Monetary Policy with Foreign Currency Debt[1]

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Abstract

A major feature characterizing recent currency crises in emerging markets has been the large proportion of private foreign currency debt. This feature has made the conduct of monetary policy particularly difficult. This paper proposes a simple model to better understand these issues where firms are credit constrained and the currency denomination of debt matters. I argue that the recent financial crises are well explained by such a model. In this framework, monetary policy can be ineffective since the interest rate and the exchange rate channels of transmission of monetary policy go in opposite directions. This potential ineffectiveness should be taken into account in the choice of a monetary or exchange rate regime.

1 Introduction

The financial crises of the 1990s shared various features with crises from previous decades. However, the more recent crises also differed on a set of dimensions, in particular the role of financial imbalances and the extreme speed at which they occurred. Recent crises affected some economies so fast, either individually or in a wave of contagion, that some observers initially argued that these crises were not justified by fundamentals and only came from investors' change of moods. We know now, with some more perspective, that crises occurred in countries with serious imbalances. The major countries hit by a crisis, Mexico, Thailand, Indonesia, Korea, Malaysia, the Philippines, Russia, and Brazil, all had some type of imbalance, even though they differed from country to country. While Russia and Brazil had large fiscal deficits similar to numerous crises in the previous decades, the other countries had a rather sound fiscal position. In the other cases, imbalances were related to the financial sector in unprecedented ways. First, in the years prior to the crises these economies experienced spectacular increases in lending to the private sector, mainly firms but in some cases also consumers. Second, these economies were facing a high degree of capital mobility before the crises, typically following a series of liberalization measures. This implied a dependence on foreign investors either through direct borrowing by firms or through domestic financial intermediaries that borrowed from foreign investors and lent to domestic firms.

In this context of large financial imbalances, there is a series of issues that remain unresolved or not well understood, despite the increasing number of studies that analyze the recent crises. Monetary policy is obviously at the center stage of economic policy when we deal with a currency crisis. In fact, a hot debate on the optimal monetary policy response took place in the aftermath of the Asian crisis. The main aspect of the debate is whether countries should increase their interest rates in times of crises. The disagreement is so broad that even international institutions such as the IMF and the World Bank could not agree on the optimal policy. At the heart of the debate was the role of foreign currency debt, introducing a negative effect from currency depreciations. One difficulty in this debate is that economists do not have consistent analytical tools to organize ideas, which often makes the discussion confusing. Standard macroeconomic models, from the IS-LM model to the more recent dynamic optimizing models, are not suited to analyze these issues, mainly because they do not take into account the financial imbalances

that characterized the crises. New paradigms, or at least extensions of the existing models, incorporating the role of financial factors such as foreign currency debt, are needed to have a better understanding.

The objective of this paper is to present a model giving a central role to financial factors in the determination of output and the occurrence of currency crises and consider its implications for monetary policy. More precisely I will present an approach to currency crises that is based on the financial health of private firms measured by the evolution of corporate balance sheets. It is an approach that differs from previous theories of currency crises by focusing on the private sector instead of the behavior of the authorities or the central bank. At the center of the analysis is the role of private debt; in this context, foreign currency debt is particularly important. Firms are assumed to be credit constrained following Bernanke-Gertler (1989). The level of firms' cash flow or past profits determines the amount that can be borrowed. This approach gives a crucial role to the evolution of debt and its cost at the macroeconomic level, in particular in the transmission mechanism of monetary policy. It allows to fully take into account financial factors, in particular financial imbalances. Moreover, the currency composition of debt can be fully incorporated.[1]

Credit constraints are likely to be more prevalent in emerging markets: since the financial sector is less developed, firms need to rely more on their own cash-flow. The focus on the balance-sheet approach allows to introduce elements that were neglected in previous analyses but that are likely to play a crucial role in the context of crises. However, this approach does not rule out explanations that have been proposed in the previous literature and is sometimes complementary to them.[2]

The corporate balance sheet approach to crises has been developed formally in Aghion, Bacchetta, and Banerjee (1999, 2000a, 2000b) and has also been stressed in Krugman (1999a, 1999b). Two major conclusions emerge from this approach and the explicit introduction of foreign currency debt. First, an economy with a large proportion of foreign currency debt is more likely to face currency crises associated with recessions. Second, in such an economy monetary policy may be ineffective *independently* of the exchange

[1] Some authors, including Obstfeld (1994) have considered the currency composition of *public* debt in the context of currency crises, but private debt has received little attention.

[2] Similarly, Krugman (1999b, p.1) writes "I doubt that anybody believes that this is the whole story; but it is the most persuasive model of the crisis that we have. And we should therefore take that model seriously, and ask what it implies for the future".

rate regime. In standard models (e.g., Mundell-Fleming), monetary policy is ineffective under a fixed exchange rate, but is fully effective under a flexible exchange rate;[3] but with foreign currency debt, monetary policy may be ineffective also under a floating exchange rate.

These conclusions are clearly frustrating for a central bank and show that the analysis of monetary policy in emerging markets may differ substantially from the one in developed countries.[4] This monetary policy dilemma should therefore be more fully taken into account in the design of macroeconomic policy. It should also be considered when choosing the optimal exchange rate regime. However, as emphasized by Eichengreen and Hausmann (1999), this choice turns out to be extremely difficult in this context.

The rest of the paper is organized as follows. In Section 2, I review the debate on monetary policy and currency crises and document some important features of economies that experienced a crisis, in particular foreign currency debt. In Section 3, I describe the model that can be summarized by two curves representing equilibrium in the monetary and in the goods sectors; the model is more formally presented in the Appendix. In Section 4 I show that a large proportion of foreign currency debt can easily lead to currency crises; there may also be multiple equilibria. I also reinterpret some of the recent crises in light of the model. Section 5 examines monetary policy under different levels of foreign currency debt. In the framework of the model, I consider the debate of whether to increase or decrease interest rates and derive precise conditions under which the interest rate should be increased. Section 6 offers concluding comments.

2 Monetary Policy and the Role of Foreign Currency Debt

It is common practice for central banks to conduct counter-cyclical monetary policy. This practice is backed by fully articulated models, typically of the keynesian type. Even though the rational expectations revolution and the focus on real business cycles has shed some doubts on this view, recent

[3] In practice, the effectiveness of monetary policy under a flexible exchange rate is often smaller than what theory predicts but can still be substantial.

[4] By emerging market economies I mean countries where the financial system is somewhat developed and with a relative degree of capital mobility. This does not include less developed countries where the issues are different.

developments of so-called neo-keynesian models have brought back a theoretical consensus in favor of active monetary policy. Moreover, the exchange rate plays a central role in the transmission process, especially in more open economies. For example, a monetary expansion can lead to a currency depreciation that reinforces the effect of a lower interest rate.

In emerging market economies, however, the common practice is often completely different. In the aftermath of the Asian currency crises several countries increased interest rates at the onset of a deep recession instead of following an expansionary monetary policy. Similarly, in 1998 Brazil and several other countries sharply increased interest rates, thereby causing a significant decline in economic activity.[5] Figure 1 shows the evolution of the dollar exchange rate as well the short term interest rate for various currency crisis episodes. In the five Asian crisis countries, interest rates were sharply increased at the end of 1997 and early 1998. This increase typically coincides with a depreciating currency. As is well known, the magnitudes are particularly large in Indonesia. The decline in interest rates that occurred later in 1998 came much faster in Korea than in Indonesia. In 1999, interest rates were sharply lower and the exchange rate has stabilized in all cases. This stands in sharp contrast to Australia which slightly decreased interest rates in 1997, even though it was also affected by the Asian crisis. A similar pattern can be observed in Mexico after the 1994 crisis and in Russia and Brazil in late 1998 and early 1999. It is interesting to notice, however, that in none of the cases was observed a substantial currency appreciation after the sharp interest rate increase.

[Figure 1 about here]

Why this difference in monetary policy? It appears that most emerging market economies are particularly sensitive to their exchange rate and are reluctant to see currency depreciations. Would they not benefit from more competitive currencies? One problem is clearly the threat of imported inflation when the depreciation is very large. However, this problem is also present in developed countries that at times also experience large depreciations. Moreover, in many cases the inflation that has followed the depreciations has not been substantial. The reason for a higher sensitivity to an

[5] For example in the Financial Times of Feb. 22, 1999, one can read: "Brazil fromally moved into a recession at the end of last year as the high interest rate policy aimed at preventing a currency crisis caused the economy to show its worst annual record of economic growth since 1992".

exchange rate depreciation appears to be the presence of foreign currency debt: domestic profits will be sharply squeezed by a depreciation when firms borrow in foreign currency. This effect may offset the increased competitiveness of a depreciation.

The fact that domestic firms or banks borrow in foreign currency is the main rationale for an interest rate increase when there is a risk of currency depreciation. For example, Stanley Fischer says "Those who criticized temporary high interest rates fail to see that further depreciation caused by lower rates would have raised the burden of dollar-denominated debts". Similarly US Treasury Secretary Robert Rubin said: "If you had looser monetary policy, you'd run the risk of substantial depreciation of the currency. ... That greatly increases the problem of repaying debt denominated in dollars" (The Wall Street Journal, June 30, 1998). However, several critics such as Radelet and Sachs (1998) or Furman and Stiglitz (1998) find that foreign currency debt is not a sufficient reason to increase interest rates, because high interest rates do not appear to prevent currency depreciations and may have disastrous output effects. Thus, it seems that the presence of foreign currency debt may fundamentally alter the transmission channels of monetary policy, but that there is no consensus regarding the best monetary policy response.

The role of foreign currency debt is not a phenomenon specific to the most recent crises. In his analysis of devaluations in developing countries, Cooper (1993) already mentions the issue in the specific case of the Argentinian devaluation of 1962. What characterizes the recent crises, however, is the increased magnitude of foreign currency debt. At this stage we do not have precise data on the proportion of foreign currency debt owed by private firms. As a proxy, one can look at the borrowing from foreign investors, which is typically denominated in foreign currency (mainly US dollars and yen). A reliable, but partial, source of data are the credit reported by the commercial banks belonging to BIS member countries. These data are now part of the new 'joint BIS-IMF-OECD-World Bank statistics on external debt'. Figure 2 present the total liabilities to foreign BIS banks, divided by GDP, in 1997, basically at the time of the Asian crisis for a set of 25 emerging market economies. It is interesting to see that the highest proportion, larger than 50% of GDP, was Thailand which was the first country hit by a crisis. Malaysia, Indonesia, Korea and the Philippines are below 30 %, but have the highest proportions among emerging markets except for Chile and Hungary. This proportion had actually increased in most of the countries prior to the crisis. For example, these liabilities represented less than 20% of GDP in

1990 in Thailand.

[Figure 2 about here]

It may be, however, that the loans made to a country do not stay in that country or are offset by loans made out of the country, for example due to currency hedging. Thus, it is useful to compare liabilities to foreign banks to claims on them. This is given in Figure 3, which shows the ratio of liabilities to claims in 1997, using again the joint BIS-IMF-OECD-World Bank statistics on external debt. Countries that have a ratio above one have a net foreign currency debt. The ranking of Figure 3 is striking. All the countries that had a ratio of liabilities to claims above 1.5 in 1997 have experienced a currency crisis in recent years, except for South Africa. Similarly, none of the countries with a ratio below 1.5 has experienced a serious crisis. Notice that a in country like Taiwan, which is an Asian country that could avoid the crisis, there was no foreign currency debt problem.

[Figure 3 about here]

Important efforts are now under way, in particular at the World Bank, to compute more precise estimates of foreign currency exposure. However, Figures 2 and 3 already show that net liabilities to foreign banks, as a measure of foreign currency debt, have been an important indicator for the recent crises. The view taken in Aghion, Bacchetta, and Banerjee (2000a, b), Krugman (1999a, b), or Mishkin (1996, 1999) is that the presence of foreign currency debt is a major factor leading to the recent crises. Moreover, foreign currency debt conditions monetary policy in important ways. The rest of this paper basically presents a simple model that organizes thoughts on foreign currency debt and monetary policy.

3 A Simple Framework

In this section I describe a simple graphical analysis that can be used to analyze currency crises and monetary policy. A more complete description of the model is given in the Appendix. A related model can be found in Aghion, Bacchetta, and Banerjee (2000a) and a more general analysis is given in Aghion, Bacchetta, and Banerjee (2000b). The model incorporates

some standard features that are found in recent neo-keynesian open economy models. These features include price rigidities that imply real effects of monetary policy; in particular, monetary policy influences the real exchange rate as nominal exchange rate fluctuations are not immediately matched by price changes. In addition to these standard features, a role for corporate debt is explicitly introduced by assuming that firms are credit constrained due to moral hazard in their behavior and that the amount of external funds they can raise depends on their internal funds. Thus, it follows the approach of Bernanke and Gertler (1989) who introduce these credit constraints in a real, closed economy, model.[6] In an open-economy, monetary model with deviations from Purchasing Power Parity (PPP), the currency denomination of debt matters. Hence, it is possible to analyze explicitly the role of foreign currency debt. While an increasing number of authors focus on the role of foreign currency debt in emerging markets, including Mishkin (1996, 1999), Goldfajn and Baig (1998), Goldfajn and Gupta (1999), Krugman (1999a), Burnside, Eichenbaum and Rebelo (1999), and Eichengreen and Hausmann (1999), they do not use a consistent model to examine the impact of monetary policy.

The model can be summarized by two curves: the IPLM curve describing the monetary sector and the W curve the real sector. Thus, the model is similar in spirit to the IS-LM framework, but the role of expectations plays a crucial role. More precisely, assume there are two periods and that unanticipated shocks can occur in the first period. Prices are preset for one period, which has two implications. First, monetary shocks can have real effects; second *nominal* exchange rate changes are matched by *real* exchange rate changes or deviations from Purchasing Power Parity. In the second period, prices adjust and these effects disappear. However, second period variables are affected by what happens in the first period. Moreover, the expectation of second period variables affects the first period. This potentially complex simultaneity is fully captured in the graphical analysis.

3.1 The Monetary Sector

The monetary sector is highly standard and is described by a money market equilibrium and an interest parity condition. Consumers have a real money

[6] Bernanke, Gertler, and Gilchrist (1999) give a survey of the literature and present a quantititative monetary model with sticky prices and credit constraints.

demand $L(Y_t, i_t)$, which is increasing in Y_t and decreasing in i_t. In particular, money market equilibrium at $t = 2$ can be expressed by the (LM) equation:

$$M_2^S = P_2 \cdot L(Y_2, i_2) \tag{1}$$

where M_2^S is nominal money supply at date 2. In addition, arbitrage in period 1 by foreign investors between domestic and foreign currency bonds yields the following interest parity (IP) condition:

$$1 + i_1 = (1 + i^*)\frac{E_2}{E_1} + \eta \tag{2}$$

where i^* is the foreign currency interest rate and η is a foreign exchange risk premium. Combining equations (IP) and (LM) and the PPP assumption $P_2 = E_2$, we get:

$$E_1 = \frac{1 + i^*}{1 + i_1} \cdot \frac{M_2^S}{L(Y_2, i_2)} + \eta \tag{3}$$

which provides a negative relationship between E_1 and Y_2. This relationship can be represented graphically in the (E_1, Y_2) space and is shown in Figure 4; we call it the IPLM curve (interest parity-LM).[7] The precise shape of the curve depends on the specific money demand function. The negative slope of the IPLM curve reflects the fact that an increase in expected Y_2 increases the demand for money in period 2, which in turn produces an exchange rate appreciation at that period, i.e., a reduction in $E_2 = P_2$. The anticipation of an exchange rate appreciation tomorrow in turn increases the attractiveness of domestic currency today, thereby producing an exchange rate appreciation today, i.e. E_1 also goes down.

[Figure 4 about here]

An increase in the exchange risk premium obviously leads to a currency depreciation and shifts the IPLM curve upwards. The curve is also shifted by changes in monetary policy at each period. For example, an increase in M_1^S implies a decline in i_1 (from money market equilibrium), which clearly shifts the IPLM curve upwards. The IPLM curve also shifts upwards with an increase in M_2^S. These effects are standard: for a given output level, the domestic currency depreciates after a monetary expansion in the first period

[7] Notice that our curve differs from the AA curve in Krugman and Obstfeld (1997) which relates E_1 with Y_1 by keeping period 2 variables constant.

due to an excess of liquidity and it depreciates after a monetary expansion in the second period due to an expected increase in inflation. This, however, takes output Y_2 as given. But monetary policy itself can affect output in a way I now describe.

3.2 The Real Sector

The real sector, summarized in a 'W' curve, is the distinctive feature of the model and the main contribution of Aghion, Bacchetta, and Banerjee (1999, 2000a, 2000b); it is based on the seminal paper by Bernanke and Gertler (1989).[8] As mentioned above, corporate balance sheets are crucial for output determination. The basic idea is that firms depend on their own available funds to finance new projects and production. These funds can obviously be used directly, but they also determine the extent to which firms can borrow from lenders. The reason is that firms are credit constrained due to moral hazard considerations. A higher level of own funds reduces the moral hazard problem, so that a firm can borrow more. Internal funds can be so large that the credit constraint is not binding. I will, however, focus on the case where it is always binding. A firm's internal funds are basically determined by retained earnings, which are proportional to past profits.

Moreover, the level of the nominal interest rate is likely to influence the amount of credit a firm can obtain. A high interest rate level increases the incentive for a firm not to repay its loan, i.e., increases the moral hazard problem and thus reduces available credit. The total funds available to firms will influence the amount of working capital and are therefore a crucial determinant for output. Moreover, in an international context, changes in the real exchange rate or in competitiveness affect output. Thus, output in the two periods, Y_1 and Y_2, can described as:

$$Y_1 = Y(\Pi_0/P_0, i_0, E_1/P_1) \quad (4)$$

$$Y_2 = Y(\Pi_1/P_1, i_1) \quad (5)$$

where Π_0/P_0 and Π_1/P_1 represent real profits in periods zero and one. First period output depends on period zero profits and interest rates; both variables are predetermined. Moreover, it depends positively on the real exchange rate given by E_1/P_1 (assuming that foreign prices are constant and equal to

[8] Aghion, Banerjee, and Picketty (1999) and Bacchetta and Caminal (2000), for example, analyze real closed economy models of this type.

one), which is different from one when there are unanticipated shocks. Second period output is not affected by competitiveness since prices adjust so that PPP holds.

What is of interest is second period output, since it affects the exchange rate in the first period (equation (3) or the IPLM curve). Y_2 depends on monetary policy in period one, measured by i_1, and on first period profits. Abstracting from labor compensation, real profits are given by output minus the real cost of debt:

$$\Pi_1/P_1 = Y_1 - Cost\ of\ debt$$

The cost of debt depends obviously on the interest rate, but in an international context it also depends on the currency composition of debt. Assume that x_1 represents the proportion of foreign currency debt. Then, the real cost of debt is:

$$Cost\ of\ debt = [(1-x_1)(1+r_0) + x_1(1+i^*)\frac{E_1}{P_1}] \cdot Debt$$

where r_0 is the real interest rate at time zero. The first element in brackets represents the cost of domestic currency debt, while the second element is the cost of foreign currency debt. It crucially depends on the real exchange rate, i.e., the ratio E_1/P_1. When there are no unanticipated shock, this ratio is equal to one and the cost is the same whether debt is in foreign or domestic currency. However, with unanticipated shocks deviations from PPP occur, which affects the cost of foreign currency debt. With currency depreciations, the cost of foreign currency debt is increased.

In this model, an exchange rate depreciation affects second-period output through two channels. First, the competitiveness effect increases first-period output Y_1, which has a positive impact on profits Π_1 and thus on Y_2. Second, a depreciation implies an increase in the cost of debt due to the presence of foreign currency debt; this channel affects negatively Π_1 and thus Y_2. Consequently, the impact of a currency depreciation on output is ambiguous. A currency depreciation will affect output negatively when foreign currency debt is large and when the competitiveness effect is not too strong (for example because the economy is not too open).

We can represent the link between output and the exchange rate graphically in the (E_1, Y_2) space with a curve called the W curve. If firms are unconstrained the W curve is always vertical, since changes in Y_1 do not

have any persistent effect on future output. The same occurs if shocks are anticipated. When firms are constrained and shocks are unanticipated, the precise shape of the curve depends on the competitiveness effect. As an example, I assume that competitiveness is as shown in Figure 5. Since I only focus on depreciations I consider an asymmetric function. When the depreciation is small there is no competitiveness effect, due for example to transactions costs. When the depreciation is large enough, there is a linear relationship between output and the nominal exchange rate.

[Figure 5 about here]

Given the competitiveness of Figure 5, Figure 6a presents total output when x_1 is small.[9] In that case, a large currency depreciation implies an increase in output. Figure 6b shows the case where firms hold a large proportion of foreign currency debt. In that case, a currency depreciation implies an output decline. Notice that the W curve has properties that are similar to an expectation-augmented Phillips curve, in the sense that it is vertical in the long run or when there are no unexpected shock.

[Figure 6 about here]

The W curve is shifted by changes in the first period interest rate. A decrease in i_1 shifts the curve towards the right as it increases lending for a given exchange rate. An increase in firms' profits also shifts the curve towards the right. Profits may increase due to a number of reasons, including an increase in productivity, a decrease in the foreign currency interest rate or in the country risk premium, or a terms-of-trade shock.

4 Currency Crises

The above framework can generate currency crises when the proportion of foreign currency debt is large. The equilibrium is simply defined by the intersection of the IPLM and the W curves. Before analyzing the details, we can already notice that the mechanism generating a crisis differs from most previous models of crises as it relies exclusively on private sector's behavior.[10]

[9] Krugman (1999b) provides another illustration of such a curve.

[10] Survey of currency crises models include Garber and Svensson (1995), Obstfeld and Rogoff (1996), Flood and Marion (1998).

In currency crises models of the so-called first generation, based on Krugman (1979) a crisis occurs when the central bank reserves are low. In models of the 'second generation' type, a crisis can happen when a government or a central bank is reluctant to defend a currency peg beyond a certain level; that level depends in particular on the interest rate level which in turn depends on the expectations of abandoning the peg. In the current set up, the authorities' behavior is not crucial. What matters is how firms are affected by the exchange rate and the interest rate and how investors react to it. This implies that the precise exchange rate policy is not so important and that we could also have crises in a flexible regime. Empirically currency crises have been observed as often with a floating exchange rate system as with fixed rates. Consequently, the analysis in most of the paper focuses on a flexible exchange rate. Moreover, we consider the authorities' behavior as exogenous.

A currency crisis occurs only under some circumstances. First, it does not happen when firms are unconstrained. In that case the W is vertical and its intersection with IPLM determines E_1. In this context, consider for example an increase in the foreign exchange risk premium η, which shifts the IPLM up. The only effect is to imply a currency depreciation with an increase in E_2: although the currency depreciation increases Y_1 , there is no persistence when firms are unconstrained. With a permanent negative productivity shock, the W curve shifts leftward, Y_2 would decline and E_1 would slightly increase. Crises will also not occur when the proportion of foreign currency debt is small as in Figure 6a. A large increase in the foreign exchange risk premium η is good for the country since it leads to a currency depreciation and an increase in output in periods 1 and 2. On the other hand a decline in firms' profits will decrease output, but have a small effect on the exchange rate.

[Figure 7 about here]

With significant foreign currency debt, things are more complicated as there are three possible outcomes. Figure 7a shows the 'normal' case, with 'satisfying' levels of output and exchange rate. This case occurs in particular when the proportion of foreign currency is small. Figure 7b shows the 'currency crisis' case, where the exchange rate is sharply depreciated and output is very low. Finally, Figure 7c shows an intermediate case with multiple equilibria, where only the two extreme equilibria are stable; these two equilibria are the 'normal' equilibrium and the 'currency crisis' equilibrium.

The reason for multiple equilibria is simple: if a large depreciation is expected, consumers will reduce their money demand because expected output is lower. This leads to a currency depreciation, confirming the consumers' expectations. On the other hand, if no large depreciation is expected, it will not occur in equilibrium. The scope for multiple equilibria in open economies with credit-constrained firms, has already been pointed out by Stiglitz (1998) and Krugman (1999a). However, as shown in this section, this multiplicity is *not* what matters fundamentally when evaluating the costs and benefits of a tight monetary policy in the aftermath of a financial crisis.

When do we get multiple equilibria? This happen when the IPLM curve cuts the W curve from above. The Appendix gives the precise condition for this to happen. It shows that multiple equilibria are more likely for a high proportion of foreign currency debt, a high level of total debt, a high income elasticity of money demand, and a low marginal competitiveness effect.

Now consider an increase in the exchange risk premium. Figure 8 shows the case where we switch from the 'normal' equilibrium $(\tilde{Y}, \tilde{E})$ to the 'currency crisis' equilibrium (Y^{**}, E^{**}), even if the shock to η is not substantial. A negative shock to firms' profits would have a similar effect by pushing the W curve downwards. Notice that a currency crisis may occur as a switch between equilibria as in the 'second generation' class of currency crises models, but this is not necessarily the case. What matters is that some fundamentals deteriorate. In the current model the fundamentals' deterioration is exogenous, but it could come endogenously as in Aghion, Bacchetta, and Banerjee (1999).

[Figure 8 about here]

The recent currency crises can easily be interpreted in the light of the above model. First, as shown in Section 2, all crises countries had a large amount of foreign currency debt, so that they have a large x_1 in the model above. This implies that these economies can be represented by a situation like in Figure 7b rather than 7a. This situation by itself may lead to a currency crisis if we believe we are in a multiple equilibrium case. In other words, the increase in foreign currency debt that happened before the crisis may have set the stage for a multiple equilibrium situation, so that the economy could for no fundamental reason jump to a currency crisis situation. However, there were some changes in fundamentals so that one does not have to believe in multiple equilibria to understand crises. Even though there is no

consensus regarding the precise factors that sparked the crises, in each case several shocks have been identified. The potential factors behind the various crises are being discussed at length in an increasing number of articles and books, so that there is no need for a review here.[11] For example, several authors note the decline in exports from Asian countries before the crises. This decline has been attributed to a set of factors including increasing competition from China, a stagnant Japanese economy, the appreciation of the dollar with respect to the yen, various sector-specific shocks (e.g., semiconductors), real exchange rate appreciation following large capital inflows, etc. These factors, combined with a wave of lending to rather unproductive projects, implied a decline in profits. The decline firm's financial health before the crisis, is shown for example by the increase in non-performing loans in Mexico and in Asian crisis countries (see Mishkin, 1996 and 1999). Thus in the Asian and Mexican cases, the crisis can be explained by a downward shift of the W curve. Such a shift has also happened in Brazil due to an increase in the country risk premium, i.e. an increase to interest rate in any currency paid by domestic firms. Moreover, the IPLM curve has also probably shifted up in the Brazilian case, due to an increase in the foreign exchange premium.

5 The Optimal Monetary Policy Response

Assume there is a bad shock hitting the economy. How should monetary policy react to it? First, I briefly review the 'normal' case and then look at a currency crisis situation.

5.1 Monetary Policy in Normal Times

When firms are unconstrained or the proportion of foreign currency debt is low, the monetary policy recommendation is similar to what we find in standard keynesian models. First, as mentioned above, an increase in the exchange risk premium can be considered as a positive shock. Second, a negative shock on firms' profits (e.g., a negative productivity shock) does not have dramatic consequences when the shock is small. Anyway, suppose that the central bank wants to increase output. The obvious reaction is to decrease the interest rate i_1. This shifts both the IPLM and the W curve

[11] For the Asian crisis, see for example Hunter et al. (1999) and Agénor et al. (1999) for wide collections of view and articles.

towards the right as shown in Figure 9. Output increases since a low interest rate leads to more lending. If the interest decline is large enough, the currency depreciation also leads to a competitiveness effect. Thus, in this case the interest rate and the exchange rate effects go in the same direction and the monetary policy response is unambiguous.

[Figure 9 about here]

5.2 Monetary Policy and Currency Crises

Assume that a bad shock, an increase in η or a decline in profits, leads to a currency crisis as in Figure 8a. What is the best monetary policy response to such a shock, if the objective is to limit the output decline and more importantly, to avoid a currency crisis? This question can be examined graphically in Figure 9b. The solid lines show the economy after the shock without policy response, while the equilibrium before the shock was at point A, implying $(\tilde{Y}, \tilde{E})$. The negative shock leads to a currency depreciation and an output decline to (Y^{**}, E^{**}) at point B.

Deciding monetary policy turns out to be much more complex in this case. Assume for a while that the W curve does not move. Then it is not a good idea to lower the interest rate as an upward shift of the IPLM curve worsens the situation. Thus, it is best to increase i_1, as advocated for example by the IMF. If the increase is large enough this can eliminate the currency crisis and restore a satisfying output level. This could be point C' in Figure 9b.

However, the W curve is not fixed when i_1 changes. With an increase in i_1 the curve also shifts down as Y_2 is lower due to a decline in lending. This downward shift obviously reduces the positive impact of an interest rate increase on Y_2. Figure 9b shows the case where the shift of the W curve fully cancels the impact of the IPLM curve, at point C. Moreover, the W curve may shift more than the IPLM curve, in which case an increase in the nominal interest rate i_1 will have an overall negative impact on equilibrium output Y_2. In this case it would be best to *decrease* the interest rate through increasing money supply M_1^s.

Thus, in the presence of a large proportion of foreign currency debt, monetary policy is much less effective since the interest rate effect and the exchange rate effect go in opposite direction. Moreover, the optimal policy response is ambiguous. Whether the nominal interest rate should increase or decrease will depend on the relative shifts of the IPLM and W curves. The

Appendix shows the precise conditions under which an interest rate increase is optimal. In particular, it is the case when the proportion of foreign currency debt is large enough and when the sensitivity of credit supply to interest rates is small.[12]

All the above results depend obviously on the credibility of the policies examined. For example, consider a restrictive policy in period one, with i_1 increasing. If policy is believed to be relaxed in the future with an increase in M_2^S, there would be little impact on E_1 even for a given Y_2. Moreover, the analysis of first-period monetary policy changes, as considered in this paper, is a useful starting point, but in general we should consider the entire dynamic path of monetary policy. Moreover, it is not only the actual path that matters but the expected one. In this perspective, it is useful to analyze monetary policy rules that provide a path for future monetary variables such as monetary targeting, inflation targeting, or a fixed exchange rate. This is done to some extent in Aghion, Bacchetta, and Banerjee (2000b) who show that monetary targeting is better than inflation targeting when inflation expectations are stabilizing. However, further work is needed, requiring a multi-period extension of the model, before clear policy conclusions can be drawn regarding the preferred policy rule.

6 Concluding Remarks

The optimal monetary policy response to a currency crisis obviously depends on the causes and mechanisms of the crisis. To the extent that there exist different explanations of recent crises there might be different recommendations for monetary policy. The research in this area is still in its early stages; important new developments which may arise should be evaluated with the fresh empirical evidence given by these crises.

The paper has drawn attention to the role of foreign currency debt in monetary policy, especially in the context of currency crises. Notice, however, that the basic monetary policy analysis is also valid in the absence of a crisis. The model described the main mechanism at work, but obviously neglected important realistic features. One feature omitted is the specific exchange

[12] Aghion, Bacchetta, and Banerjee (2000b) present a slightly different model where it is the real interest rate that affects credit, and show that it is not optimal to decrease the interest rate.

rate regime. One could introduce foreign exchange reserves and an objective function of the central bank, as in the 'second generation' of currency crises models. This would allow to incorporate more traditional elements of the currency crisis literature. The role of banks is another important omitted feature. Part of the foreign currency debt exposure is at the level of banks to an extent that varies from country to country. For example, in Indonesia the foreign currency loans went mainly to the corporate sector, while in Korea or Thailand banks received many of these loans. Introducing explicitly banks in the simple model would not affect the basic mechanism presented above: bank losses due to currency depreciation will certainly spill over to reduced lending to firms. However, the introduction of banks would definitely give us a more precise understanding of the crisis and of the transmission of monetary policy.[13]

Still another important extension is the role of the fiscal sector. First, large fiscal deficits may crowd out private investment and thus future output. Second, public debt may itself be denominated in foreign currency so that a currency depreciation has further negative effects (see Obstfeld, 1994).

The other direction for further research is of course empirical. A major difficulty with the balance-sheet approach is that it relies on aggregate corporate data. Unfortunately these data are usually not available, especially in emerging market economies. Firm data is typically of microeconomic nature, and even if available a large number of firms is necessary to have an idea of the aggregate behavior of the corporate sector. Fortunately, as mentioned above, new data sets on corporate balance sheets from crises economies are being constructed. The balance-sheet approach can therefore be applied and evaluated. Furthermore, the various effects can be quantified. A first step in this direction is made by Gray (1999) who computes the impact of exchange rate and interest rate changes on firms' value in Asian economies. He finds that the exchange effect is much more important for Indonesia than for Korea.[14] This implies that interest increases are more desirable in Indonesia.

[13] Buch and Heinrich (1999) focus on the foreign exchange exposure of banks in currency crises. Kho and Stulz (1999), however, find that bank currency exposures only was an issue in Indonesia and the Philippines.

[14] More precisely, Gray finds that a 50% currency depreciation decreases the estimated present value of corporate sector equity by 9% of GDP in Korea and by 21% in Indonesia. A 30% temporary rise in interest rate decreases this value by 2.5% in Korea against 1% in Indonesia. However, these estimates do not incorporate the impact of a higher interest rate on future lending.

Nevertheless, much more work is needed in this direction.

As for the debate on monetary policy at the time of crises, the presence of foreign currency debt raises important challenges. The approach that I have presented does not solve the issue of the precise policy stance, but hopefully clarifies the discussion. It has been shown that monetary policy can be ineffective in such a context. An increase in interest rates is desirable only in some circumstances, in particular when the potential negative impact on future output is small. Advocates of interest rate increases, such as the IMF, certainly believe this to be the case. Indeed it seems that in countries like Korea and Mexico, a short-lived increase in interest rates allowed exchange rates to stabilize. One might wonder, however, whether an even more restrictive monetary policy could have limited the drastic currency depreciation. Moreover, there is a high degree of uncertainty regarding the impact of higher interest rate. Thus, a restrictive monetary policy bears the risk of creating a recession if the output impact is underestimated or the exchange rate impact is overestimated. This was probably the case of Brazil in 1998 (see footnote 3). This risk of recession appears to be much higher in economies facing crises situation.

Are there solutions to the ineffectiveness of monetary policy in presence of high levels of foreign currency debt? I can suggest two extreme ways out of this dilemma. The first one is to give up monetary policy altogether as in a fully credible currency board or with dollarization. The other solution is to put limits to foreign currency debt. It is most unfortunate that economists cannot run real macroeconomic experiments. It would be interesting to know what would have happened if Asian countries had restricted the amount of foreign currency borrowing in the 1990s.

A Appendix

A.1 General Framework

The model is closely related to Aghion, Bacchetta, and Banerjee (2000a, b), but introduces explicitly the competitiveness effect. It is a two-period small open economy monetary model.[15] Goods prices are determined at the

[15] Strictly speaking, the model has infinite horizon, but we focus here on the first two periods only, with the implicit assumption that the government will adjust its monetary policy from period three onward to maintain a given interest rate.

beginning of each period and we consider the impact of an unanticipated shock (for example on current sales or productivity) in period one. Hence, during period one, some variables, such as the nominal exchange rate, will adjust while prices are preset for the entire period.[16] The interest rate to be paid at the end of the period is also unaffected by the shock since it is determined when the debt is contracted. There is a single tradeable good and purchasing power parity (PPP) holds ex ante, i.e. $P_t = E_t^e$ for $t = 1, 2$, where P_t is the domestic price, E_t^e the expected nominal exchange rate (the price of foreign currency in terms of domestic currency) at the beginning of period t, and the foreign price is constant and equal to one. During period $t = 1$, however, there may be ex-post deviations from PPP as a result of an unanticipated shock.[17] These deviations play a crucial role in the analysis. There is full capital mobility and uncovered interest parity holds up to a risk premium.

The economy is populated by identical entrepreneurs who face credit constraints which prevent them from borrowing and investing more than a multiple of their current real wealth (retained earnings or cash-flow) W_t, in the spirit of Bernanke and Gertler (1989). Entrepreneurs' wealth is therefore the fundamental variable that determines investment and output. Entrepreneurs can borrow in either domestic or foreign currency. Consumers need money for their transactions and there is a central bank that can alter interest rates or the exchange rate by affecting money supply.

The timing of events can be summarized as follows: first the price P_1 is preset and firms borrow and invest. Borrowing can be in domestic currency, in proportion $1 - x_1$, at interest rate i_0; or in foreign currency, in proportion x_1, at interest rate i^* and using the exchange rate E_0. Then an unanticipated shock occurs followed by a monetary adjustment which determines the exchange rate E_1 and the nominal interest i_1. Simultaneously, period 1's output and profits are generated and firms' debts are repaid; foreign currency debt is repaid at E_1. A fraction $(1 - \alpha)$ of net retained earnings after debt repayment, namely W_2, is saved for investment in period 2. Borrowing in domestic currency is done at interest rate i_1 and borrowing in foreign currency uses the exchange rate E_1.

[16] The assumption that prices are preset for one period is commonly made in monetary models of an open economy, following Obstfeld and Rogoff (1995).

[17] Producers set prices in domestic currency by taking the foreign price (adjusted by the expected exchange rate) as given.

A.2 The Monetary sector

The IPLM curve is fully described in the main text. Notice that we assume that the second period interest rate i_2 is exogenously fixed. This implicitly means that monetary policy stabilizes inflation or the nominal interest rate. Moreover, the exchange risk premium could be a positive function of i_1, but with a derivative inferior to one. If this is the case, changes in i_1 have a smaller impact on the IPLM curve.

A.3 Output and Entrepreneurs' Debt

Production is determined both by investment in physical capital and by competitiveness. Consider first the case without unanticipated shock where PPP holds. In this case there is no competitiveness effect since the real exchange rate is constant. Then production is determined uniquely by the amount of capital K_t through a linear production technology, $Y_t = \sigma K_t$.[18] Assume that capital fully depreciates within one period; then entrepreneurs' capital stock is simply the sum of own funds W_t and borrowed funds D_t, i.e., $K_t = W_t + D_t$. Borrowed funds can be either in domestic currency at interest rate i_{t-1} or in foreign currency at i^*. Moreover, due to a moral hazard problem, entrepreneurs may be credit constrained and can at most borrow an amount D_t proportional to their cash flow W_t, $D_t \leq \mu_t W_t$. The factor μ_t depends on the development of the financial sector (measured in particular by the cost of monitoring) and is lower for a lower level of financial development. We assume that the proportionality factor μ_t is a negative function of the nominal interest rate: $\mu_t = \mu(i_{t-1})$.[19] A more fragile financial sector implies a higher sensitivity of μ_t to an interest rate increase.

When the constraint is binding, the amount of cash flow determines investment. When it is non binding investment is simply determined by the cost of capital and the level and composition of debt does not matter.

With unanticipated shocks and deviations from PPP, we assume that entrepreneurs can increase their exports independently of the level of investment. This effect will be stronger the more open the economy is to trade. We can denote the competitiveness effect in real terms by $\chi(E_t/P_t)$ with $\chi' > 0$

[18] See Aghion, Banerjee, and Picketty (1999) for a justification of this specification.

[19] See Aghion, Bacchetta, and Banerjee (2000a) for a justification.

and $\chi(1) = 0$. When firms are unconstrained, output is given by:

$$Y_t = \sigma K(i_{t-1}) + \chi(E_t/P_t) \tag{6}$$

so that only the interest rate and the exchange rate matter. This is the standard result found for example in IS-LM. However, if there are deviations from PPP in period 1 only, Y_2 is not affected by competitiveness and only depends on the interest rate. When firms are credit constrained, total output is then given by:

$$Y_t = \sigma(1 + \mu(i_{t-1}))W_t + \chi(E_t/P_t) \tag{7}$$

Output depends on wealth available at the beginning of the period. Wealth depends on the previous period profits, which in turn depend on the level and composition of debt. We denote by x_t the proportion of debt D_t which is in foreign currency. We keep x_t as exogenous in this analysis. In Aghion, Bacchetta, and Banerjee (2000b) we give a more extensive discussion.

Consider second period output Y_2, which depends on the wealth W_2 available at the beginning of period 2, and assume there is an unanticipated shock at time $t = 1$. Aggregate nominal profits net of debt repayments at the end of period 1, are simply given by:

$$\Pi_1 = P_1 Y_1 - [(1 - x_1)(1 + i_0) + x_1(1 + i^*)\frac{E_1}{E_0}]P_0 D_1$$

where $Y_1 = \sigma(1 + \mu(i_0))W_1 + \chi(E_1/P_1)$.[20] We assume that the competitiveness effect is strong enough so that profits are always positive in equilibrium. Entrepreneurs use a proportion $(1 - \alpha)$ of these profits as their own retained earnings for production in the following period (a proportion α of profits is distributed or consumed). Total net wealth available for next period production is thus equal to:

$$W_2 = (1 - \alpha)\frac{\Pi_1}{P_1}$$

Since PPP holds in period 2, there is no competitiveness effect and we have:

$$Y_2 = \sigma(1 + \mu(i_1))(1 - \alpha)\{Y_1(\frac{E_1}{P_1}) - [(1 - x_1)(1 + r_0) + x_1(1 + i^*)\frac{E_1}{P_1}]D_1\} \tag{8}$$

[20] An open question is whether an exchange risk premium should be included for the cost of foreign currency debt. For convenience, I do not include it here.

where r_0 is the real interest rate on domestic debt and $Y_1(\frac{E_1}{P_1})$ is a shortcut notation reminding the competitiveness effect of period one.

At the beginning of period 1, all variables on the right-hand side of (8) are fixed except for E_1 and i_1 (P_1 is given since prices are preset). An increase in i_1 clearly reduces Y_2 since it reduces the availability of funds D_2 at the beginning of period 2. The nominal exchange rate E_1, however, has an impact on Y_2 only if there are deviations from PPP in period 1, i.e., if there is an unanticipated shock such that $E_1 \neq P_1$. Moreover, an unexpected increase in E_1 has an ambiguous impact on Y_2. On the one hand, it increases Y_1 through a greater competitiveness χ. On the other hand, a higher E_1 implies lower profits Π_1 in presence of foreign currency debt. Which effects dominates depends in particular on the degree of openness of the economy and on the proportion of foreign currency debt.[21] Equation (8) then gives the W curve, described in the text.

A.4 Currency Crises and Optimal Monetary Policy

First, there are multiple equilibria when the IPLM curve cuts the W curve from above. It can be verified that this happens when the following condition holds: $\sigma(1+\mu)(1-\alpha)(x_1(1+i^*)-\chi') > E_1 L/L_y$, where χ' is the marginal competitiveness effect, L is real money demand in period 2 and L_y is the derivative of money demand with respect to Y_2. The condition is more likely to hold when x_1, μ, and L_y are large and when χ' is small.

If one fully solves the system of equation (3) and (8) it is possible to see that an increase in interest rate is optimal, in the sense of increasing output, if the following condition holds:

$$-\frac{\mu'}{1+\mu} < \left\{\frac{E_1-\eta}{1+i_1} - \eta_i\right\}\sigma(1+\mu)(1-\alpha)(x_1(1+i^*)-\chi')\frac{D_1}{Y_2} \qquad (9)$$

where $\eta_i > 0$ and $\mu' < 0$ are the derivatives η and μ with respect to i_1. Condition (9) holds in particular when $\mu'(i_1)$ is small and when x_1 is large. This is also the case when the extent of lending, measured by μ, is large. On the other hand, when the risk premium η is sensitive to the interest rate, in particular when domestic and foreign currency assets are imperfect substitutes, it is less desirable to increase interest rate since the exchange

[21] Notice that all debt contracts are signed for one period. Longer contracts would obviously introduce additional interet rate effects.

rate is less responsive. Similarly, if the economy is more open to trade in goods χ' is larger and an interest increase is less desirable.

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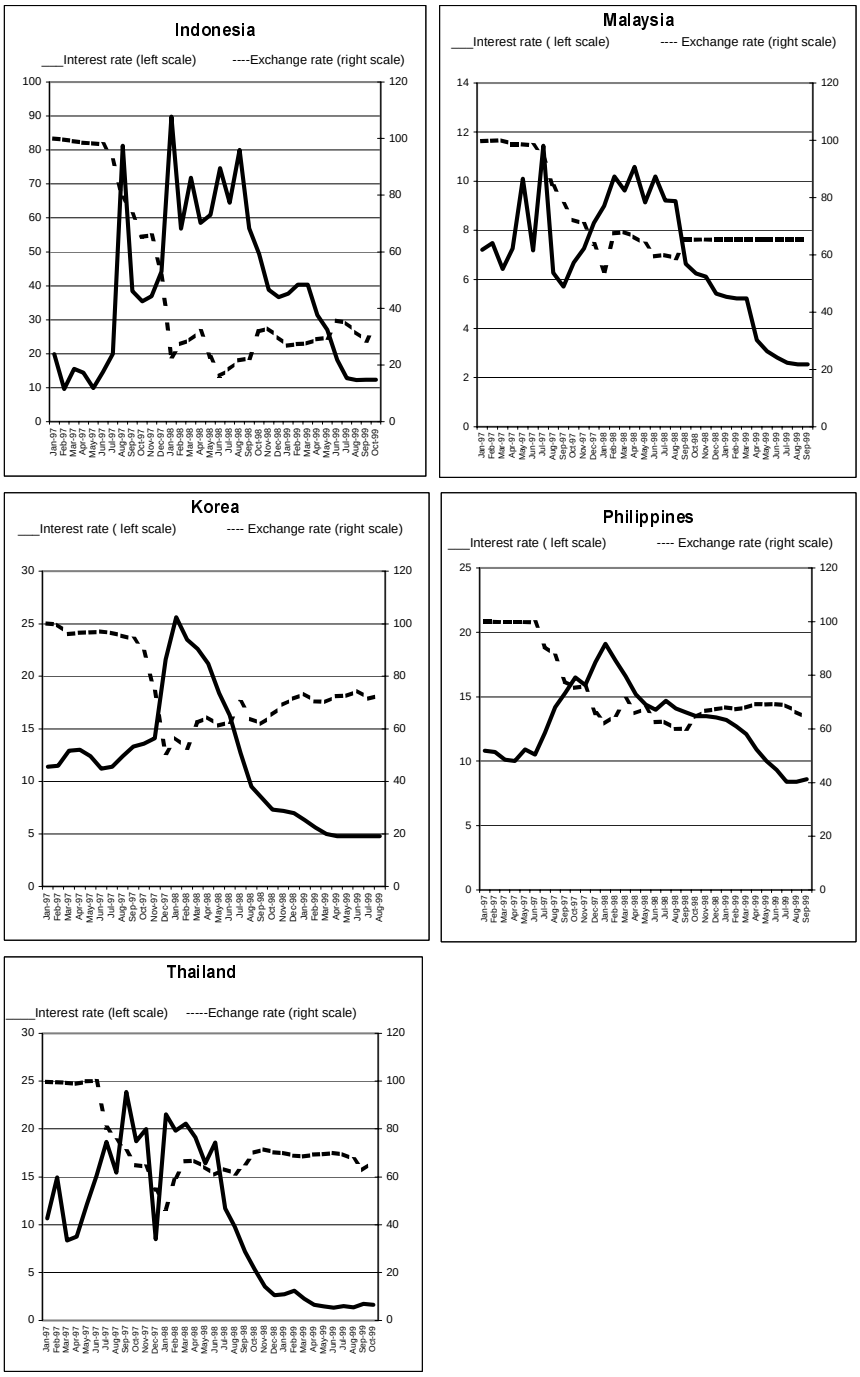
Indonesia
___Interest rate (left scale)
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Malaysia
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Korea
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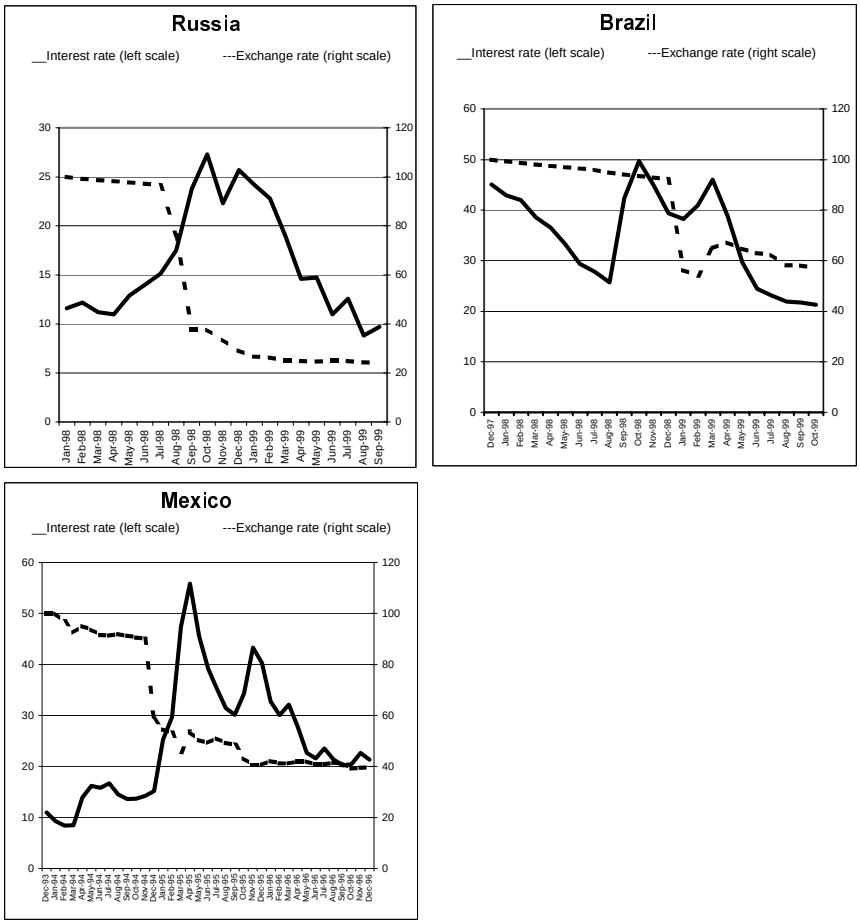
Figure1



Note
Exchange rate is end-of-period dollar per domestic currency, normalized at 100 in the first period.
Interest rates are the following: Mexico: net return on one-month financial Promissory notes;
Russia:deposit rate; Brazil: overnight rate on repurchase agreement;
Philippines:T-bill rate; Korea, Malaysia and Thailand:call money rate.

Source: Datastream

Figure 1(cont.)

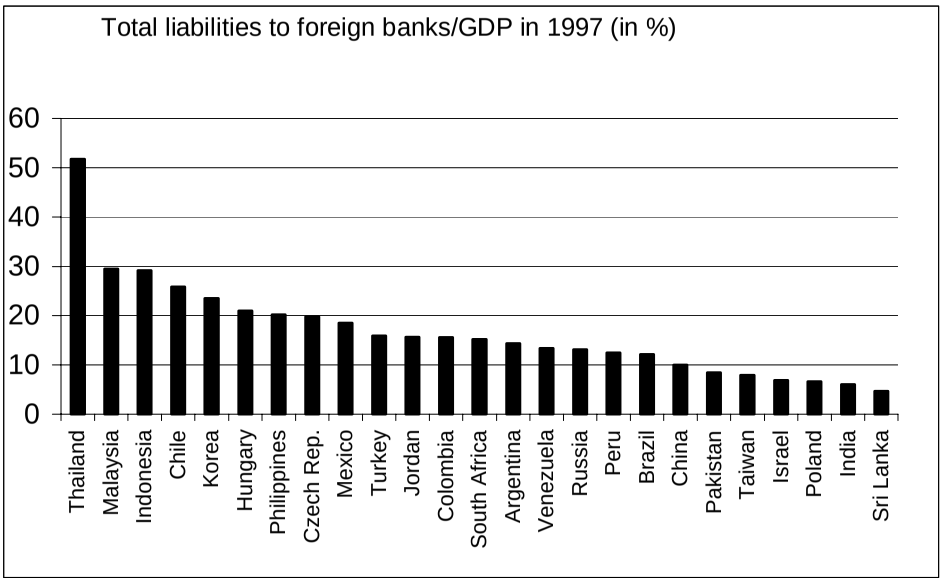


Figure 2

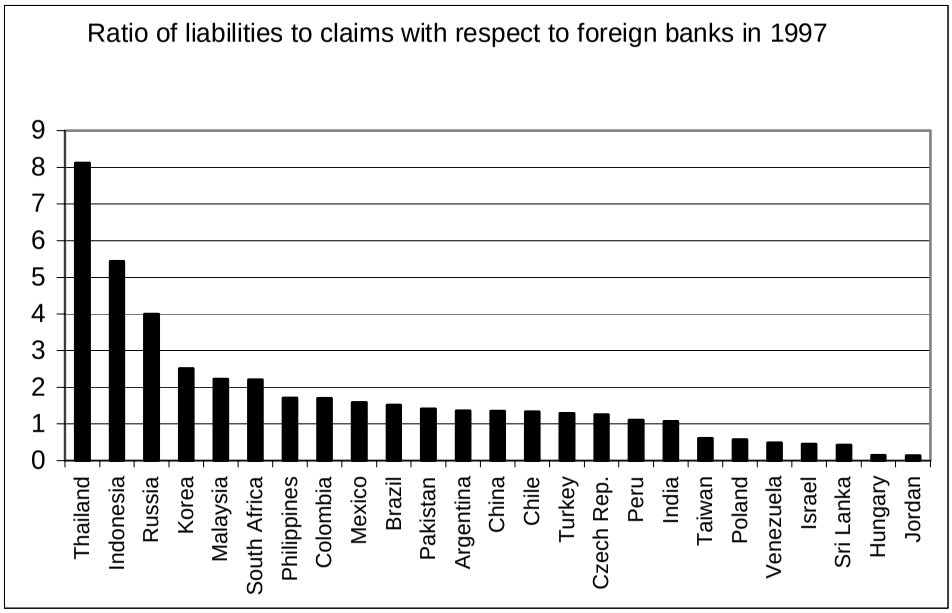


Figure 3

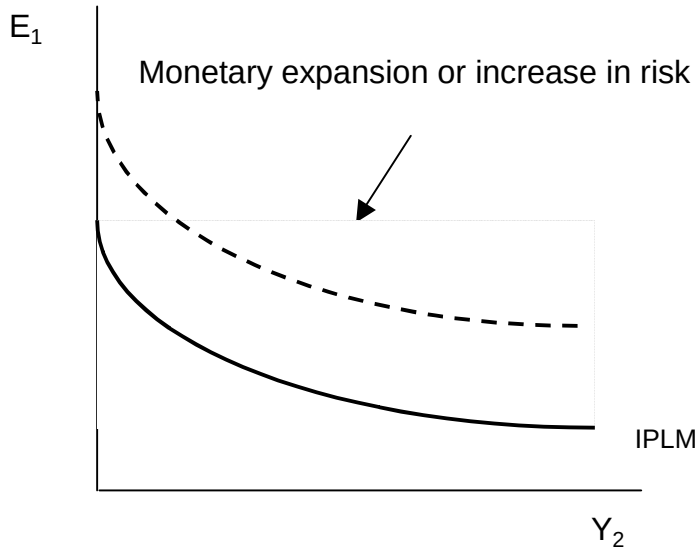
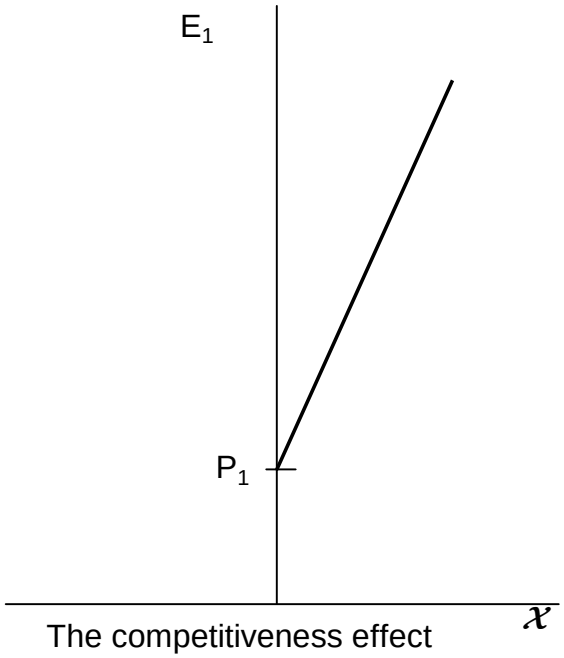


Figure 4



The competitiveness effect

Figure 5

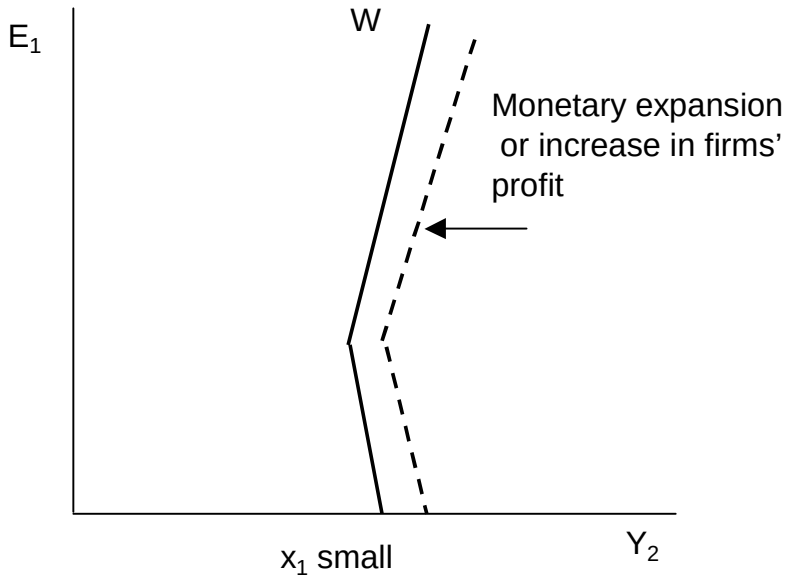


Figure 6a

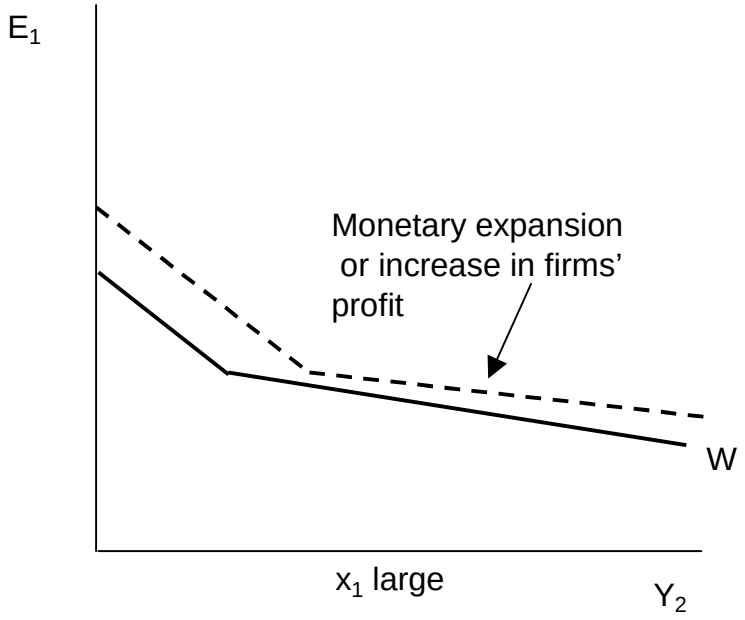
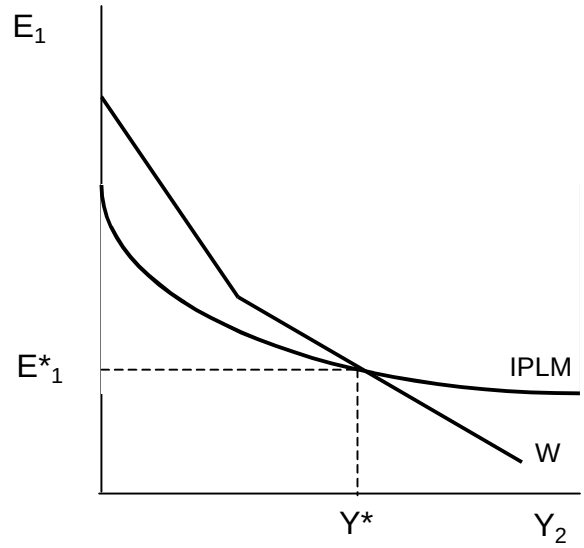
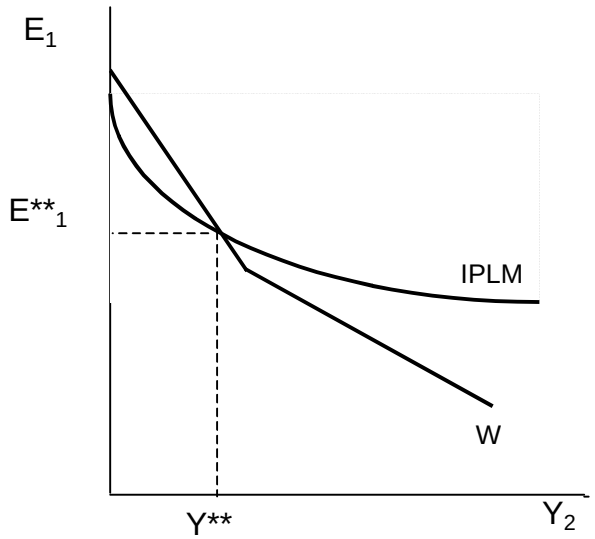


Figure 6b



'Normal' case

Figure 7a



Currency Crisis

Figure 7b

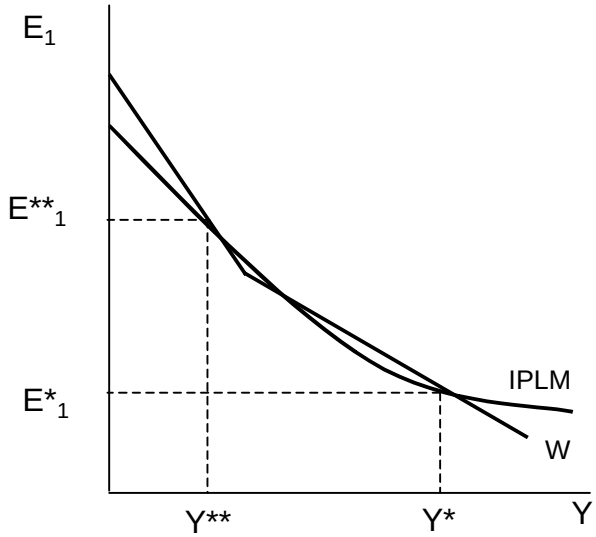
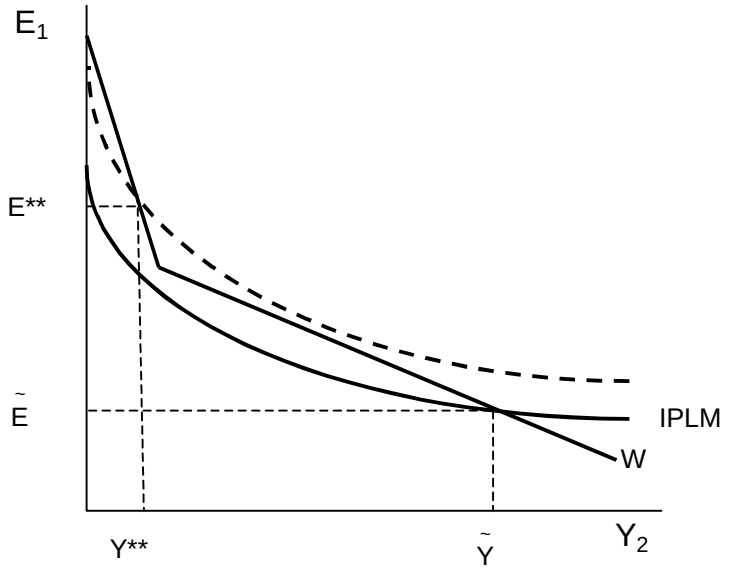


Figure 7c



Increase in risk premium and currency crisis

Figure 8

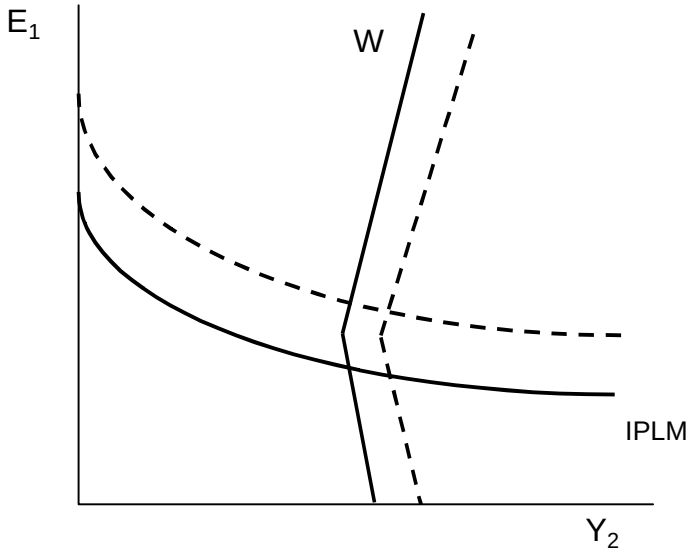
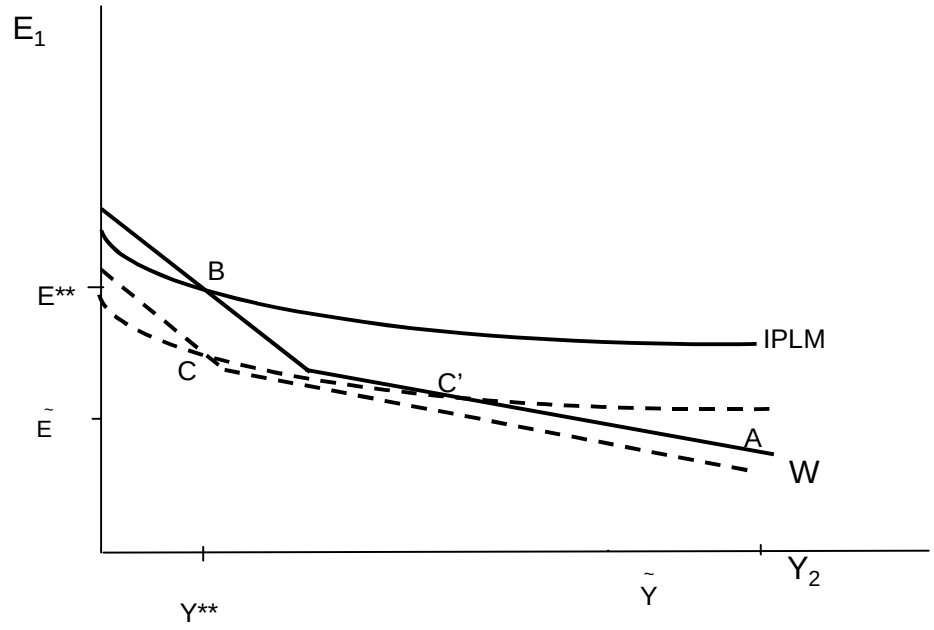


Figure 9a



Monetary policy and currency crisis

Figure 9b