and investment

[7] Consider the following simple idea. There are two countries: one has N trees while the other has 1 tree. All trees are identical in their expected income and its variance; the large country just has more of them. Shocks to each tree are uncorrelated. Assume that the exchange rate moves with the realization of relative output. If there were no transactions costs of investing abroad, then it would be optimal to hold a globally diversified portfolio: the large country would invest $1/(N+1)$ of its wealth in the small country, while the latter would invest $N/(N+1)$ in the large country. Now introduce costs to international transactions. If all countries were of size 1, then the presence of transaction costs would not affect the composition of the world portfolio. But if country size differs, then the benefits of international diversification will be greater for the small country than for the large one. There will be less appetite in the large country to hold the currency of the small country, while there will still be a large appetite for the small country to hold the assets of the large one. This is to say, large countries offer significant diversification possibilities, while small countries do not. If the transaction costs associated with international diversification are the same for investors in both countries, then the world will choose to invest in a few large currencies. Notice that this is through no fault of the small country, but a consequence of the existence of cross-border costs and asymmetries in size and diversification.

to produce current account surpluses. This is straightforward, so it should be evident why countries would want to avoid currency crises.

But from the basic model we have studied so far this may seem puzzling.[8] After all, if the currency collapses this makes the economy more competitive. This should have an expansionary impact on output. Why does a collapse in confidence in the currency cause the economy to go into recession? If investors expect the currency to depreciate this should raise competitiveness. This certainly seems to be part of the logic underlying the second generation models – that is where the benefit from devaluation comes from. But in more recent crises, those since the Tequila crisis of 1994 the collapse of the exchange rate has been associated with contraction not expansion. Hence, explaining why modern crises are contractionary is important.

It is clear that something is missing in the standard model. The reason is that the standard model cannot accommodate contraction is that it does not have a channel for investor confidence to impact on the economy. We would expect, and we observe, that crises in confidence have strong, deleterious effects on investment spending. We need to incorporate this into the model.

Before considering mismatch, we should note that even if a rise in the real exchange rate improves competitiveness, the sudden reversal in the current account will still be painful. Moving from a current account deficit of 5-8% of GDP to a surplus of similar magnitude requires a real shift in expenditure. Exports cannot rise that fast, even if the economy is very open. So much of the shift must occur via decreases in imports and increases in savings. Note that the less open is the economy the greater the change in the real exchange rate that will likely be needed to shift expenditure by the required amount (that is, the amount required to restore confidence in the currency). Nonetheless we still need to find a channel for the exchange rate collapse to cause contraction.

[8] See DeLong, "The International Financial Crises of the 1990s: Analytics," at http://www.j-bradford-delong.net/macro_online/ifc_stub.html

First, we could note that investment depends not only on interest rates but on exogenous factors, such as Keynes' animal spirits. We can go further by considering the impact of such a crisis on investment. Let θ be the indicator of a crisis. We will discuss its magnitude and determination shortly. Now we write investment as:

$$I = g(r, \theta) = I_0 - g_1 r - g_2 \theta \tag{8}$$

What (8) says is that investment depends negatively on a crisis in confidence. This makes sense. During such a crisis banks don't lend and savers demand liquidity. So this has a negative impact on the IS curve. It shifts it to the left, offsetting the gain from increased competitiveness.

But where does θ come from? It is good to start with currency mismatch.[9] We consider a hypothetical case where banks make sound loans but there is a mismatch between assets and liabilities. This happens in many emerging markets where banks lend in domestic currency but borrow in dollars or Euros.[10]

Consider a situation in which the peso-dollar exchange rate is 5:1, and in which a hypothetical bank with 200 million pesos of capital has received 800 million pesos in deposits, and has loaned out all of the 1 billion pesos it has in sound, prudent loans to operating companies. The bank's balance sheet is given in figure 4.

Now suppose the bank takes advantage of cheaper rates in New York on dollar liabilities and borrows $100 million. This will support 500 million

[9] Notice that currency mismatch may be the result of original sin. But it does not have to be. Another reason why currency mismatch may occur is moral hazard. It may just be cheaper to borrow in foreign currency, and if there are implicit government deposit guarantees, banks may borrow in foreign currency even if they could borrow in domestic currency.

[10] Of course this begs the question of why banks engage in this mismatch. Another way to think about this is to ask why the banks do not hedge this risk by purchasing forward contracts. By engaging in this currency mismatch the banks are exposing themselves to currency risk in the event of devaluation. The question then is why do they do it.

Assets	Liabilities and Net Worth
Loans: 1,000 million pesos	Deposits: 800 million pesos
	Capital: 200 million pesos

Figure 4: A Bank Balance Sheet

pesos in loans, at the current exchange rate. Again the bank makes sound loans. The balance sheet is now given by figure 5. Notice that with an exchange rate of 5 pesos to the dollar assets and liabilities are balanced. If the loans are sound so is the bank.

Borrowing in foreign markets is efficient. We know this from our analysis of capital market liberalization. It accesses the economy to world savings, not just domestic savings, and this can be important for emerging market economies. The cost of borrowing is likely to be lower in this case. Notice that there are two reasons for this:

- capital is less scarce in the richer countries
- currency risk premium on domestic borrowing

The latter point is important here. One reason why the cost of borrowing in dollars is lower than in pesos is because there is some risk that the peso will be devalued. So part of the extra cost is a risk premium. But then, we have to consider the risk associated with foreign borrowing – currency mismatch. The problem is that borrowing and lending take place in different currencies and changes in the exchange rate will effect the value of this lending.

Suppose, for example, that the value of the peso declines. Say it moves to 10 pesos to the dollar. All of a sudden the bank's balance sheet is in ruins. Why? Because the value of its liabilities has increased dramatically in peso terms. It still owes $100 million dollars, but these are now worth P1 billion –

Assets	Liabilities and Net Worth
Loans: 1,500 million pesos	Deposits: 800 million pesos Borrowed: 100 million dollars Capital: 200 million pesos

Figure 5: Balance Sheet with Currency Mismatch

peso liabilities have doubled in value.[11] Given that the bank acquired assets worth only P500 million for these liabilities havoc is no surprise. Indeed, the bank's net worth has been wiped out, as is evident in figure 6. Notice that the bank now has negative net worth of P300 million.

Assets	Liabilities and Net Worth
Loans: 1,500 million pesos	Deposits: 800 million pesos Borrowed: 100 million dollars Capital: -300 million pesos

Figure 6: Balance Sheet after Exchange Rate Shock

How will depositors respond to this shock? They will clearly fear for their savings. A run on the bank is likely. It certainly cannot lend more. The bank will have to call in loans to survive. This will dampen lending

[11] Of course the value of the peso could have increased. In that case the peso value of the liabilities would have decreased and the bank would be more profitable. Obviously there is no crisis in that case.

further. In other words investment spending will collapse. There will be a race to liquidity. And since the exchange rate shock is common to the country we should expect this to effect many banks.[12]

The point of the story so far is that a collapse of investment can arise from a sudden depreciation of domestic currency when there is currency mismatch. The larger the depreciation the greater the impact on balance sheets, so the larger should be the impact on investment. This suggests that we let the crisis variable depend on exchange rate depreciation according to something like:

$$\theta = \begin{cases} 0 & , \text{ if } \Delta e \leq 0 \\ \phi_c(\Delta e)^2, & \text{if } \Delta e > 0 \end{cases} \tag{9}$$

Expression (9) says that when the currency appreciates there is no confidence crisis, and hence no impact on investment. When the currency depreciates, however, the magnitude of the crisis will depend on the square of the exchange rate change and on the degree of currency mismatch, ϕ_c.

Investment will thus shift by

$$\Delta I = -g_2\theta = -g_2[\phi_c(\Delta e)^2] \tag{10}$$

And the impact on the IS curve then depends on two opposing forces of the currency appreciation. One is the traditional increase in competitiveness, causing IS to shift to the right by $\phi\Delta q$, and the second is the shift to the left as in (10). So the nature of the shift depends on whether

$$\phi\Delta q \gtreqless g_2[\phi_c(\Delta e)^2] \tag{11}$$

And given that prices are fixed we can replace q with e, so that 8 with:

$$\phi\Delta e \gtreqless g_2[\phi_c(\Delta e)^2] \tag{12}$$

[12] Even banks that have little mismatch may be affected if depositors *fear* that they may suffer. Since depositors have less information about bank liabilities they are likely to run on all banks.

What does expression 12 imply? Given that the RHS depends on the square of the exchange rate change, the larger is the depreciation of the currency the more likely the impact on the IS curve will be negative.[13] This means that a large exchange rate change, occasioned by a collapse in confidence in the currency, will have a negative impact on demand. The reason is that the effect of the mismatch on investment spending outweighs the competitiveness boost.

5 Effect on Policy

Original sin changes the way traditional policy tools work. According to the standard textbook theories, when a country faces a sudden stop in capital flows, there exists some optimal combination of expenditure-reducing policies (monetary or fiscal contraction) and expenditure switching policies (devaluation) that should accomplish adjustment to external balance (the new balance of payments constraint), without necessarily sacrificing internal balance (i.e., without a recession). Why did all the countries in the East Asia crisis of 1997-98 suffer a sharp loss in output growth regardless of their mix of devaluation and expenditure-reduction?

Consider a graphical representation with the interest rate and exchange rate (price of foreign currency) on the axes, as illustrated in Figure 7 To satisfy external balance, there is an inverse trade-off between the two instruments. A devaluation and an increase in the interest rate are each ways of improving the trade balance – the latter by reducing expenditure – and so the more you have of one the less you need of the other. To satisfy internal balance, the trade-off is traditionally considered to be upward-sloping. An increase in the interest rate reduces the domestic demand for domestic goods, while a devaluation increases the net foreign demand for domestic goods; if

[13] And although this is not really in the model, we may think that the loss of confidence effect can happen quite quickly, before exporters can respond to a devaluation.

you have more of one, you also need more of the other, to prevent excess supply or excess demand. The existence of two instruments suggests that one can achieve both internal and external balance.

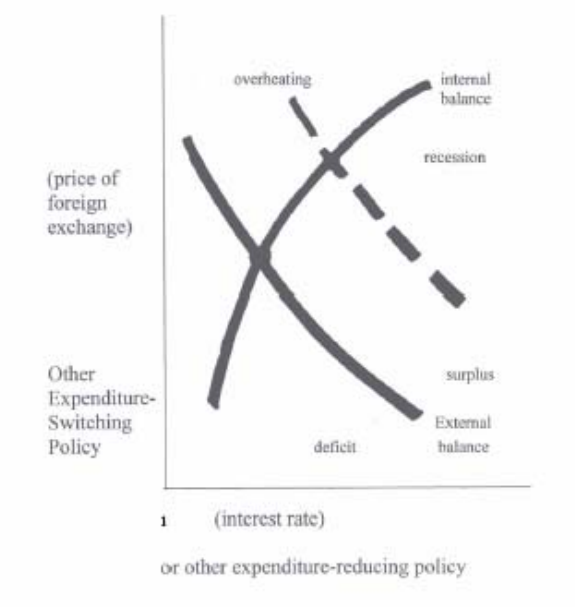

Figure 7: The Traditional Tradeoff

Now suppose that there is an external shock that throws the economy into a balance of payments deficit. It could just be that foreign investors no longer are happy with the economy, or a shock to demand for our exports. In any event, to maintain external balance we need a higher value of e for any value of i. Hence, the EB curve shifts up to EB_1 in figure 8. The economy starts at point A, but after the shock this is a point of external imbalance. Using exchange-rate policy to achieve external balance moves us along the arrow line till we reach EB_1. But now we are no longer in internal balance. This makes sense: the depreciation of the currency causes net exports to rise, so there is an excess demand for goods. To restore internal balance we raise

interest rates. You can see that we eventually converge to point B.[14]

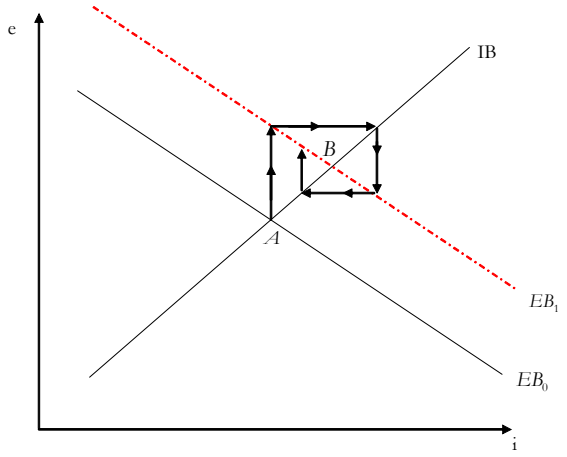

Figure 8: Adjustment to an external shock in the standard model

Where the traditional framework needs most to be modified is the relationship giving internal balance, not that giving external balance. By now the evidence seems strong that devaluation is contractionary, at least in the first year, and perhaps in the second as well. With original sin, devaluation may be contractionary. Then the internal balance line slopes down, not upwards.

How does this change our analysis? Consider figure 9. We again are in equilibrium at point A, when the economy experiences a negative shock to external balance. But now, because of currency mismatch, the internal balance schedule is negatively sloped. Why? Because devaluation worsens balance sheets and depresses bank lending, to such an extent that it offsets any expansionary effect from currency deprecation. Then, if we let the currency depreciate we move to point C, which is taking us away from the new equilibrium at point B. We would be better off trying to maintain the value

[14] Hopefully, in practice, both policies are used simultaneously so that we get to B quicker!

of the currency and using higher interest rates to improve external balance in this case. But this may be impossible if there are insufficient reserves to maintain the peg. The key point, is that if the internal balance schedule is negatively sloped, and if the currency collapse takes us to point C, then we do not have good options.

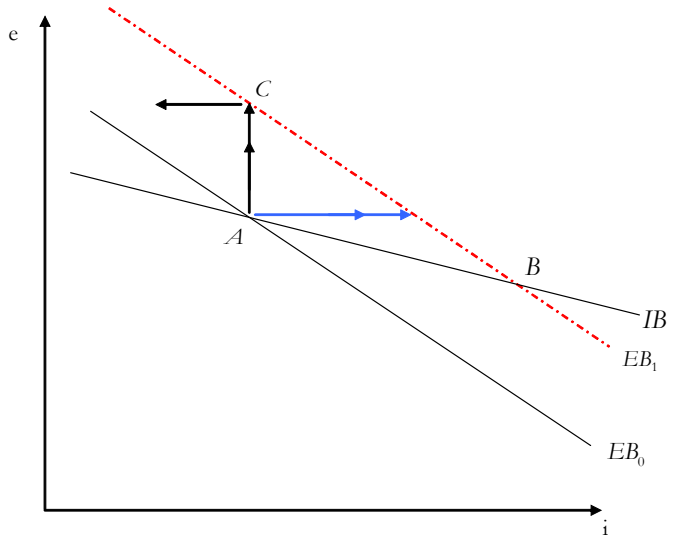

Figure 9: External Adjustment with Original Sin

Notice, that we could even have the slope of IB be disturbingly similar to the slope of the external balance line. It is hard to see where the two intersect, if they intersect at all. This means that it is hard to see what combination of policy instruments, if any, can simultaneously satisfy both internal and external balance, after an adverse shock has shifted the latter outward.(as illustrated in Figure 10). The depressing conclusion is that there is no escape from recession.

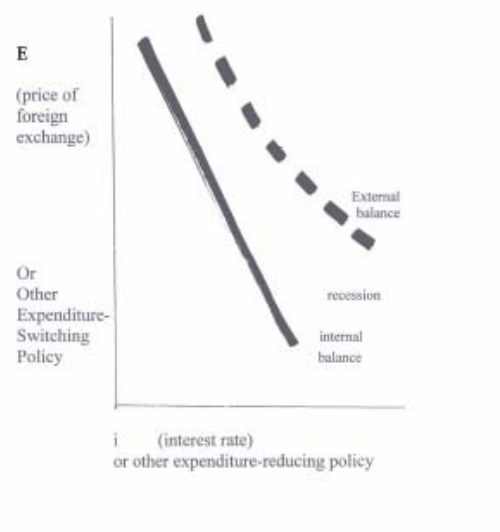

Figure 10: Internal and External Balance when Devaluation is Contractionary

6 Emerging Market Crises

Emerging markets crises are interesting because they feature several phenomena that are hard to explain:

- *sudden stop.* The sudden reversal of capital inflows and the current account, a large recession in domestic production and absorption, and a collapse in asset prices.
  - note that this effect is opposite of conventional models where devaluation is expansionary because it improves the terms of trade, or even of neoclassical models, which model the current account as a vehicle for consumption smoothing
- *contagion.* The spreading of crises from one country to another in a similar region, cross-country spillovers

- *twin crises.* Currency crises and banking crises are intertwined in emerging markets.

The problem is also interesting because it seems intertwined with financial liberalization. The benefits of liberalization are lessened if associated with such crises.

One important factor in this is *original sin* (Most countries do not borrow abroad in their own currency and do not borrow in local currency at long maturities and fixed rates even at home, a fact that has been referred to as "Original Sin"). Original sin is what transforms currency crises into full-blown banking financial crises.

6.1 Sudden Stops and the Capital Market

Sudden stops lead to sharp reversals in the current account and in consumption and investment. The need to switch expenditure requires large changes in the real exchange rate. This leads to painful consequences, which can include bank failures given the balance sheet consequences of currency mismatch.

Notice that it is not the poorest countries that are hurt – they have no access to capital in the first place. Nor is it the rich countries. They do not suffer balance sheet problems when they devalue. Probably because nobody expects them to monetize deficits. It is the intermediate, emerging market economies that suffer most.

This leads to several questions.

6.1.1 Capital Market Liberalization

Maybe the response should be to restrict capital flows. Restrictions on capital inflows. In the midst of the Asian crisis Malaysia implemented capital controls, and it did not seem to suffer that much.

Hard for economists to see the benefits. But Krugman and Rodrik have argued its case.[15] Is there a reason why international financial markets are different from domestic financial markets? Why shouldn't developing economies benefit from financial smoothing?

One argument is that controls may be needed if financial markets are underdeveloped. After all, even a trapeze artist needs a net. If prudential regulation is insufficient then maybe some restrictions are needed, at least until financial markets develop.

A second argument has to do with emergencies.[16] Capital flows can prevent the use of fiscal and monetary policy in a recession. If the authorities try to combat inflation capital will flow out. But if there are controls then macro policy can be used. Of course such controls can lead to worse outcomes, especially cronyism. But there is any rationale?

One could argue that if investors are irrational maybe controls would be beneficial. But it could be that investors really react to the expectations of bad policy. After all, investors do not flee the dollar when we go into recession. This is because investors do not expect that deficits will be monetized or debt defaulted on. But when an emerging market economy goes into recession it may be credible that they will default. If times are rough it may not make sense for such an economy to export capital. Hence, default may be preferable. Then investors are correct to flee. But the problem is the expectation of bad policy. Under such circumstances it makes more sense to

[15] Frankel describes Rodrik's paper as fail-safe econometrics. That is, define the hypothesis so failure to find an effect (in this case, of capital market liberalization on growth) is *support* for your hypothesis. It could be you just did not explain who liberalizes the capital market.

[16] But capital controls are not necessary to cope with emergencies as Rogoff points out: "Yes, the relatively closed Chinese and Indian economies did not catch the Asian flu, or at least not a particularly bad case. But neither did Australia nor New Zealand, two countries that boast extremely open capital markets. Why? Because the latter countries' highly developed domestic financial markets were extremely well regulated. The biggest danger lurks in the middle, namely for those economies—many of which are in East Asia and Latin America—that combine weak and underdeveloped financial markets with poor regulation."

correct policy, deepen financial markets, and prevent the policies that cause investors to worry. This may also require governments of such countries to *signal* that they are tough. The problem, of course, is that you can only signal this when times are tough. Of course this is what happened with the gold standard. The question is how to get this in the modern period.

- Perhaps it is better with dollarization and no capital controls then the reverse
- Or more flexibility in exchange rates

Rich countries clearly benefit from international financial liberalization. And if you have democracy it is hard to implement capital controls anyway. Why should emerging economies be denied the benefits? Clearly it is best if capital markets can be liberalized. The key point is to do this in away that is efficient. Ironically, it is probably best if this is done first with FDI, then with securities markets and last with banks. Yet the opposite order is more frequent.

6.2 Moral Hazard

It is because of the prevalence of the third generation type crises that calls for IMF reform and the end to moral hazard are heard. The moral hazard argument is that the expectations of bailouts on the part of the IMF encourage countries to undertake policies that make them more likely to suffer speculative attacks. Moral hazard induces risk taking, and crises are the result. More to the point, because foreign investors "know" that they will be bailed out in the event of a crisis they do not attach sufficient risk premia to lending to such countries. If investors knew they would not be bailed out they would not make such risky investments.

Notice that if the moral hazard problem was really severe, then all countries could borrow at the same rate. We would expect to see little variation

in interest rates on dollar denominated debt. This is not observed, however, as figure 11 makes clear.

Figure 11: Interest Spreads on Dollar-Denominated Debt

It is also hard to see enormous moral hazard problems from analysis of event studies. Consider figure 12 which shows the emerging markets index and some events in the late 1990's. When Mexico is bailed out why do yields rise? The picture suggests that the market evaluated such debt as more risky, but if the bailout theory is correct, what risks were there for creditors? Similar for other events, though the Russian crisis is an exception. Even here, is it the fact of no bailout changing expectations or the contagion from Russia to other markets that is crucial?

Moreover, there is a lot of evidence that financial institutions lost money in these crises. According to the Institute of International Finance, private investors lost some $225 billion during the Asian financial crisis of the late 1990s and some $100 billion as a result of the 1998 Russian debt default.

Moreover, the moral hazard story gets the composition of capital flows wrong. The one type of capital flow that is certainly note bailed out is

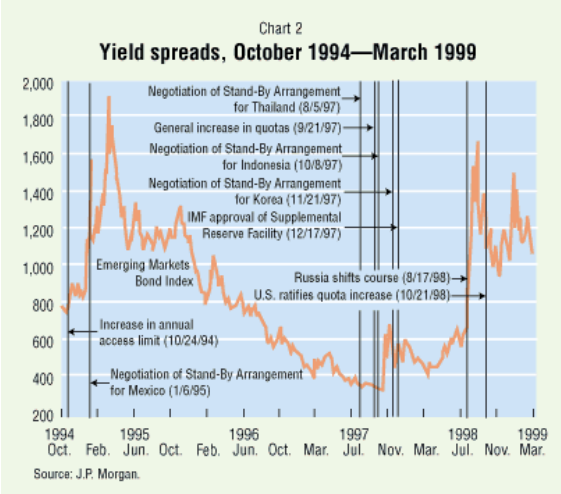

Figure 12: Emerging Market Yields and Selected Events, 1995-1999

FDI. The moral hazard view would thus predict that, in the aftermath of the bailouts, bond issues and loans should have risen, while direct foreign investment collapsed. But, guess what: again the prediction was completely at odds with reality. After the Tequila meltdown, FDI in Latin America boomed while all other capital flows collapsed.

And clearly debtors lost. For Mexico, the presumably lucky recipient of a large bailout, being saved meant a decline in gross domestic product of 7 percent in one year (1995); the banking system crashed and the costs of the bank cleanup are still being felt today; outgoing president Salinas de Gortari was widely reviled, had to go into exile and lost any chance of landing the next job he coveted: chairman of the World Trade Organization. Can one begin to conceive that Salinas –an economist with a Harvard degree— deliberately chose to pay these humongous costs in exchange for getting a few more dollars and a bit more growth in 1993-94?

And Mexico is not alone. Annual output losses reached 14 percent for Chile in 1982, almost 6 percent for Korea, 8 percent for Thailand and nearly 14 percent for Indonesia in 1998, 11 percent for Argentina in 2002. In all

these countries banks crashed and governments had to leave office (or, in the case of Chile, only managed to remain in power by bringing the troops out on the streets). Intentional outcomes? Wild miscalculations? The mind baffles.

In his presidential address to the Latin American and Caribbean Economic Association, Guillermo Calvo put the matter best: moral hazard "would imply that either emerging market policymakers deliberately brought their economies into painful maelstrom (in exchange, perhaps, for a brief mirage of affluence) or that they exhibited a fantastic lack of judgment, bordering on the insane. However, since there is no scientific evidence that those characteristics are the monopoly of emerging market policymakers ... the moral hazard view must ... be classified as an intellectually appealing but unsubstantiated conjecture."

One last strike against the moral hazard argument is that most countries generally do repay the IMF, if not on time, then late but with full interest. If the IMF is consistently paid, then private lenders receive no subsidy, so there is no bailout in any simplistic sense.

6.2.1 Mussa's Theorem

Even if moral hazard is a problem with IMF lending that still does not mean that it is a bad idea. Insurance also induces moral hazard yet we think of it as a beneficial social institution. Nobody argues that insurance companies should be eliminated because they cause moral hazard. But this still raises the question of whether IMF lending causes moral hazard.

Mussa's theorem suggests that the typical reasoning is false. Suppose that the following two assumptions hold:

Assumption 1 The emerging market country is run by a benevolent policymaker who chooses its borrowing so as to maximize the welfare of the representative resident.

Assumption 2 The IMF lends at the actuarially fair interest rate.

Then we have the following theorem (Mussa's theorem):

Theorem 3 *Under assumptions A1 and A2, the anticipation of IMF crisis lending increases the volume of capital flows to emerging market countries and reduces the cost of borrowing for these countries. In addition, the anticipation of crisis lending may decrease the domestic efforts to avoid a crisis. However, the IMF does not generate moral hazard stricto sensu. The expectation of IMF lending unambiguously increases the welfare of recipient countries at no cost to the rest of the world.*

What is the intuition? Because of assumption 2 the IMF does not alter the returns to rich country investors of holding emerging market debt. It implies that investing in the IMF provides the same return (zero) as investing in the debt market, and that the creation of the Fund leaves the welfare of rich country investors unchanged. What is the role of the IMF then? It has a better collection technology. That is, it can collect from debtors in states that private creditors could not (perhaps by its size, more likely by its precedence in contracts). This means the IMF can lend, prudently, when private creditors cannot. And that means it can prevent some debt crises that would otherwise occur.

Notice that this means that the IMF does increase lending to emerging market economies. But not because of moral hazard, but rather because investors see that in some potentially bad cases the presence of the IMF will prevent a disaster that would otherwise lead to a default. The IMF is providing insurance, but it is optimal insurance, so it is not distorting. Note that this argument shows that the IMF does not create moral hazard in terms of the creditors – it does not lead to rich country investors pouring money where they should not.

What about Assumption 1? This is necessary to insure that the IMF does not distort the decisions of the debtor. The IMF could still, perhaps, cause the debtor country to supply too little effort to pay back the loan. This

would be moral hazard on the debtor side. But with assumption 1, this also does not happen. Without it, a policymaker may encourage more capital inflows than the economy optimally desires. The presence of the IMF makes this possible. So the economy gets stuck with more debt than it can afford or desire. But if the policymaker is benevolent, this cannot happen.

The Mussa Theorem does not prove that there is no IMF induced moral hazard. It merely states conditions – assumptions 1 and 2 – under which IMF lending cannot give rise to moral hazard. Notice, however, that even if these conditions are satisfied, and there is no IMF induced moral hazard, IMF lending will generally have implications such as increasing capital flows or lowering the interest rates at which countries borrow – not because it creates moral hazard, but simply because it makes the world a safer place.

So if somebody shows that with IMF lending borrowing countries run more expansionary monetary and fiscal policies, that *does not mean* that moral hazard exists. The point of the IMF is to improve the possibilities for countries that get in trouble so that they can run more expansionary monetary and fiscal policies.

7 The Essential Problem

The essential problem is that many emerging market economies cannot borrow in their own currencies. This creates mismatch. It also makes them vulnerable to shocks, and makes their debt hard to repay precisely when times are tough. Suppose that creditors and debtors were to efficiently share risk. Then debt repayments would depend on the state of the economy. When times are good for a debtor they pay more and when times are bad they pay less, but the expected payment is the same. That is the payoffs are based on the probabilities of the states.

Let π_i be the probability of state i, d_i be the debt repayment in state i, and r the rate of return needed to induce creditors to lend. Suppose that

π_1 is the bad state and π_2 is the good state, and let $d_1 < d_2$. Then if these probabilities are known, creditors should be happy with a state-contingent contract as long as

$$\pi_1 d_1 + \pi_2 d_2 \geq r \tag{13}$$

in a world with two states, and $\sum_i \pi_i d_i \geq r$ in the many state world (as long as all the states are known). Of course there may be disagreements about the likelihood of states, but this contract has the virtue of producing the same repayments as a normal debt contract with one big plus – repayment is more likely.

It should be obvious that it would be easier for the debtor to repay if the payment was lower in tough times. But the problem is more severe because of original sin. When a negative shock hits an emerging economy it must repay in dollars but its income is in pesos (or baht, etc.). Hence, a negative shock to the peso increases the real cost of debt repayment. So, in effect, for the debtor repayment is *state contingent*, but in the opposite direction of what is optimal. When times are tough the burden of debt increases.

Imagine lending to an umbrella manufacturer. You might want to condition repayment on rain. When it is raining the manufacturer repays more, and vice versa. But you would not want to condition the repayment positive on the price of swimming trunks! When swimming trunks are in high demand nobody buys an umbrella! But that is what dollar denominated debt is to emerging market economies.

The Victorian might say, fine, then improve institutions and original sin will go away. Perhaps, over a long period, but look at Chile. It has very good institutions and policy yet it borrows only in dollars. Same for Asian Tigers.

It is true that Argentina seems debt intolerant, but why?

7.1 Sovereign Bankruptcy Mechanisms

If the stampede out of a crisis if the problem, perhaps one of the solutions is to generate bail-ins. The problem now is that coordination is difficult. One lender can mess it up. So the IMF wants to create a SDRM (Sovereign Debt Restructuring Mechanism). The Fund's laws would be changed to allow a super-majority of creditors to restructure a country's debt. Once such a majority agreed to the terms of a workout, any dissatisfied bondholders would be prevented from challenging it. This arrangement would not legally extend the Fund's power, but it would override current American law, which allows any bondholder to sue for full payment in the event of a default. The idea is that this would enable some bail-ins, and thus lower the cost of debt crises.

The essential idea is to create an ordered bankruptcy system rather than the competition for the exits. But it would still involve lots of lending. Not as much progress on this as imagined.

8 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.

It is important to note that emerging market crises have occurred in countries with fixed exchange rates – Mexico, in 1994, Thailand, Indonesia and Korea in 1997, Russia and Brazil in 1998, and Argentina and Turkey in 2000.

Why are fixed exchange rate regimes, especially softer pegs, so susceptible to crises?

Can't be just the absence of exchange rate risk – after all this is not really eliminated. Instead there is a peso problem, but still severe. It must be more moral hazard. If people believe the government will defend the exchange rate, then borrowing in foreign currency makes sense.

References

[1] Taussig, Frank W., *International Trade*. New York, MacMillan, 1928.