The International Financial Crises of the 1990s: Analytics

J. Bradford DeLong
http://www.j-bradford-delong.net/

November 2001

The decade of the 1990s was marked by the sudden emergence of *capital-account international financial crises*. In a typical such crisis, a sudden loss of confidence in the value of a country's currency by international currency speculators was followed by a rapid rise in the value of foreign currency—in the exchange rate—the threat of large-scale bankruptcies of banks and firms, financial panic, and a sharp severe recession.

This type of crisis hit first in the Mexican peso crisis of 1994-1995. Then followed the far-reaching East Asian crisis of 1997-1998. The decade ended with crises in Brazil, Turkey, and Argentina. Governments, central banks, and international organizations have spent the past half decade frantically trying to repair the flaws and plug up the institutional holes that generated these crises. But it is by no means certain that they have succeeded. We may well see more such crises in the future: therefore it is important to try to understand how and why they happened.

A Confidence Collapse: The Standard Analysis

The first couple of these crises came as a shock and a surprise to economists. The standard textbook analysis suggested that a loss of confidence in the value of a country's currency should be not contractionary but expansionary. It should be followed not be a recession but by a boom. Why? Because a loss of confidence in the value of a country's currency makes its products more competitive, and boosts its exports.

In the standard sticky-price framework, a loss of confidence in the value of the currency by international currency speculators is modelled as a sudden increase $\Delta\varepsilon_0$ in the baseline long-run expectation ε_0 in the exchange rate-determination equation:

$$\varepsilon = \varepsilon_0 - \varepsilon_r(r - r^f)$$

where ε is the value of the exchange rate, ε_0 is international currency speculators' expectation of the exchange rate's long-run fundamental value, r is the domestic real interest rate, r^f is the foreign real interest rate, and ε_r is a parameter depending on the expected persistence of cross-country interest rate differentials that captures how sensitive the exchange rate is to a shift in the interest rate.

An increase $\Delta\varepsilon_0$ in the baseline long-run expectation ε_0 increases the equilibrium exchange rate for each possible value of the domestic interest rate. The higher equilibrium exchange rate boosts exports.

Thus the increase increase $\Delta\varepsilon_0$ in the baseline long-run expectation ε_0 increases baseline autonomous spending A_0 in the IS curve equation:

$$Y = \mu \times A_0 - \mu \times (I_r + X_\varepsilon \varepsilon_r) \times r$$

by an amount:

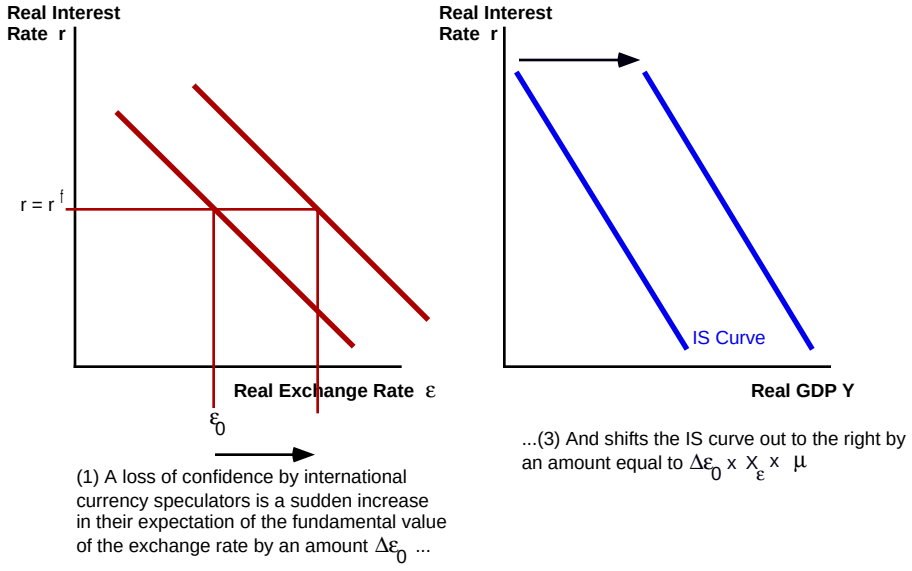
$$\Delta A_0 = X_\varepsilon \times \Delta\varepsilon_0$$

where Y is the level of real GDP μ is the multiplier, X_ε is the sensitivity of exports to the exchange rate, and I_r is a parameter that captures the sensitivity of investment spending to changes in the interest rate.

Thus the effect of a sudden loss of confidence in a country's currency is to shift the IS curve to the right by an amount equal to $\mu \times X_\varepsilon \times \Delta\varepsilon_0$. For any given value of the domestic real interest rate r, the equilibrium level of real GDP Y is higher by an amount $\mu \times X_\varepsilon \times \Delta\varepsilon_0$ because of the boom in exports induced by the rise in the value of foreign currency. A loss of confidence by foreign exchange speculators in the currency is good news for employment and output (unless, of course, the central bank responds by raising domestic real interest rates to prevent the value of foreign currency from rising). This scenario was confirmed, most recently, by the British financial crisis of 1992: as German interest rates rose speculators lost confidence in the willingness of the British government to keep its currency, the pound sterling, pegged to the then-German currency, the mark. The British government first raised interest rates to prevent the value of the mark

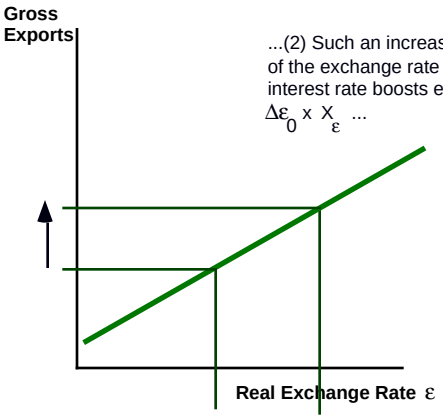
from rising against the pound (sending Britain into recession), and then allowed the pound to depreciate, causing an export-led boom.

Standard Analysis: A Loss of Confidence in the Currency Shifts the IS Curve Rightward



(1) A loss of confidence by international currency speculators is a sudden increase in their expectation of the fundamental value of the exchange rate by an amount $\Delta\varepsilon_0$ ...

...(3) And shifts the IS curve out to the right by an amount equal to $\Delta\varepsilon_0 \times X_\varepsilon \times \mu$



...(2) Such an increase in the equilibrium value of the exchange rate for any given value of the interest rate boosts exports by an amount equal to $\Delta\varepsilon_0 \times X_\varepsilon$ ...

Why, then, did the loss of confidence in currency values by international speculators in the 1990s lead countries into situations of high unemployment and lowered output? Why did Mexico, East Asia, and Brazil all see the collapse in confidence followed by a recession, not a boom? What is the flaw in the standard, textbook analysis?

What Is a Capital-Account International Financial Crisis?

The flaw in the standard, textbook analysis is that the function determining the level of investment spending is too simple. The standard investment function makes investment spending I depend only on baseline investment spending I_0, on the domestic real interest rate r, and on the sensitivity of investment spending to the interest rate I_r:

$$I = I_0 - I_r \times r$$

But the degree of financial crisis—call it C—can also be an important determinant of investment spending. Thus we need to complicate the investment function to be:

$$I = I_0 - I_r \times r - I_c \times C$$

What is a financial crisis? Why is it a hindrance to investment spending? A *financial crisis* is when a large proportion of the banks and companies in the economy are insolvent—or are feared to be insolvent. An operating company or a bank is *insolvent* when its

liabilities are greater than its assets—when it couldn't pay all of its bills if it were required to pay them today.

When a financial crisis hits, banks are unwilling to lend additional money to operating companies: perhaps the operating company is already insolvent and is concealing its insolvency, so that the bank's money will go to pay earlier creditors of the company and never return to the bank. When a financial crisis hits, operating companies are unwilling to spend money on investment projects: perhaps some bank will suddenly ask for repayment of a loan, or perhaps some company to which credit has been extended will fail; in such circumstances operating companies are wise to hoard their liquid cash in case of adverse contingencies, and are not wise if they diminish their liquidity by spending to expand their capacity. The sensitivity of an economy's level of investment spending to the degree of financial crisis C is captured in the parameter I_c in the extended investment function above. How large the parameter I_c turns out to be in any particular case depends on many institutional factors that vary widely across economies.

Currency Mismatch and Financial Crisis

Why does a collapse of international currency speculator confidence cause a financial crisis? It doesn't have to. It doesn't always do so. A collapse of international currency speculator confidence causes a financial crisis only when an economy's banks and operating companies suffer from a large-scale currency mismatch. We say that an economy suffers from *currency mismatch* when its banks and operating companies have their assets denominated in domestic currency, but their liabilities denominated in foreign currency. Then a

sudden increase in the value of foreign currency can make businesses and banks that were soundly-financed and solvent at the old exchange rate unsoundly-financed and insolvent at the new, and so cause a large-scale financial crisis.

For example, 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:

A Bank Balance Sheet

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

Now suppose that the bank takes advantage of the fact that investors in New York are willing to lend it money. Suppose that it borrows an extra 100 million in dollars, turns around and exchanges those dollars for 500 million pesos, and then loans out those 500 million pesos as well. The bank's balance sheet is then:

A Bank Balance Sheet with Currency Mismatch

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

We say that the bank has acquired a currency mismatch in its portfolio. A change in the exchange rate will not change the (peso-denominated) value of its assets. A change in the exchange rate will, however, change the (peso-denominated) value of its liabilities. A fall in the exchange rate—an increase in the value of the peso relative to the dollar—will reduce the (peso-denominated) liabilities of the bank, and add to its profits and capital. A rise in the exchange rate—a fall in the value of the peso—will increase the (peso-denominated) liabilities of the bank, and cause losses. If the losses are large enough, the bank will become insolvent.

Suppose that at this stage—with the bank having borrowed heavily abroad in dollars—international currency speculators lose confidence in the peso, and the exchange rate rises from 5:1 to 10:1. The consequences for the bank are disastrous. The $100 million it had borrowed that used to be worth 500 million pesos is now worth 1 billion pesos. The bank is insolvent: its capital is not +200 but –300 million pesos.

Consequences of Currency Mismatch

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

In such a situation there *may* be a run on the bank: someone is going to lose 300 million pesos, after all, and the last people to withdraw their money from the bank are likely to lose the most. In such a situation there *will* be an end to the bank's functioning considered as a source of financing for investment. Who will deposit their money in or lend to such a bank? How will it acquire resources to make any more loans? Anyone who had been planning to use this bank to acquire financing for their investment projects is out of luck.

If many banks and companies suffer from such a currency mismatch, a rise in the exchange rate may render them insolvent and cause a financial crisis. Moreover, a twenty percent rise in the exchange rate is more than twice as bad as a cause of crisis than a ten percent rise in the exchange rate. We model this interaction of currency mismatch and exchange-rate change as a potential cause of financial crisis by writing down an equation for the magnitude of the financial crisis indicator variable C:

$$C = \begin{cases} 0, & if \quad \Delta\varepsilon \leq 0 \\ \phi c \times (\Delta\varepsilon)^2, & if \quad \Delta\varepsilon \geq 0 \end{cases}$$

If the exchange rate stays constant (or if it falls—the value of the home currency increasing), then there is no financial crisis: the value of the crisis indicator variable C is zero. If the exchange rate—the value of foreign currency—rises, the crisis indicator variable C takes on a value proportional to (a) the degree of currency mismatch ϕ_c and (b) the square of the change in the exchange rate $\Delta\varepsilon$.

(Note: Do not take this functional form seriously. It is intended only to provide an easy and computationally tractable way of writing down a model in which the magnitude of financial crisis depends on the degree of currency mismatch and the change in the exchange rate, with the proviso that a bigger change in the exchange rate has a more-than-proportional effect as a cause of financial crisis.)

A Collapse in Confidence and Financial Crisis

Now let us analyze the consequences of a collapse in international currency speculator confidence in the currency if there is a considerable currency mismatch in the economy. As before, the collapse in confidence is modelled as a sudden increase $\Delta\varepsilon_0$ in the baseline long-run expectation ε_0 in the exchange rate-determination equation:

$$\varepsilon = \varepsilon_0 - \varepsilon_r(r - r^f)$$

where ε is the value of the exchange rate, ε_0 is international currency speculators' expectation of the exchange rate's long-run fundamental value, r is the domestic real interest rate, r^f is the foreign real interest rate, and ε_r is a parameter depending on the expected persistence of cross-country interest rate differentials that captures how sensitive the exchange rate is to a shift in the interest rate.

Let us allow the central bank to react to the collapse in confidence by raising the domestic real interest rate by an amount Δr, so that the change $\Delta\varepsilon$ in the exchange rate is not just the change $\Delta\varepsilon_0$ in ε_0 but:

$$\Delta\varepsilon = \Delta\varepsilon_0 - \varepsilon_r \times \Delta r$$

Thus the change in exports brought about by the collapse of confidence and the central bank's reaction is:

$$\Delta(GX) = X_\varepsilon \Delta\varepsilon = X_\varepsilon \Delta\varepsilon_0 - X_\varepsilon \varepsilon_r \Delta r$$

Now consider the change in investment spending. Consider, first, the case in which:

$$\Delta r \geq \frac{\Delta\varepsilon_0}{\varepsilon_r}$$

In this case the rise in domestic interest rates more than offsets the effect on the exchange rate of the collapse of confidence. The exchange rate—the value of foreign currency—remains the same (or declines). Thus the value of the financial crisis variable C in the extended investment function:

$$I = I_0 - I_r \times r - I_c \times C$$

is zero, and the change in investment spending is:

$$\Delta I = -I_r \times \Delta r$$

The change in real GDP is equal to the multiplier μ times the sum of the changes in exports and in investment:

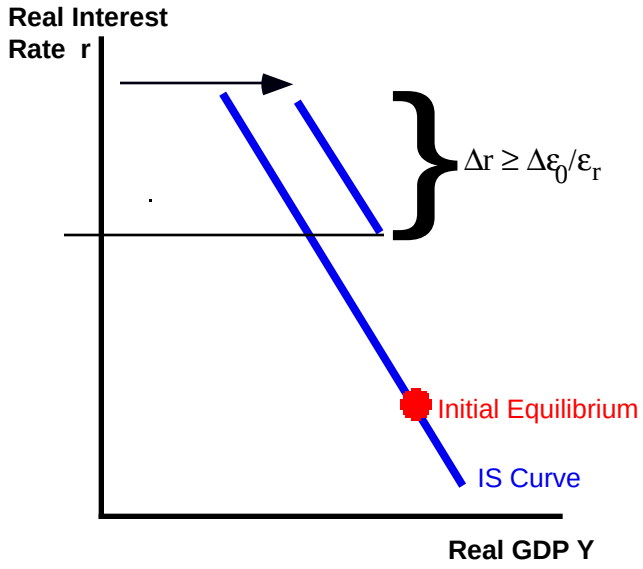
$$\Delta Y = \mu(\Delta I + \Delta GX) = \mu(-I_r \times \Delta r + X_\varepsilon \times \Delta\varepsilon)$$

If we rewrite this in terms of the change in international currency speculators' expectations $\Delta\varepsilon_0$ and the central bank's reaction Δr, we obtain:

$$\Delta Y = \mu X_\varepsilon \Delta\varepsilon_0 - \mu(I_r + X_\varepsilon \varepsilon_r)\Delta r$$

Thus we see that this is the same result as we found in the beginning: the first term tells us that the collapse in confidence is expansionary—shifts the IS curve out and to the right, raising equilibrium real GDP—and the second term captures the economy's move along the new IS curve driven by the central bank's response to the collapse of confidence.

If the Rise in the Interest Rate Is large Enough, a Collapse of Confidence Shifts the IS Curve Rightward



If the Central Bank Is Not So Aggressive…

But what if the central bank does not increase interest rates by so much? What if $\Delta r \leq \Delta\varepsilon_0/\varepsilon_r$? To raise interest rates by enough to keep the exchange rate stable may—and in the figure below does—produce a substantial fall in real GDP relative to the initial pre-confidence collapse equilibrium: high interest rates discourage investment. Suppose the government does not want to discourage investment so much. What happens then?

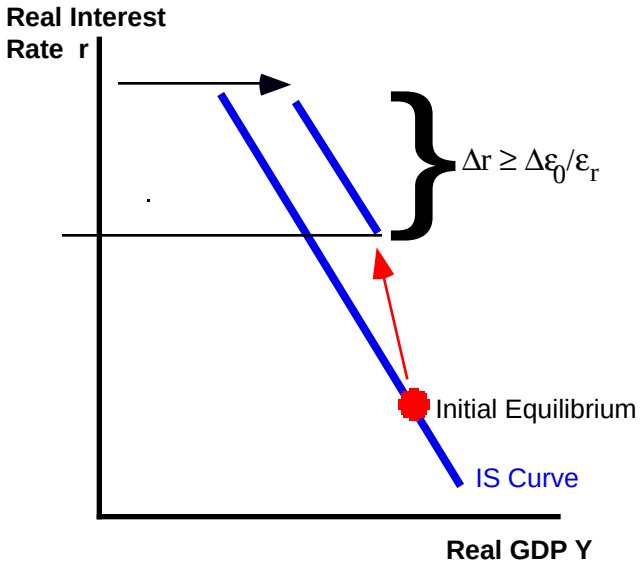
If the central bank does not increase the interest rate by enough to keep the exchange rate stable, then the model becomes more complicated. The change in exports is still the same:

$$\Delta(GX) = X_\varepsilon \Delta\varepsilon = X_\varepsilon \Delta\varepsilon_0 - X_\varepsilon \varepsilon_r \Delta r$$

And the change in real GDP is still the multiplier times the sum of the change in exports and the change in investment:

$$\Delta Y = \mu(\Delta I + \Delta GX)$$

But Raising the Interest Rate to Keep the Exchange Rate Stable May Induce a Recession…



But the change in investment is now:

$$\Delta I = -I_r \Delta r - I_c C = -I_r \Delta r - I_c \phi_c (\Delta\varepsilon)^2$$

If we rewrite the change in the exchange rate as a function of the collapse in confidence and the central bank's reaction:

$$\Delta\varepsilon = \varepsilon_r \times \left(\frac{\Delta\varepsilon_0}{\varepsilon_r} - \Delta r \right)$$

and substitute into our equation for real GDP, we obtain a three-part expression for the change in real GDP triggered by the cuollapse in confidence and the central bank's reaction:

$$\Delta Y = \mu X_\varepsilon \Delta\varepsilon_0 - \mu\left(I_r + X_\varepsilon \varepsilon_r\right)\Delta r - I_c \phi_c \varepsilon_r^2 \left(\frac{\Delta\varepsilon_0}{\varepsilon_r} - \Delta r \right)^2$$

The first term:

$$\mu X_\varepsilon \Delta\varepsilon_0$$

is the familiar expansionary, rightward shift in the IS curve generated by the boom in exports. The second term:

$$-\mu\left(I_r + X_\varepsilon \varepsilon_r\right)\Delta r$$

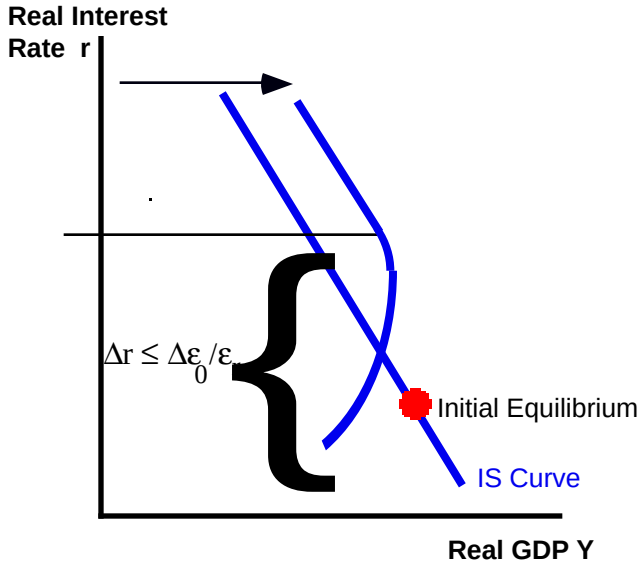
is the familiar move along the IS curve generated by the central bank's reaction to the collapse in confidence. It is the third term:

$$-I_c \phi_c \varepsilon_r^2 \left(\frac{\Delta\varepsilon_0}{\varepsilon_r} - \Delta r \right)^2$$

that captures the effects of financial crisis. It is equal to the product of:

- The square of the amount by which the increase in interest rates falls short of the amount needed to keep the exchange rate stable.
- The square of the sensitivity of the exchange rate to changes in the interest rate.
- The degree of currency mismatch ϕ_c.
- The sensitivity of investment to the degree of the financial crisis I_c.
- A minus sign.

The Shape of the IS Curve with Financial Crisis



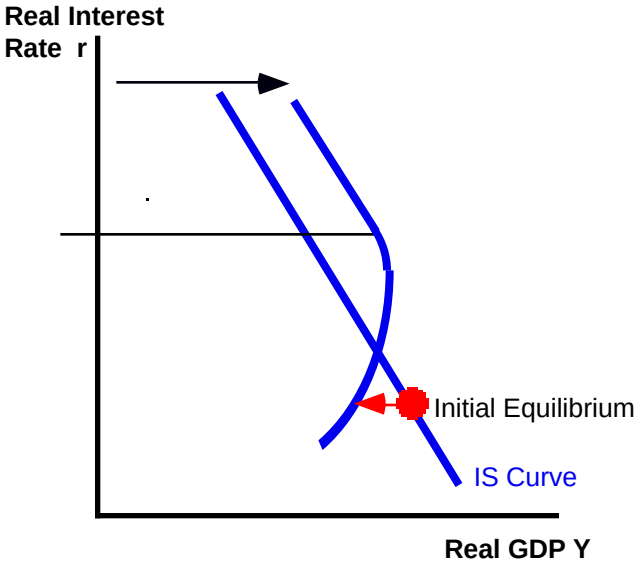
Because of this third term, the post-confidence crisis IS curve does not continue down and to the right as the interest rate falls below the level required to keep the exchange rate stable. Instead, the IS curve turns back and to the right as the interest rate continues to fall: the boost to investment that one would expect from lower interest rates is

outweighed by the damage to investment done by the bankruptcies and feared bankruptcies as lowered interest rates raise the value of foreign currency, and a higher value of foreign currency combined with currency mismatch accentuates the financial crisis.

All Options Are Bad Options

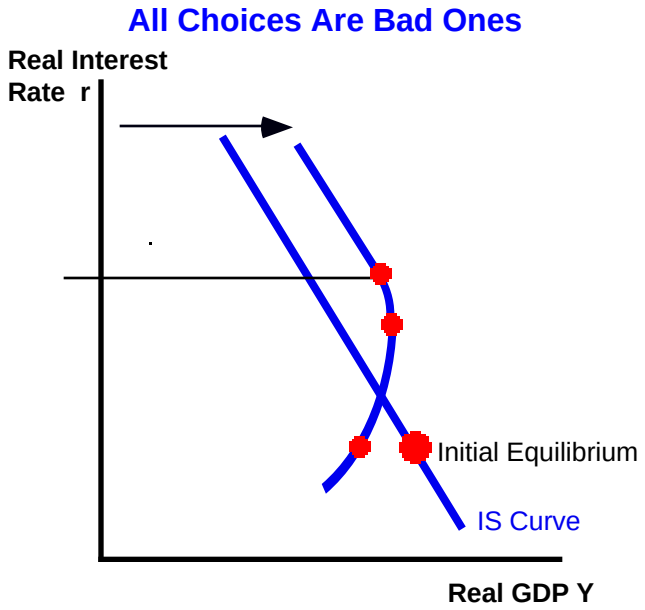
The traditional argument for floating exchange rates—for paying no attention to the exchange rate in setting monetary policy—is that a floating exchange rate allows one to ignore shocks impinging on the economy from outside and to focus on maintaining full employment at home. But in the case of a currency mismatch, this is not true.

The Shape of the IS Curve with Financial Crisis



As the figure below shows, a central bank that does not raise interest rates and lets the exchange rate rise as speculators lose confidence in the currency may well find it in a deeper recession—because of the

financial crisis thereby triggered—than if it had raised interest rates high enough to keep the exchange rate stable.



In fact, for some parameter values—those corresponding to the figures above, for example—there is *no* interest rate policy that the central bank can follow to maintain production and employment at their pre-crisis levels. If the central bank raises interest rates to keep the exchange rate stable, a recession ensues: output and employment fall. If the central bank keeps interest rates stable and lets the collapse in confidence have its full effect on the exchange rate, a recession ensues: output and employment fall. The best the central bank can do is try to find the "sweet spot" where the recession is smallest: where it has not raised interest rates so high as to cripple investment spending via the cost of capital, and has not let the exchange rate shift so much as to

cripple investment spending via the resulting financial crisis, but to strike the best balance between the two.

The Role of the International Monetary Fund

What can be done in such a situation, when currency mismatch combined with an adverse shift in international currency speculator confidence produces a full-scale financial crisis with widespread bankruptcies and threatened bankruptcies, and leaves the central bank with nothing but a choice between which kind of recession to accept?

Minimize the Damage

The first thing to do is to make sure that the financial crisis does as little damage as possible to the level of output and employment: to keep the exchange rate from jumping enough to cause massive bankruptcies, but also to keep from raising the interest rate enough to totally disrupt investment. Raise domestic interest rates to keep the exchange rate from jumping too much, but don't raise domestic interest rates too much either.

It is interesting to note that IMF advice to follow such "middle way" policies came under attack during the financial crises of the 1990s from both the right and the left. From the right, critics like those found on the editorial page of the *Wall Street Journal* denounced the IMF and the U.S. Treasury for advising the affected countries that the values of their domestic currencies should fall—that the home-currency value of foreign currency, the exchange rate, should rise. Right-wing critics demanded that crisis-affected countries raise interest rates high enough to keep their exchange rates stable, no matter how high such interest rates had to be and no matter what the

consequences for output and employment. From the left, other economists denounced the IMF and the U.S. Treasury for advising countries to allow the real interest rate to rise at all. They demanded that crisis-affected countries keep their real interest rates at pre-crisis levels—no matter how large the jump in the exchange rate would be, no matter how large the resulting chain of bankruptcies was, and no matter what the consequences for output and employment.

From the standpoint of our model, at least, it is clear that *both* the right wing and the left wing critics engaged in economic malpractice: neither was willing to take a look at the entire situation, and at the consequences of the policies they recommended.

Avoid the Problem

A better strategy is to avoid the problem entirely: keep situations of currency mismatch from developing through proper prudential regulation of banks and financial markets. In many countries, however, good bank examiners and bank regulators are hard to find. In many other countries, moreover, political interference with bank regulation keeps bank regulators from being able to prevent problems from developing. Congressional interference in the U.S., after all, set the stage for the Savings-and-Loan crisis of the end of the 1980s. To demand that government regulators keep problems from developing is a reasonable demand. But to expect that government regulators—overworked, underpaid, and subject to pressure from their political masters—will always be able to do so is an unreasonable demand.

Declare National Bankruptcy

A third possibility is to deal with an approaching financial crisis by having the government orchestrate a default: the burden of foreign debt cannot be amplified by exchange rate movements if the foreign debt is never paid. But this is a risky policy to follow: it may lead to a cure worse than the disease, because it runs the risk of cutting one's economy off from a large chunk of potential suppliers and markets, and thus losing the—very large—benefits of the international division of labor.

Ask the IMF For Help

The fourth possibility—the one followed by every crisis-afflicted country—is to ask the IMF for a large-scale hard-currency loan to ride out the crisis. Under conditions of limited capital mobility, the change in the exchange rate is not:

$$\Delta\varepsilon = \Delta\varepsilon_0 - \varepsilon_r \times \Delta r$$

but instead:

$$\Delta\varepsilon = \Delta\varepsilon_0 - \varepsilon_r \times \Delta r - \varepsilon_R \times \Delta R$$

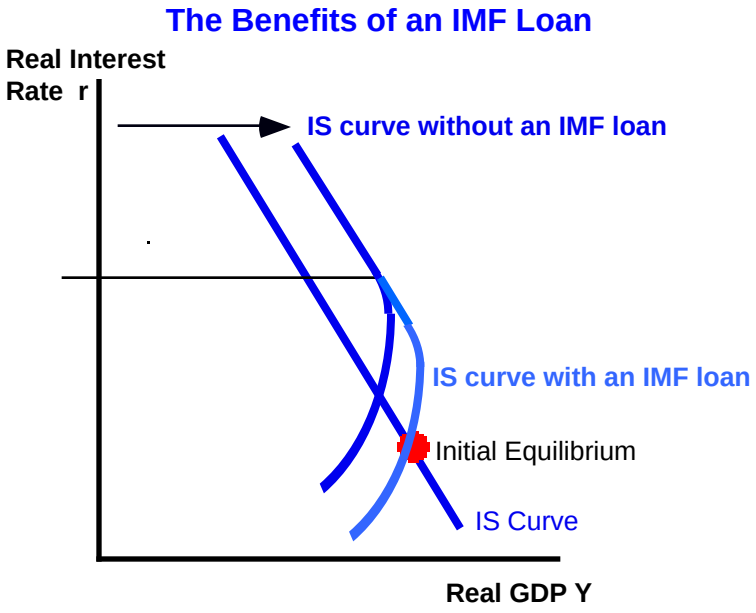
where ΔR is the change in the country's foreign-exchange reserves. An IMF loan gives the country more reserves to spend. And the ability to spend down reserves changes the equation for the shift in real GDP from:

$$\Delta Y = \mu X_\varepsilon \Delta\varepsilon_0 - \mu\left(I_r + X_\varepsilon \varepsilon_r\right)\Delta r - I_c \phi_c \varepsilon_r^2 \left(\frac{\Delta\varepsilon_0}{\varepsilon_r} - \Delta r\right)^2$$

to:

$$\Delta Y = \mu X_{\varepsilon}\Delta\varepsilon_0 - \mu\left(I_r + X_{\varepsilon}\varepsilon_r\right)\Delta r - I_c\phi_c\varepsilon_r^2\left(\frac{\Delta\varepsilon_0}{\varepsilon_r} - \frac{\Delta R}{\varepsilon_r} - \Delta r\right)^2$$

It thus diminishes the size of the third, financial crisis term: for those levels of the interest rate for which financial crisis disrupts investment, it disrupts investment less. In the graphical language of the IS diagram, the smaller financial crisis term means that the lower limb of the IS curve is extended further to the right, and slopes back to the left less rapidly.



Thus an IMF loan gives the country better short-run options. It allows the country to suffer a smaller recession during the crisis. But it also obliges the country to undertake whatever policy changes the IMF requires as conditions for its crisis-time assistance. Indeed, with sufficient financing and clever policy choices, the confidence shock might be absorbed without any reduction in output or employment at all.

Conclusion

Let's recapitulate the argument of this long and somewhat involved section:

In a typical international financial crisis, a sudden loss of confidence in the value of a country's currency by international currency speculators is followed by a rapid rise in the value of foreign currency—in the exchange rate—the threat of large-scale bankruptcies of banks and firms, financial panic, and a sharp severe recession. A collapse of international currency speculator confidence causes a financial crisis only when an economy's banks and operating companies suffer from a large-scale currency mismatch, so that a shift in the exchange rate raises liabilities while leaving assets unchanged, and threatens to throw them into bankruptcy.

Such a wave of bankruptcies or threatened bankruptcies will greatly reduce investment spending. Thus a country facing a loss of confidence in its currency and suffering from currency mismatch has a choice among poisons only: Does its central bank raise interest rates to keep the exchange rate stable and the burden of foreign debt manageable, thus causing recession by making the cost of capital too

high? Or does the central bank keep interest rates low and allow the exchange rate to jump, making the burden of foreign debt unmanageable, causing widespread bankruptcies and fear of bankruptcies, and causing recession as the wave of financial crisis disrupts investment? Neither option is attractive.

In such a situation there are four and only four things that a country and its central bank might do. First, minimize the damage—chose the interest rate and exchange rate policy that is the best of the available bad options. Second, avoid dangerous situations in the first place—have a banking and financial sector regulatory system aggressive and competent enough to keep situations of large-scale currency mismatch from arising. Third, if necessary, remember that default is always an option: the burden of foreign debt cannot disrupt domestic banks' and companies' operations if they are forbidden by law to pay off their foreign debt. Fourth, ask for a loan from the IMF in order to get a better set of short-run policy options: IMF money can allow a country to keep its interest rate lower without suffering such a large jump in the exchange rate, and can keep the exchange rate from moving so far as to cause mass bankruptcy without requiring such a large increase in the interest rate.