

# Currency Crises and Monetary Policy in an Economy with Credit Constraint and Risk Premium

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## Abstract

This paper extends the currency crises model of Aghion, Bacchetta and Banerjee (2000, 2001, 2004) in two directions. First, we consider the medium term effects including the impact of monetary policy. We show that adverse medium term effects are present in some scenarios that can potentially reverse the monetary policy recommendation in the original model. A tight monetary policy can have adverse effects beyond the short term and can potentially cause a currency crisis in the medium term. Second, we add a risk premium and find that this increases the likelihood of a crisis, can help explain contagion, and that prospective capital controls will increase the risk premium and therefore increase the likelihood that such controls will be needed as an emergency measure.

JEL: E51, F30, O11

KEY WORDS Currency crises, Foreign-currency debt, Balance sheets, Interest parity, Risk premium, Contagion, Capital control, Monetary policy.

## 1 Introduction

The unexpectedness and the severity of the Southeast Asian crisis demonstrates the importance of understanding the underlying mechanisms of currency crises as well as the optimal

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policy response to an emerging crisis. One of the findings in the immediate aftermath was the inadequacy of the existing models of currency crisis to explain the events. Neither the first-generation models relying on inconsistent economic policy nor the second-generation models where the government faces a trade-off between maintaining the fixed exchange rate and a desire to boost output and employment by pursuing a more expansionary monetary policy are consistent with empirical evidence.<sup>1</sup> The Asian countries had an impressive economic performance the years preceding the crisis. After the crisis, following the depreciation, they all experienced deep recessions in which output fell at unprecedented rates.

These empirical observations motivated the development of a third-generation of currency crisis models.<sup>2</sup> Common within this latter approach is that they focus on stock rather than flow variables. There is no common denominator of which stock variables to focus on or the transmission mechanism. One strand of the literature emphasize vulnerabilities in the financial sector (Corsetti, Pesenti and Roubini (1999a,1999b) and Chang and Velasco (2000,2001)) while another strand focus on adverse impacts of foreign currency denominated liabilities on the balance sheets of the corporate sector (Krugman (1999), Aghion, Bacchetta and Banerjee (2000,2001,2004), Cho and Kasa (2008), Miller, García-Fronti and Zhang (2005,2006) and Bergman and Hassan (2008)). One of the appealing aspects of these frameworks is that the expectation of a depreciation can be self-fulfilling and thus enabling the existence of multiple equilibria.

One key issue within the third-generation framework concerns the role of monetary policy. Krugman (1999), Aghion, Bacchetta and Banerjee (2000,2001,2004), Cho and Kasa (2008), and Miller, García-Fronti and Zhang (2005,2006) all suggest that a tight monetary policy both prevent and resolve a currency crisis. However, there are also studies suggesting that a loose monetary policy and a depreciated currency is the optimal response, see for example Furman and Stiglitz (1998), Gertler, Gilchrist and Natalucci (2003), Céspedes, Chang and Valasco (2004), Christiano, Gust and Roldos (2004) and Bergman and Hassan (2008).<sup>3</sup>

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<sup>1</sup>Blackburn and Sola (1993) provide a survey of first-generation models whereas Rangvid (2001) surveys the second-generation models.

<sup>2</sup>Allen et.al. (2002) surveys the early literature.

<sup>3</sup>There is no consensus in the empirical literature, tight monetary policy may increase, decrease, or may not affect the probability of a successful speculative attack (see Furman and Stiglitz (1998), Gould and Kamin (2001), Kraay (2003) and Goderis and Ioannidou (2008)). Moreover, in a recent study of 22 episodes of systemic sudden stops that took place during the Tequila crisis 1994, the East-Asian crisis in 1997 and the Russian crisis in 1998, Ortiz, Ottonello and Sturzenegger (2007) find that countries that

Aghion, Bacchetta and Banerjee (2000,2001) (ABB) present a stylized macroeconomic framework that encompasses mechanisms that can account for both multiple equilibria to explain the rapid spread of the crisis and the severe output collapse caused by the depreciated currency and an explicitly modeled monetary sector that allows us investigate the effects of monetary policy. This model has been extended in different directions recently. Miller, García-Fronti and Zhang (2005,2006) expand the model by introducing demand-side effects. They show that if output is demand determined in the period when there is a negative supply shock or a sudden change in expectations, there will be an additional negative effect on output in the next period. The policy recommendation is unchanged, however. Tight monetary policy can prevent or resolve the crisis. Furthermore, they show that the fall in output could be reduced if the government at the same time implement an expansionary fiscal policy. Bergman and Hassan (2008) replace UIP with the assumption that the nominal exchange rate is a martingale. In this alternative model it is shown that the optimal response to an emerging currency crisis is to implement a loose monetary policy, the opposite to what is derived within the standard ABB framework. The reason for this result is that UIP is not assumed to hold.

In this paper we extend the ABB (2000,2001) model in different directions and compare our expanded model to the benchmark ABB model. First, we delve deeper into two issues not discussed by ABB, the curvature of the two main relationships determining the number and position(s) of equilibria and the behavior of the model in the medium term including the consequences for monetary policy. We show that adverse medium-term effects are present and that they can potentially reverse the effects of tight monetary policy, i.e., reverse the policy recommendation found by ABB. Second, we add a risk premium on domestic assets and show that the existence of a risk premium increases the likelihood of a crisis. In addition, the inclusion of a risk premium allows us to discuss contagion and herding, issues that are left untouched by ABB. A risk premium also allow us to discuss the effect of prospective capital controls, an issue discussed by for example Krugman (1999) and Miller et.al. We show that an expectation of future capital controls (an increased risk premium on domestic assets) can increase the likelihood that such controls will be needed. In particular, there is a trade-off between having the option of a beneficial emergency use of capital controls and the adverse effect on the risk premium stemming from the possible future imposition of such controls.

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raised the interest rates and implemented a restrictive fiscal policy experienced larger falls in output than countries implementing a looser policy.

The remainder of the paper is organized in the following way. The next section presents the essential features of the ABB (2000, 2001) model including some aspects not covered in ABB’s original article, the medium term effects and the existence of multiple equilibria. In the following section we add a risk premium to the model and examine the role of monetary policy both in the short term and in the medium term. The final section summarizes our main results.

## 2 The Aghion, Bacchetta and Banerjee framework

This section presents the ABB (2000, 2001) model. Their first paper, ABB (2000), presents a simple exposition of the effects of the exchange rate on the balance sheets of the corporate sector, while in ABB (2001) the authors present a full stylized macroeconomic model to explain the crisis. In ABB (2004) they present a model including a banking sector and with full-fledged microfoundations. This model can be considered a foundation for the more readily applicable model in ABB (2001). In the following we shall therefore employ the framework from ABB (2001) that several other authors have also utilized and expanded (e.g. Miller et al. (2005, 2006), Bergman and Hassan (2008)), since this allows us to benefit from higher transparency and ease of exposition, relative to the fully micro-founded model.

This section presents ABB’s basic framework (henceforth called the “benchmark ABB model”). While presenting the framework below we shall delve deeper into some issues that are either untouched or left for future research in ABB’s (2001) exposition. We will focus on the curvature of the two main relations determining the number of possible equilibria and the possibility that there is a currency crisis in the medium term. In relation to this latter case, we also examine consequences for the monetary policy recommendation that interest rates should be increased in order to prevent or resolve a currency crisis. It is crucial to determine whether the two curves have the shapes assumed by ABB since they determine, among other things, whether the model can have multiple stable equilibria. The central point of the model is that a shock causes an unexpected deviation from *ex post* PPP; ABB consider whether this deviation can lead to a severe drop in output in the following period (the short term), while noting that a crisis cannot happen thereafter (the long term). This is not the case as will be shown below, however. It can be shown that a deviation from PPP impacts the burden of foreign currency debt over two periods, not only one period ahead, suggesting that there are important insights to gain by also considering the second period after the shock (we shall call this the *medium term*) from

the following periods.

## 2.1 The general framework

The setup is an infinite-horizon model of a small open economy where prices are preset one period ahead. Purchasing power parity (PPP) holds *ex ante*, and since the foreign price level is constant and normalized to one we have:

$$P_t = E_t^e \quad (1)$$

Where  $P_t$  is the domestic price level, and  $E_t^e$  is the *ex ante* expectation of the nominal exchange rate measured as units of domestic currency per unit of foreign currency.

During the first period ( $t = 1$ ) the economy is subject to an unanticipated shock.<sup>4</sup> Since prices are fixed for the period, the exchange rate must move to accommodate the shock, and thus PPP may not hold *ex post*. There are no further shocks, and therefore PPP holds *ex post* in all other periods:

$$P_t = E_t \quad \forall \quad t \neq 1 \quad (2)$$

Where  $E_t$  is the realized nominal exchange rate.

There is free capital mobility, and foreign and domestic bonds are considered perfect substitutes, so uncovered interest parity (UIP) prevails, i.e., with  $i_t$  denoting the short-term nominal interest rate and  $i^*$  denoting the corresponding foreign interest rate (which is assumed constant over time and thus have no time subscript) we have:

$$(1 + i_t) = (1 + i^*) \frac{E_{t+1}^e}{E_t} \quad (3)$$

Completing the description of the monetary sector consumers have a standard real money demand function:  $m^d(y_t, i_t)$ , where  $y_t$  is nominal output/income,  $m^d(0, i_t) > 0$ <sup>5</sup> and as usual  $m'_{y_t} > 0$  and  $m'_{i_t} < 0$ . Employing this, equilibrium in the money market can be described by the classical LM-equation:

$$M_t^S = P_t \cdot m^d(y_t, i_t) \quad (4)$$

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<sup>4</sup>This can be either a real shock to, e.g., productivity or a sudden shift in expectations.

<sup>5</sup>This assumption is needed, due to the simplification of a 100% rate of depreciation of physical capital described below, which means that in case of a crisis, there will be no production in  $t = 2$ .

where  $M_t^S$  is the nominal money supply.

On the real side of the economy, the supply of goods is described by a production function with capital ( $k_t$ ) as the sole input. ABB make the further simplifying assumption of having only working capital, so the rate of depreciation is 100%. Due to informational problems in the credit market firms are prevented from offering the present value of their future revenues as collateral (this is basically an open economy extension of the Bernanke and Gertler (1989) financial accelerator mechanism). This credit constraint means that they can borrow no more than a fraction  $\mu$  of their current real wealth ( $w_t$ ), where  $\mu$  is in essence a credit multiplier, and so, when the constraint is binding, with the production function  $f$  current production becomes:

$$y_t = f(k_t) = f[(1 + \mu)w_t]. \quad (5)$$

When the constraint is not binding the levels of borrowing and output are given by the standard first-order condition:  $f'(k_t) = 1 + r_{t-1}$ , where  $r_{t-1}$  is the real interest rate in effect in the current period.

These imperfections in the credit market play a critical role in the model, since, whenever the constraint is binding, firms cannot secure additional external funding in case of a negative shock to their wealth. In fact, since lower wealth means a decrease in credit availability, the imperfections amplify the negative effects of such a shock, so the credit market may act pro-cyclically. On the other hand, if the constraint is not binding, when hit by a shock to their wealth firms can maintain their desired level of investment through increased borrowing, and thus the shock would have no effect on next period's output. For this reason when using the model to explain crises we shall assume that the constraint is binding.

As demonstrated below assuming that the credit multiplier is constant allows us to determine the shape and position of the two main relations and thus the location(s) of possible equilibria. Since this enhances the clarity of the benchmark model and simplifies the process of modifying the framework and interpreting the modified results, we shall restrict ourselves to this case like in the basic setup of ABB (2001).

Since firms can borrow either in domestic currency or in foreign currency (at the rates of  $i_{t-1}$  or  $i^*$  respectively), and since the burden of foreign currency debt is affected by changes in the exchange rate, the composition of the corporate sector's debt plays an important role. It is assumed that out of total debt ( $d_t$ ) the quantity of domestic cur-

rency debt is  $d_t^c$ . This assumption can be justified in the present setup by considering that the shock affecting the exchange rate and shifting the burden of domestic currency debt relative to foreign currency debt is completely unexpected and thus not taken into account when firms choose the composition of their debt. Since it is a crucial assumption in the model that firms have foreign currency debt however, it would be an interesting and relevant extension of the model to assume that the currency composition of the debt is endogenous. Jeanne (2000) presents a model with asymmetric information where the currency composition of firms' foreign debt is endogenous and shows that holding foreign currency debt can solve a commitment problem in the presence of moral hazard.<sup>6</sup>

Given the currency composition of firms' debt their aggregate nominal net profit ( $\Pi_t$ ) becomes:

$$\Pi_t = P_t y_t - (1 + i_{t-1}) P_{t-1} d_t^c - (1 + i^*) \frac{E_t}{E_{t-1}} P_{t-1} (d_t - d_t^c) \quad (6)$$

When profits are positive, entrepreneurs consume/distribute a fraction  $\alpha$  hereof and retain the fraction  $1 - \alpha$  for investment (and collateral) resulting in next period's wealth being:

$$w_{t+1} = (1 - \alpha) \frac{\Pi_t}{P_t} \quad (7)$$

When profits are negative wealth in the following period will be zero, and since without collateral firms cannot borrow production must also be zero.

This completes the description of the model. An equilibrium in this setup is a series of prices, exchange rates and output levels, which for a given monetary policy, i.e. given series of  $M_t^S$  and  $i_t$ , satisfy equations (3)–(7). In the next section we shall condense these equations into two main relations that can be presented graphically in the  $(y_2, E_1)$ -plane.

If we assume that monetary policy authorities keep the nominal interest rate constant from period 2 onwards, e.g., due to a policy of inflation targeting in the absence of shocks in the medium and long term; it is straightforward to gather the equations of the model into two curves that describe the relationship between the current exchange rate and future output. From above we know that both curves are downward sloping. Aside from noting this, however, ABB just assume that the IPLM-curve is downward sloping and convex whereas the W-curve is assumed to be downward sloping and concave. Since one of the strong points of the model is that we can solve it graphically, and since the shape

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<sup>6</sup>For an overview of other models dealing with the currency composition of debt see ABB (2004) p. 15.

and the position of the curves determine the number, position(s) and stability of possible equilibria, it is important to explicitly ascertain that the IPLM–curve is convex and that the W–curve is concave. In the following we shall examine the second order derivatives of the IPLM– and W–relations in order to determine their curvature.

By using *ex ante* PPP in equation (1) to combine the UIP–equation in (3) with the LM–equation in (4) for  $t = 2$ , we obtain the IPLM (“Interest-Parity-LM”)–curve:

$$E_1 = \frac{1 + i^*}{1 + i_1} \frac{M_2^S}{m^d(y_2, i_2)}. \quad (8)$$

It is easily confirmed that the slope of this relation in  $(y_2, E_1)$ –space is negative and given by:

$$\frac{dE_1}{dy_2} = -\frac{1 + i^*}{1 + i_1} \frac{M_2^S}{[m^d(y_2, i_2)]^2} m'_{y_2} < 0$$

The intuition behind the slope of the IPLM–curve is straightforward: For a given value of  $i_2$  an increase in (expected) future output raises the (expected) future demand for domestic real money balances, which results in (expectations of) a future appreciation of the exchange rate. This anticipation of a future appreciation increases the attractiveness of holding domestic currency today and must therefore yield an appreciation of the current exchange rate (i.e. a reduction in  $E_1$ ).

The second order derivative of the IPLM–curve is given by:

$$\frac{d^2E_1}{dy_2^2} = \frac{1 + i^*}{1 + i_1} \left\{ \frac{2M_2^S}{[m^d(y_2, i_2)]^3} (m'_{y_2})^2 - \frac{M_2^S}{[m^d(y_2, i_2)]^2} m''_{y_2} \right\} \quad (9)$$

and as can be observed we cannot determine the sign this derivative without an assumption about the second order derivative of the money demand function, but since the nature of this demand is not specified, this is not straightforward. If we consider a standard money–in–the–utility function (both log– and CRRA–utility) or cash–in–advance approach, they both yield  $m''_{y_t} = 0$ , which means that the sign of (9) will be positive. The same would be true for a money demand, including some kind of satiation point, possibly implying  $m''_{y_t} < 0$ , and since on the other hand no prevalent economic intuition seems to suggest  $m''_{y_t} > 0$  we shall henceforth assume that  $m''_{y_t} \leq 0$  resulting in a positive sign in (9). We can therefore ascertain that the IPLM–curve is indeed downward sloping and convex as assumed by ABB.

While the IPLM–relation is a combination of equations that are standard in macroeco-

nomic literature, the W (“Wealth”)–curve captures the effect of the assumed credit market imperfections. By combining equations (5)-(7) while using the definition of the real interest rate and the fact that in  $t = 0$  PPP holds *ex post*, we obtain:

$$y_2 = f \left\{ (1 + \mu)(1 - \alpha) \left[ y_1 - (1 + r_0)d_1^c - (1 + i^*) \frac{E_1}{P_1} (d_1 - d_1^c) \right] \right\}. \quad (10)$$

Representing equation (10) along with a non–negativity constraint on output ( $y_2 \geq 0$ ) in  $(y_2, E_1)$ –space yields the W–curve. We note that entering period 1 all variables on the right–hand side of (10) except for  $E_1$  are predetermined, and, like the IPLM–curve, the W–curve describes a negative relationship between the current exchange rate and future consumption. It is straightforward to confirm that the slope (for a positive  $y_2$ ) is given by:

$$\left. \frac{dE_1}{dy_2} \right|_{y_2 > 0} = - \frac{P_1}{(1 + \mu)(1 - \alpha)(1 + i^*)(d_1 - d_1^c)} \frac{1}{f'(k_2)} < 0. \quad (11)$$

Intuitively the negative slope of the W–curve is explained by the connection between the exchange rate and the balance sheets of firms: when prices are fixed a depreciation of the period–1 exchange rate increases the burden of foreign currency debt and thereby reduces the profit of domestic firms. This reduction in current profits translates into lower investment (because firms are credit constrained) and so results in a lower future output.

It is important to observe that it is the deviation from *ex post* PPP caused by the unexpected first period shock that leads to the negative relationship between  $E_1$  and  $y_2$ . In the absence of shocks where PPP holds *ex post*, we have  $E_1 = P_1$ , and it is clear from equation (10) that the W–curve is vertical in the  $(y_2, E_1)$ –plane. Intuitively if there is no unexpected shock there is no change in the real exchange rate and thus no change in the burden of foreign currency denominated debt.

The second order derivative of the W–curve is:

$$\left. \frac{d^2 E_1}{dy_2^2} \right|_{y_2 > 0} = \frac{P_1}{(1 + \mu)(1 - \alpha)(1 + i^*)(d_1 - d_1^c)} \frac{f''(k_2)}{[f'(k_2)]^3}. \quad (12)$$

To determine the sign of this second derivative we need to make an assumption about the returns to scale of the production function, which with only one input equals the marginal product of capital. If we assume constant returns to scale ( $f''(k_2) = 0$ ) we see that the second order derivative in equation (12) equals zero, so the W–curve becomes a straight line. Considering, however, that having only one input is a rather gross simplification, which could be interpreted as a short cut for having a fixed labor input:  $y_t = F(k_t, \bar{l}) =$

$f(k_t)$ , we shall instead make the more appropriate and rather standard assumption of a decreasing marginal product of capital ( $f''(k_2) < 0$ ), which in turn results in the derivative in (12) being negative. The W-curve is therefore downward sloping and concave as was assumed but not shown in ABB.

## 2.2 Solution and implications of the model

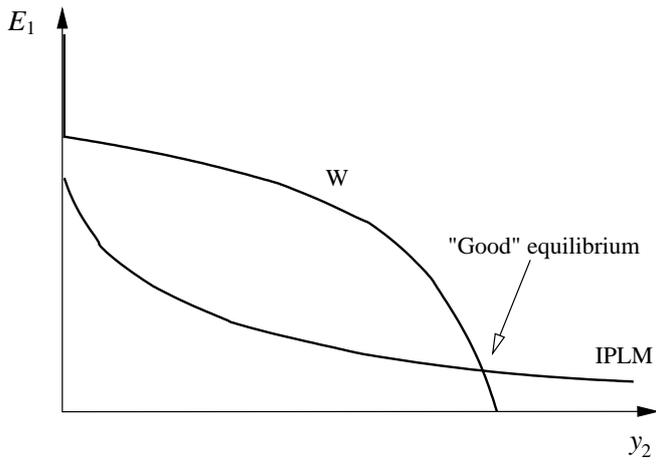
The position of the IPLM- and the W-curves are given by the predetermined levels of period-1 prices and output, the level and composition of the debt and the monetary policy variables. We can distinguish between three possible scenarios as discussed at length in ABB. These three scenarios are shown in Figure 1.<sup>7</sup>: (i) The “good” case, where the economy is healthy enough and/or the shock is small enough so that a crisis equilibrium does not emerge following the shock, and thus the exchange rate will stay low and output high (depicted in Figure 1(a)). (ii) The “bad” case, in which the shock is so large and/or the state of fundamentals so bad that a crisis is the only possible outcome, i.e. the unexpected currency depreciation is so large that it drives profits and thus second period output to zero (Figure 1(b)). (iii) Finally and perhaps most interestingly, an intermediate case, we could call the “ripe-for-attack” case, in which there are two locally stable equilibria: a “good” and a “crisis”-equilibrium (Figure 1(c)). There are several ways in which a crisis can occur: A shock to fundamentals for example a fall in productivity (i.e. a change in the production function  $f(\cdot)$ ) or a tightening of credit markets (a drop in  $\mu$ ) that shift the W-curve down, or an increase in the foreign interest rate ( $i^*$ ) that shift the IPLM-curve up. In these cases the economy could move from a situation as in Figure 1(a) (or 1(c), where the good equilibrium prevails) to the “bad” scenario in Figure 1(b) where a depreciation of the exchange rate and a drop in future output is inevitable. A shift in expectations: If the economy is described by Figure 1(a) only a change in fundamentals can bring about a crisis, but if the economy is in the more fragile “good” equilibrium in the multiple equilibrium “ripe-for-attack” scenario (Figure 1(c)) a sudden shift in expectations can trigger a crisis, because an anticipation of a depreciation results in a lower expected output, which leads to a drop in money demand. This, in turn, leads to an actual depreciation and so validates the agents’ expectations. A combination of these two scenarios may also push the economy from the “good” scenario to the “ripe-for-attack” scenario. Whether or not there will be a crisis depends on the agents’ perception of the “severity” of the shock (i.e. on whether they change their money demand sufficiently).

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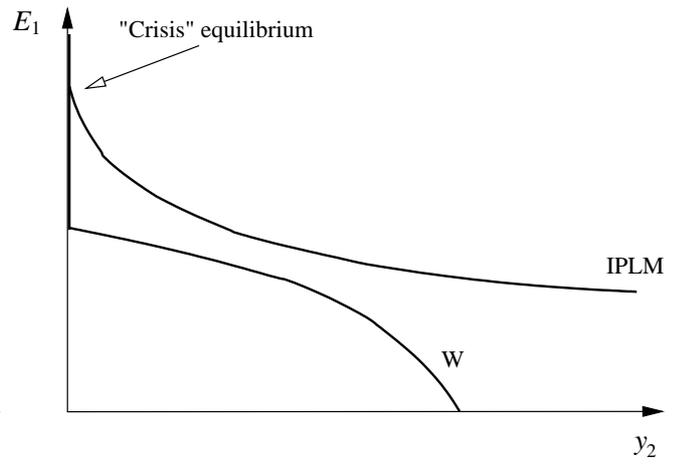
<sup>7</sup>Not counting states where the curves intersect in the second quadrant, since the exchange rate cannot turn negative, nor the case of tangency between the curves, since this is just a special case of figure 1(c).

Figure 1: The three possible scenarios.

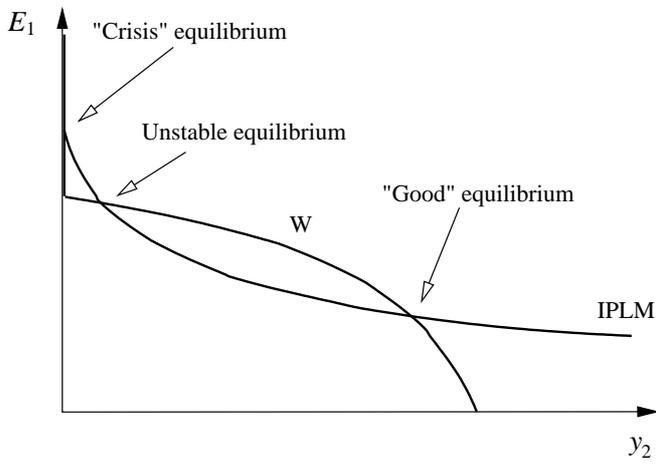
(a) The "good" scenario.



(b) The "bad" scenario.



(c) The "ripe-for-attack" scenario.



If the agents assess that the shock will lead to a crisis, the change in their behavior will make the exchange rate in the current period plummet and thus output in the next period collapse.

As can be observed from Figure 1 it is a *necessary* condition<sup>8</sup> for a currency crisis to emerge (either with certainty in the “bad” scenario or depending on expectations in the “ripe-for-attack” scenario) that the IPLM–curve intersects the  $y_2$ –axis above the W–curve, i.e. for a crisis equilibrium to exist we must have:

$$E_1|_{W, y_2=0} = \frac{P_1[y_1 - (1 + r_0)d_1^c]}{(1 + i^*)(d_1 - d_1^c)} < \frac{1 + i^*}{1 + i_1} \frac{M_2^S}{m^d(0, i_2)} = E_1|_{IPLM, y_2=0}. \quad (13)$$

From this condition we can observe which relative values of the variables increase the likelihood of a collapse. Firstly, equation (13) illustrates as previously mentioned that a high level of foreign currency denominated debt ( $d_1 - d_1^c$ ) increases an economy’s predisposition to crises, but several other variables also play a role, and it is easy to imagine values of these other variables with which even an economy with a large quantity of foreign currency debt would not be crisis–prone. There is a wide scope of measures economic policy makers can consider in order to prevent crises. Though policy makers cannot directly control  $i^*$ ,  $y_1$ ,  $P_0$ , and  $P_1$ , monetary policy can set  $i_1$ ,  $i_2$  and  $M_2^S$  while subsidies, taxes and/or regulations can influence foreign currency borrowing ( $d_1 - d_1^c$ ). In addition to considering crisis prevention on the longer horizon changes in some of the variables like the interest rate are also relevant as a possible short–term response to early signs of an impending crisis. We shall return to a discussion of the optimal monetary policy response below, but first we consider the possibility of a crisis in the medium term.

### 2.3 The economy in the medium and long term

ABB briefly consider whether there could be a crisis in period 3 (caused by the shock to the economy in period 1 and/or the policy measures taken in response to this) but note that if the economy does not collapse in the period after the shock, it will not do so in the following periods either. This conclusion is based on the ascertainment that the relationship between  $E_1$  and  $y_3$  is positive, but as demonstrated in the following this is far from true with certainty. Since the risk of a collapse in the medium term is an important issue when considering how to react preemptively to a possible crisis this is a significant insufficiency in ABB’s exposition, and therefore we shall investigate the matter in more

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<sup>8</sup>ABB erroneously indicate this as a *sufficient* condition.

detail here.

To consider the medium-term effects of the initial shock we must investigate the relationship between the exchange rate in the period of the shock ( $E_1$ ) and output in the third period ( $y_3$ ). For this purpose we now derive the third period equivalents of the IPLM- and the W-curves.

Firstly, by using *ex ante* PPP to combine the UIP relation in (3) for both  $t = 1$  and  $t = 2$  with the LM-equation in (4) for  $t = 3$  we obtain the first relation between  $E_1$  and  $y_3$  which we shall call the IPLM<sub>3</sub>-curve:

$$E_1 = \frac{(1 + i^*)^2}{(1 + i_1)(1 + i_2)} \frac{M_3^S}{m^d(y_3, i_3)}. \quad (14)$$

We can confirm that given monetary policy the IPLM<sub>3</sub>-curve, like the IPLM-curve, is downward sloping (but in the  $(y_3, E_1)$ -plane):

$$\frac{dE_1}{dy_3} = -\frac{(1 + i^*)^2}{(1 + i_1)(1 + i_2)} \frac{M_3^S}{[m^d(y_3, i_3)]^2} m'_{y_3} < 0.$$

The important difference between period 2 and 3, however, is reflected in the W-relation. By combining equations (5)-(7), assuming the economy evaded a crisis in the first period and remembering that as the shock hits the economy in period 1, PPP does not hold *ex post*, we get the following expression:

$$y_3 = f \left\{ (1 + \mu)(1 - \alpha) \left[ y_2 - (1 + i_1) \frac{P_1}{P_2} d_2^c - (1 + i^*) \frac{E_2}{E_1} \frac{P_1}{P_2} (d_2 - d_2^c) \right] \right\}.$$

Subsequently using UIP and the fact that in period 2 PPP holds *ex post* again, we arrive at the final expression for the second relation between  $E_1$  and  $y_3$ :

$$y_3 = f \left\{ (1 + \mu)(1 - \alpha) \left[ y_2 - (1 + i^*) \frac{P_1}{E_1} d_2 \right] \right\}. \quad (15)$$

It is important to note that, as in period 2, third period output cannot be negative, and thus by representing equation (15) along with the restriction  $y_3 \geq 0$  in the  $(y_3, E_1)$ -plane we arrive at the W<sub>3</sub>-curve. The non-negativity constraint means that for values of  $E_1$  corresponding to  $y_3 \leq 0$  in (15) the W<sub>3</sub>-curve is a vertical line on  $y_3 = 0$ . This also means that equation (15) is only relevant if a crisis was avoided in period 2. If the economy succumbed to crisis (i.e.  $y_2 = 0$ ) there is no wealth to invest or use as collateral in period 3, and the entire W<sub>3</sub>-curve is vertical in  $y_3 = 0$ .

A first interesting insight of equation (15) is that because PPP holds at all times after period 1 the currency composition of the debt plays no role from the medium term and onwards. A second insight is that, contrary to what ABB writes, without further assumptions we cannot determine the sign of the slope of this curve. The effect of the exchange rate in the current period on output in the third period (i.e., the inverse slope of the  $W_3$ -curve for  $y_3 > 0$ ) is given by<sup>9</sup>:

$$\frac{dy_3}{dE_1} = f'(k_3)(1 + \mu)(1 - \alpha) \left\{ \underbrace{\frac{dy_2}{dE_1}}_{(i)} + (1 + i^*)P_1 \left[ \underbrace{-\frac{1}{E_1}d'_2(E_1)}_{(ii)} + \underbrace{\frac{1}{E_1^2}d_2(E_1)}_{(iii)} \right] \right\} \quad (16)$$

As we can observe from equation (16),  $E_1$  affects  $y_3$  through three different channels working in opposite directions. The intuition behind the negative effect is:

- (i) As explained above, the balance-sheet effect means that a depreciation of the exchange rate resulting from the first period shock has a negative impact on second period output. This results in lower firm wealth, and so (due to the credit constraints) lower capital stock and production in period 3. Mathematically:  $\frac{dy_2}{dE_1} < 0$ , as demonstrated in equation (11).

On the other hand there are two effects working in the positive direction:

- (ii) Even though lower firm wealth at the end of period 2 means lower period-3 output, the reduced borrowing also means that there is less debt to repay.
- (iii) Finally, as there are no surprises in period 2, and PPP thus holds *ex post*, the domestic price level catches up, so to speak, to the exchange rate. This increase in the price level yields a reduction in the period-2 debt burden that can be considered through two channels:
  - (a) When prices increase relative to the exchange rate, it results in a real exchange rate appreciation that lowers the burden of foreign currency debt; and the larger the nominal depreciation in the first period the larger the real appreciation in the second period must be to restore PPP.

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<sup>9</sup>Note that, because of the credit constraints, second period's total debt ( $d_2$ ) depends on the wealth held in the beginning of that period, which in turn depends on the first period exchange rate:

$$d_2(E_1) = \mu w_2(E_1) = \mu(1 - \alpha) \frac{\Pi_1(E_1)}{P_1}$$

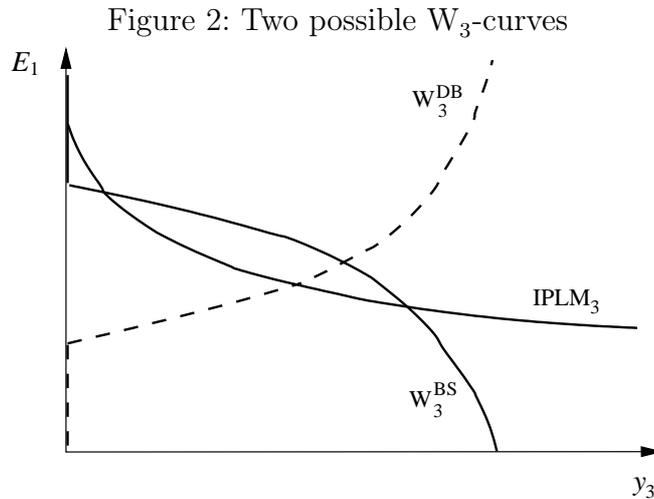
and since, as can be verified from equation (6), a depreciation increases the burden of foreign currency debt, we have that  $\Pi'_1(E_1) < 0$ , resulting in:  $d'_2(E_1) < 0$ .

- (b) The increasing prices also mean an increase in domestic inflation which in turn lowers the real interest rate and thus equally reduces the burden of domestic debt.

As mentioned above, since both UIP and PPP hold in the second period, there is no difference between liabilities denominated in foreign and domestic currency, so (a) and (b) are mirror images.

These reductions in the period-2 debt burden have a positive effect on the wealth of firms and through that on output period 3.

As given by equation (16) and illustrated in Figure 2; if the period-1 balance-sheet effect (i) dominates, the  $W_3$ -curve will be downward sloping (depicted as  $W_3^{BS}$ ), while if the reductions in the period-2 debt burden (ii) and (iii) dominate, it will be upward sloping ( $W_3^{DB}$ ). We see that if the first case holds and the period-1 balance-sheet effect dominates (like in the short-term  $W$ -curve) there is a possibility of both multiple equilibria and crisis in period 3, whereas if the  $W_3$ -curve is upward sloping there cannot be multiple equilibria though a crisis still cannot be ruled out.



Furthermore we can observe from equations (10) and (16) that the strength of the opposing effects depends on the size of the period-1 depreciation, so the sign of the derivative in (16) can vary for different ranges of  $E_1$ . An example of a plausible scenario could be: If a crisis in period 2 is avoided, and the currency depreciation is minor, the positive effect on the debt burden in period 2 could mean that there is a positive effect on output in the third period, but if the depreciation is large and has a sufficiently adverse

effect on second period’s production and thus firm wealth, the overall effect on period-3 output could be negative. In such a scenario the  $W_3$ -curve would be upward sloping for lower values of  $E_1$  and backward bending for higher values of  $E_1$ .

All in all the effect of the current exchange rate on third period’s output is significantly more complicated than ABB concludes. We cannot with any straightforward assumptions exclude the possibility of a crisis in period 3, and this is important to have in mind when considering policy measures, as we shall demonstrate below.

## 2.4 Beyond the third period

By using equations (2) and (3) and combining (5)–(7) for  $t \geq 3$  we find that in the long term (i.e. from period 4 and onwards) and assuming that monetary policy is unchanged is given by:

$$y_{t+1} = f \{ (1 + \mu)(1 - \alpha) [y_t - (1 + i^*)d_t] \} \quad \forall \quad t \geq 3.$$

Since both PPP and UIP hold *ex post*, the only effect of the initial shock is what is “inherited” through the previous period’s output, which, if the economy have avoided a crisis so far, will be positive and continue such going forward. With the description of the economy in place we turn to a discussion of monetary policy.

## 2.5 Monetary policy

Since the monetary side of the ABB framework is explicitly specified, it lends itself naturally to the analysis of monetary policy. So far we have taken the monetary policy variables ( $i_1$ ,  $i_2$  and  $M_2^S$ ) as given, but this section examines how the monetary authorities should act in response to a crisis. As noted in the presentation of the general framework we shall restrict ourselves to the simple case of a constant credit multiplier ( $\mu$ ), since this allows for a clearer presentation and enables us to utilize the insights from the previous section to consider the effects of monetary policy on the equilibrium in the medium term, which is an issue entirely left out of ABB’s (2001) article.

As we can see from the LM-equation (4), since prices are preset the nominal interest rate must adjust to equilibrate the money market, and so equation (4) can be rewritten as:

$$i_t = \phi \left( \frac{M_t^S}{P_t}, y_t \right)$$

where  $\phi$  is the inverse of the money demand function with respect to  $i_t$ . On account of the standard liquidity effect the relationship between money supply and the interest rate is unambiguously negative. This means we can use either of the two variables when discussing monetary policy, and without loss of generality we shall therefore consider only the interest rate.

To investigate the optimal course of monetary policy we consider the necessary condition for a crisis given in equation (13) and repeated here for convenience:

$$E_1|_{W, y_2=0} = \frac{P_1[y_1 - (1 + r_0)d_1^c]}{(1 + i^*)(d_1 - d_1^c)} < \frac{1 + i^*}{1 + i_1} \frac{M_2^S}{m^d(0, i_2)} = E_1|_{IPLM, y_2=0}$$

we see that the position of the IPLM–curve depends on the stance of monetary policy in the first period, so by raising (lowering) the current nominal interest rate in response to a shock the monetary authorities can shift the IPLM–curve downwards (upwards). With regard to the W–curve, however, the effect of the interest rate goes through the burden of domestic debt, but since output depends on wealth in the previous period, which in turn depends on the interest rate in effect when the debt due in that period was contracted, there is a two–period lag between output and the interest rate. Therefore changing the current interest rate has no effect on the W–curve, and so by raising the interest rate and shifting the IPLM–curve down the central bank can avoid a crisis.

We now consider the implications of this in the medium term. As we have shown above, the economy in this framework is not immune to crisis in the third period, and therefore we must examine the impact monetary policy has on the economy in the medium term by considering the IPLM<sub>3</sub>– and W<sub>3</sub>–curves derived above. From equation (14) it is obvious that the position of the medium term IPLM<sub>3</sub>–curve depends on the stance of monetary policy in both periods 1 and 2. From equation (15) we see that like the W–curve in the short term the W<sub>3</sub>–curve is unaffected by policy. The explanation in the medium term is different, however. Since output in period 3 depends on the debt due in period 2 that in turn depends on the interest rate in period 1 (when the debt was contracted), at first glance one could suppose that  $i_1$  would affect  $y_3$ . Since both the PPP and the UIP hold *ex post* in period 2, however, there can as already mentioned be no difference between the burden of liabilities denominated in domestic and foreign currency. The equality of the real interest rate on domestic and foreign debt is secured as the domestic price level catches up to the exchange rate and thus cancels any effect of nominal interest rate hikes on the domestic real interest rate. Though the W<sub>3</sub>–curve is hence unaffected by monetary

policy, the slope of the curve is a crucial determinant for the outcome of such policy. This is illustrated in Figure 3 that compares the two main scenarios regarding the  $W_3$ -curve discussed above. We shall consider them in turn:

- (i) If the first period balance-sheet effect of  $E_1$  dominates the  $W_3$ -curve, so the downward sloping  $W_3^{\text{BS}}$ -curve prevails, the interest rate hike in the first period that shifts the  $\text{IPLM}_3$ -curve to  $\text{IPLM}_3'$  is also optimal considered in the medium term, as it prevents multiple equilibria in period 3 and ensures that only the “good” equilibrium  $A$  is feasible.
- (ii) This conclusion changes, however, if the positive effect of  $E_1$  on the debt burden of period 2 dominates the  $W_3$ -curve so the upward sloping  $W_3^{\text{DB}}$ -curve prevails. In this case the nominal appreciation brought about by the first period interest rate hike becomes detrimental to firms, because it must be followed by lower prices in the medium term to ensure the real depreciation needed to restore PPP. The dashed  $W_3^{\text{DB}}$ -curve in Figure 3 illustrates this, and the corresponding story is: If the economy avoids the crisis in period 1 *without* raising the interest rate, output in the third period is given by the “good” equilibrium  $B$ , but if the central bank follows the policy recommendation and tightens the first period stance, the resulting increase in the second period debt burden could bring about a crisis that drives  $y_3$  to zero as dictated by the “bad” equilibrium  $C$  at the intersection of the  $\text{IPLM}_3'$  and the  $W_3^{\text{DB}}$ -curve. Intuitively the lower period-2 prices result in both (a) lower inflation and thereby a higher real interest rate on domestic debt and (b) a depreciation of the real exchange rate that increases the burden of foreign currency debt equivalently. Both effects decrease firm profit and if strong enough they can cause a crisis in the medium term.

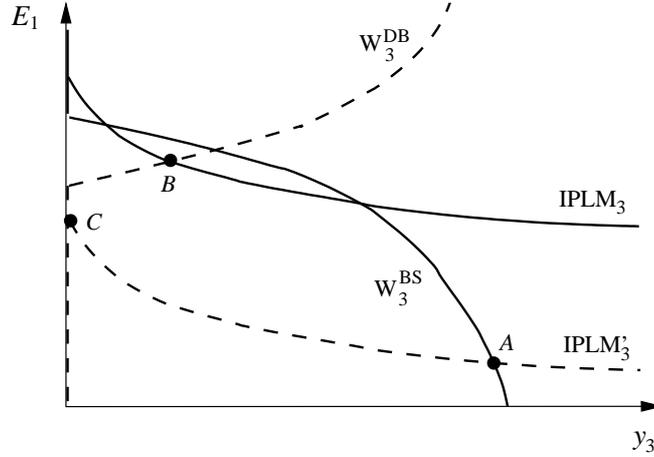
In conclusion we find that once we include a consideration of the medium-term consequences of the first period monetary policy stance, then, depending on the characteristics of the economy, we might have to modify the policy recommendation of hiking the first period interest rate. This is an important qualification of ABB’s findings.

Following these insights it seems natural to consider whether there is a scope for an active monetary policy beyond the first period. So far we have assumed that in the medium and long term monetary policy is held constant as the government follows an interest rate targeting or inflation targeting policy.<sup>10</sup> One could consider, however, whether if the

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<sup>10</sup>If monetary policy remains constant, inflation is fixed from period 4 and onwards.

Figure 3: The effect of an interest rate hike in the medium term.



economy is characterized by the description in (ii) above this strategy is sub-optimal, since relaxing this assumption would give the monetary policy authorities more room to maneuver. One important caveat about these considerations is that in periods after period 1 this framework is a perfect foresight model. This means that changing the interest rate in the second period will have an effect on the exchange rate in the preceding period, but as introducing uncertainty beyond the first period is beyond the scope of this thesis we shall assume that the central bank announces its entire future course of action with full credibility in response to the initial shock.

As documented in equation (14) and mentioned previously, the position of the  $IPLM_3$ -curve depends on both  $i_1$  and  $i_2$ , so at first glance it might seem as if the central bank could counteract the medium-term effects of the tight policy stance in the first period by adopting a lax monetary policy in the second period and through that shift the  $IPLM_3'$ -curve back to  $IPLM_3$ . This strategy, however, counteracts the short-term effects of the first period rate hike too, as it leads to a depreciation of  $E_1$ . Intuitively, lowering the interest rate in period 2 causes a depreciation because it makes it less attractive to hold domestic currency in the second period, but this foreseen depreciation makes domestic currency an unattractive asset in the first period too and thereby prevents the desired first period appreciation. We can observe this by considering the expression for the short-term  $W$ -curve in equation (10) too: To lower the interest rate in the second period, the central bank must increase the supply of money  $M_2^S$ , which ceteris paribus shifts  $IPLM$ -curve up and leads to a depreciation that can cause a crisis in the short term. This means that if the economy is characterized by an upward sloping  $W_3$ -curve the central bank potentially

faces a trade off when conducting monetary policy in the periods following a shock. It needs to carefully evaluate whether and how much to tighten the first period monetary policy stance as there is a risk of inflicting a deterioration of the balance sheets of firms strong enough to cause a crisis in the medium term.

This conclusion holds for monetary policy in the later periods too: Since PPP and UIP holds *ex post* in all periods beside the first, the exchange rate in the medium and the long term has no impact on the economy, and the monetary authorities cannot with any means cause a depreciation in the first period without increasing the risk of a crisis. Considering the recommendations to monetary policy this means that when the shock occurs the central bank needs to assess which of the above mentioned effects will dominate the  $W_3$ -curve in the medium term and include this in the evaluation of how much to hike the current interest rate.

### 3 A risk premium on domestic bonds

Uncovered interest parity builds on the assumption that domestic and foreign interest-bearing assets are perfect substitutes, and it is a critical building block of the ABB model. UIP is, however, considered by many studies to be, in the words of Flood and Rose (2002): “a dismal empirical failure”. Therefore it is relevant to examine a deviation from UIP in the form of a risk premium on domestic assets as a modification to the benchmark ABB framework.<sup>11</sup> In addition to obtaining a better approximation of the facts introducing a risk premium in the model provides a means for considering contagion between “healthy” economies and a means for discussing the effect of prospective capital controls; a measure suggested by Krugman (1999) and Miller et al. (2006) as emergency response to an impending crisis.

We shall assume that there is a constant, exogenously given risk premium ( $\eta$ ) on domestic bonds. Including this premium the interest parity condition becomes:

$$(1 + i_t) = (1 + i^*)(1 + \eta) \frac{E_{t+1}^e}{E_t}. \quad (17)$$

Introducing a risk premium on domestic assets also affects the benefits of firms, as it changes the foreign currency cost of the debt of firms to foreign creditors to  $(1 + i^*)(1 + \eta)$ .

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<sup>11</sup>As has already been mentioned, ABB (2001) briefly consider the possibility of a risk premium, but do not develop it formally aside from a modified IPLM-curve.

This does not, however, induce firms to alter the currency composition of their debt, since *ex ante* PPP 1 and the modified interest parity condition 17 ensure that the expected cost of foreign and domestic debt, measured in domestic currency, are still equivalent. Intuitively an increase in the risk premium will bring about a depreciation of the current exchange rate subsequently causing the future appreciation that ensures interest parity holds. Domestically the future appreciation will, through PPP, result in lower inflation and thereby a higher real interest rate which equalizes the cost of borrowing in foreign and domestic currency.

Including the changed cost of foreign currency borrowing the aggregate nominal profit of firms is now given by:

$$\Pi_t = P_t y_t - (1 + i_{t-1}) P_{t-1} d_t^c - (1 + i^*)(1 + \eta) \frac{E_t}{E_{t-1}} P_{t-1} (d_t - d_t^c) \quad (18)$$

With the risk premium formally implemented, we now develop the modified IPLM- and W-curves to consider the effects.

### 3.1 Short term implications of introducing a risk premium in the ABB framework

Combining the interest parity condition including a risk premium 17 with the standard LM-relation 4 and applying *ex ante* PPP 1 for  $t = 2$  yields the following modified IPLM-relation:

$$E_1 = \frac{(1 + i^*)(1 + \eta)}{1 + i_1} \frac{M_2^S}{m^d(y_2, i_2)} \quad (19)$$

Inserting the modified expression for aggregate nominal profit 18 into the production function 5 along with the equation for firm wealth 7 and using *ex post* PPP 2 for  $t = 0$  yields:

$$y_2 = f \left\{ (1 + \mu)(1 - \alpha) \left[ y_1 - (1 + r_0) d_1^c - (1 + i^*)(1 + \eta) \frac{E_1}{P_1} (d_1 - d_1^c) \right] \right\} \quad (20)$$

Finally, representing 20 along with the non-negativity constraint  $y_2 \geq 0$  in the  $(y_2, E_1)$ -plane yields the modified W-curve.

In order to examine the impact of the introduction of a risk premium on the likelihood of a crisis we derive a modified version of the necessary condition for a crisis following from

the modified IPLM- and W-curves:

$$E_1|_{W, y_2=0} = \frac{P_1[y_1 - (1 + r_0)d_1^c]}{(1 + i^*)(1 + \eta)(d_1 - d_1^c)} < \frac{(1 + i^*)(1 + \eta)}{1 + i_1} \frac{M_2^s}{m^d(0, i_2)} = E_1|_{IPLM, y_2=0}$$

From this we can observe that an increase in the risk premium shifts the modified IPLM-curve upwards in the  $(y_2, E_1)$ -plane, since, for a given current interest rate and future money demand, a higher risk premium implies a higher (i.e. a depreciated) exchange rate. We also note that a higher risk premium shifts the modified W-curve downwards in  $(y_2, E_1)$ -space, because the increased burden of foreign currency debt for a given current exchange rate ( $E_1$ ) results in lower current firm wealth and thus lower investment and production in the future. Therefore we can conclude that a country specific (positive) risk premium by affecting both the IPLM- and W-relations unambiguously increases the short term likelihood of a crisis.

### 3.2 Implications of a risk premium in the medium term

To consider the effect of a risk premium in the medium term we derive the IPLM<sub>3</sub>- and W<sub>3</sub>-curves as we have done above but substituting the interest parity relationship including the risk premium 17 for the UIP 3 and the modified expression for firm benefits 18 for the benchmark equation 6. We find that the modified IPLM<sub>3</sub>-curve is given by:

$$E_1 = \frac{(1 + i^*)^2(1 + \eta)^2}{(1 + i_1)(1 + i_2)} \frac{M_3^S}{m^d(y_3, i_3)}$$

While the modified W<sub>3</sub>-curve for  $y_3 \geq 0$  is given by:

$$y_3 = f \left\{ (1 + \mu)(1 - \alpha) \left[ y_2 - (1 + i^*)(1 + \eta) \frac{P_1}{E_1} d_2 \right] \right\}$$

Studying these equations we can immediately conclude that the risk premium enters the medium term relations in the same way it enters the short term IPLM- and W-curve ergo it must have the same qualitative effects in the medium term, i.e. increase the likelihood of a crisis. At a first glance the one exception could seem to be the case of an upward sloping W<sub>3</sub>-curve described above, because shifting the W<sub>3</sub>-curve down or the IPLM<sub>3</sub>-curve up actually reduces the likelihood of a crisis in this case. Upon further consideration, however, we see that this case is no exception: since a higher risk premium makes the economy more vulnerable in the first period, it forces the central bank to a larger interest rate hike to avoid the crisis, and so because it would have led to a crisis in the short term this special

case would-be beneficial effect of the risk premium never exists in the medium term.

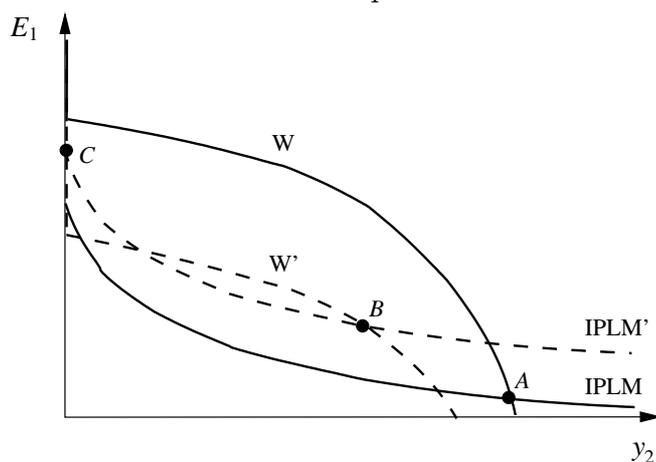
The unambiguous conclusion about risk premia is an interesting finding for several reasons: Firstly, as previously discussed, empirical evidence support the existence of risk premia in the foreign exchange market. More specifically, studies have found both country risk and exchange risk premia on securities issued by countries and companies in emerging markets (see e.g. Domovitz et al. (1998) for an extensive study of Mexican securities). We have now documented that the existence of such premia, according to a modified version of the ABB framework, makes an economy more vulnerable meaning that it will be more likely to suffer a currency crisis if hit by an unexpected shock. In addition to this a risk premium allows us to use the present framework for explaining the contagion of crisis into “healthy” economies as well as provides a means for considering the effects of prospective capital controls. The following two sections expand on each of these points respectively.

### **3.3 Using risk premia to explain contagion**

We have already considered above how the effect on of a foreign crisis on domestic expectations can cause a such a crisis to spread from one economy to others considered similar in the eyes of market participants, but expectational shifts can only push an economy over the edge if it is already in the vulnerable “ripe-for-attack” scenario. The inclusion of a risk premium on domestic assets, however, introduces a way of explaining how even healthy economies for which only the “good” scenario is initially feasible can suffer from the contagiousness of crises.

Though we have assumed that the risk premium is country specific, it seems likely (in a world of less than full information) that important events in one country can affect market participants’ assessment of both the country and exchange rate risk of other economies with similar characteristics. In the case of Southeast Asia it is likely that the occurrence of a less than fully foreseen currency crisis in Thailand signalled to investors that the economical setup of the ASEAN countries was more vulnerable and their debt and currency thus more risky than previously perceived. Such interlinkages between risk premia can help explain the contagion of healthy economies as illustrated in figure 4. The story corresponding to the figure is: if we assume that due to the similarities of the ASEAN-5-countries, the collapse of the Thai Baht caused foreign investors to increase the risk premia demanded on debt and other assets from countries with economical characteristics akin those of Thailand. From the viewpoint of another ASEAN-country this would shift the IPLM-curve up to  $IPLM'$  and the  $W$ -curve down to  $W'$  and could thus move the

Figure 4: An increase in the risk premium on domestic assets



economy from a scenario where only the “good” equilibrium  $A$  is feasible into the “ripe-for-attack” scenario in which it can either escape the crisis in the “good” equilibrium  $B$  or collapse into the “crisis” equilibrium  $C$  depending on market expectations.<sup>12</sup>

This way of explaining contagion is based on how market sentiment regarding some groups of countries (e.g. the emerging markets in general) can shift suddenly. The impact of market sentiment is fundamentally beyond the framework of the ABB model, but through the introduction of a risk premium this section has provided a simplified exposition of how sentiment can help explain the spreading of the crisis from Thailand into the Philippines, Malaysia, Indonesia and finally Korea, though these economies were all previously considered relatively healthy.

### 3.4 The effect of prospective capital controls

In addition to considering “standard” monetary policy both Krugman (1999) and Miller et al. (2006) suggest temporary capital controls as a means of preventing a crisis following a sufficiently adverse shock, and Miller et al. demonstrate theoretically in a modified version of the ABB framework that capital controls can be effective in preventing a crisis. Their argument shall not be repeated here, but a comment is in order. Since they implicitly assume that capital controls have no effect on the economy before their imposition (possibly because they are completely unexpected), the possibility of capital controls do not influence the *ex ante* likelihood of a crisis. By means of the risk premium introduced in

<sup>12</sup>If the increase in the risk premium is large enough, it is also possible for the economy to be pushed all the way into the “bad” scenario where only the “crisis” equilibrium is feasible.

the modified framework in the previous sections we can consider the effect of *prospective* capital controls.

Because capital controls drive a wedge between the domestic and the foreign interest rate,<sup>13</sup> the expectation of a possible future imposition of capital controls will increase the risk premium demanded by foreign investors to hold domestic assets. As Neely (1999) concludes (when considering the resumption of free capital flows after a period of capital controls): “blocking the departure of capital temporarily subsidizes investment but raises the perception of risk, increasing a risk premium and/or deterring future investment”.<sup>14</sup> Though this result is intuitively appealing, the lack of data on the expectations of future capital controls virtually prohibits empirical studies. Dooley and Isard (1980), however, examine data on German and Euromark interest rates in the 1970’s using a simple model of portfolio behavior and the fact that Germany had capital controls in place in the period 1970–74. They find that the resulting deviation from interest parity can be divided into a part attributable to “the effective tax imposed by existing controls” and a part caused by the “political risk premium associated with prospective controls”.<sup>15</sup>

Considering this effect of prospective capital controls on the risk premium yields the paradoxical result that an expectation of future capital controls (as a probable response to a future shock) shifts the *W*-curve up and the *IPLM*-curve down by causing a higher risk premium on domestic assets; this in turn makes the economy more vulnerable and therefore increases the likelihood that such capital controls will be needed. These arguments do not dispute that an unexpected imposition of capital controls can be an optimal response to an impending crisis, but if we assume that the agents understand the objectives of the monetary policy authorities and thus will foresee that capital controls are an option, there will be a trade off between the negative effect of the prospective capital controls on the risk premium and the benefit of retaining capital controls as an option in response to a crisis. Depending on the circumstances such a trade off could make it optimal for monetary authorities to relinquish the option of capital controls e.g. by signing a credibly binding international agreement prohibiting capital controls. Whether this will be the case depends among other things on the parameters of the model, the nature of expectations and the sequence in which the agents and the monetary authorities act. At any rate it is important for the central bank to consider the potentially negative effect of prospective

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<sup>13</sup>See e.g. Grilli and Milesi-Ferretti (1995).

<sup>14</sup>Neely (1999) p. 28.

<sup>15</sup>Dooley and Isard (1980) p. 370.

capital controls both when considering rhetoric and actual policy.

In 1998 during the Southeast Asian crisis Malaysia did in fact impose controls on international capital transactions, and it could provide for an interesting study of the effects described above to examine whether the announcement of these controls by the Malaysian authorities affected the risk premium on securities issued by governments and firms in the other ASEAN countries. This would be a rather complex empirical task, and so it is outside the scope of this paper.

## 4 Conclusions

This paper re-examines the Aghion, Bacchetta and Banerjee (2001) model and extends the analysis in different directions. First we formally derive the curvature of the two main relations (the IPLM-curve and the W-curve) and confirm the hitherto assumed shapes of the curves representing these relations. This is an important extension because the shapes of these curves are crucial in determining the number and stability of the potential equilibria. Our second contribution is that we explicitly examine the medium-term implications of the model we conclude that contrary to what ABB (2001) writes, we cannot exclude the possibility of neither multiple equilibria nor crisis in the medium term. This finding is important both for the understanding of crises as well as for the policy recommendations drawn from the model. Specifically we find that for some characterizations of the economy the short-term policy recommendation of raising the interest rate can have an adverse effect beyond the short term that could potentially cause a crisis; and so including a consideration of the medium term alters the optimal monetary policy response for some economies. This has the implication that policy makers must carefully evaluate the characteristics of their economy before bringing the different monetary policy advice to bear. This feature of the model is also consistent with empirical observations that interest rate defenses have been successful in some cases but unsuccessful in other.

Our main contribution is that we extend the model by assuming that agents are risk avert such that a risk premium on domestic assets is added to the UIP relation. Empirical studies have found risk premia in the foreign exchange market and some have found it especially relevant for emerging market securities. Not surprisingly this has the impact of making the economy more vulnerable to crisis, but in addition a risk premium can help explain contagion of healthy economies previously characterized by the “good” scenario if there is imperfect knowledge and the economy in question is considered similar to an

economy in crisis by market participants. Furthermore adding a risk premium provides a means for a theoretical inspection of the effect of prospective capital controls. A consideration of this issue yields the result that an expectation of future capital controls, by raising the risk premium, can increase the likelihood that such controls will be needed. This means the policy maker faces a trade-off between having the option of a potentially beneficial emergency use of capital controls and the adverse effect on the risk premium stemming from the possible future imposition of controls. An implication of this finding is that it could be optimal for the relevant authorities in some countries to relinquish this option if this can be done credibly. We also find that the negative impact of a risk premium extend to affect both the depth and duration of a crisis.

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