

**SUPPLY SHOCKS AND CURRENCY CRISES:  
THE POLICY DILEMMA RECONSIDERED**

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## **Abstract:**

The stylised facts of currency crises in emerging markets include output contraction coming hard on the heels of devaluation, with a prominent role for the adverse balance-sheet effects of liability dollarisation. In the light of the South East Asian experience, we propose an eclectic blend of the supply-side account of Aghion, Bacchetta and Banerjee (2000) with a demand recession triggered by balance sheet effects (Krugman, 1999). This sharpens the dilemma facing the monetary authorities - how to defend the currency without depressing the economy. But, with credible commitment or complementary policy actions, excessive output losses can, in principle, be avoided.

## **Keywords:**

Supply and demand shocks, financial crises, contractionary devaluation, Keynesian recession.

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# SUPPLY SHOCKS AND CURRENCY CRISES: THE POLICY DILEMMA RECONSIDERED\*

## Introduction

The “third generation” approach developed by Aghion, Bacchetta and Banerjee (2000), hereafter ABB, shows how liability dollarisation can trigger a fall in output as devaluation disrupts the *supply-side* of the economy; and the possibility of multiple equilibria implies a risk of sudden collapse in the exchange rate. Their influential analysis applies beyond the region of East Asia for which the model was initially developed: ‘fear of floating’ in Latin America, for example, is widely attributed to such balance sheet effects.

By contrast, in ‘analytical afterthoughts’ on the Asian crises, Paul Krugman (1999) adopted a *demand-side* account of a small open economy to argue that “a loss of confidence by foreign investors can be self-justifying, because capital flight leads to a plunge in the currency, and the balance-sheet effects of this plunge lead to a collapse in domestic investment.”

Can these two approaches be reconciled? What do the data suggest? What are the implications for policy? These are questions tackled in this paper.

## Some stylised facts from SE Asia

It is sometimes said that for countries, like Indonesia, Malaysia, Korea and Thailand, the currency crises of 1997-1998 abruptly changed the sign of the growth rate -- instead of growing in double figures, they contracted just as fast. Contraction typically began in the first two quarters after devaluation, with output reaching its lowest point within a year: the one-year fall in GDP averaged 10%. For small open economies, it is commonly assumed that export demand will act promptly to stabilise overall demand in the economy. But export volumes in the year after devaluation grew below trend, particularly for Indonesia: so it is difficult to argue that exports played a stabilising role in the short run.

A longer-run perspective may be obtained by plotting realised output against an estimate of trend potential, as Aghion and Banerjee (2005) do for Indonesia in their Clarendon Lectures. Repeating the exercise for Korea, Malaysia and Thailand produces similar results, with output falling sharply below the initial trend path estimated using pre-crisis observations; and recovering thereafter onto a lower trend.

On the Blanchard and Quah (1989) criterion, where shocks to output are classified as demand or supply depending on whether they are temporary or persistent, the data seem to indicate a severe *supply* shock. But would supply-side effects set in so rapidly? And with such magnitude? In the ABB model, strictly interpreted, it is *future* output that falls due to a productivity shock (amplified it may be by reduced investment due to the crisis): but output at the time of crisis remains unchanged as it is predetermined by past investment.

A more plausible interpretation of the data might be that the prompt initial fall in output reflects a temporary *demand* effect: while the subsequent downshift from pre- to post-crisis trend indicates a fall in potential *supply*. To accommodate this interpretation one needs to blend the determinants of demand and supply. This is the objective of this paper.

### **Supply-side shocks and policy response**

ABB's supply-side model focuses on the balance sheet effects of devaluation on the private sector in a small open economy. With liability dollarisation and one-period of price stickiness for the traded good, a rise in the price of the dollar generates adverse balance sheet effects; so investment is cut back, reducing productive potential in the next period. This "third generation" account offers a persuasive channel for the transmission of the exchange rate effects to the supply side; and the multiplicity of equilibria opens up the prospects of sudden shifts in the exchange rate.

An attractive feature of this model is that the equilibrium can be found at the intersection of two schedules relating to the goods market and to the asset market (not unlike the IS and LM schedules of Keynesian macroeconomics - except that the goods market refers to supply). These are plotted with future output (on the horizontal axis) and the exchange rate in the crisis period, measured by the domestic currency price of a dollar (on the vertical). Aggregate supply, the S-curve is, perhaps surprisingly, a *decreasing* function of the price of a dollar: this is because of the adverse balance-sheet effects of liability dollarisation on investment. (There is, however, a floor to the level of output reached in recession.) Asset market equilibrium is also decreasing in the exchange rate, and captures the impact of foreign interest rates and post-crisis monetary policy. (Some factors impact on both schedules: the increase of interest rate when the shock occurs, for example.) The intersection of these two curves defines equilibrium: but, because they are non linear, multiple equilibria can occur.

These schedules highlight the dilemma faced by policy-makers after a significant, unanticipated decline in the productivity which reduces aggregate supply and threatens recession with currency collapse (where the economy is in recession and asset market

equilibrium occurs at a greatly devalued rate against the dollar). “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?” ask ABB. They reply that “A standard recommendation (the IMF position) is to increase the interest rate”; and they observe that this shifts asset market equilibrium in line with the contraction of aggregate supply, so as to check the fall in the currency and the economy. Unfortunately high interest rates induce a *further* contraction of aggregate supply: so tight money is chasing a moving target. ABB go on to provide a condition that ensures that higher interest rates during the crisis will avoid recession and deliver a new equilibrium. (This condition requires that debt be largely denominated in foreign currency and that rising interest rate does not substantially reduce the credit available for investment.)

## Allowing for demand failure -- and “twin crisis”

The ABB analysis assumes that there is no aggregate demand failure resulting from the productivity shock. The demand for exports of a small open economy is typically assumed to be unlimited: so export demand would, in theory, provide an automatic stabiliser. But, as we have seen, the data do not support this.

To modify the supply-side approach and allow for demand contraction, the obvious step is to incorporate a multiplier effect of depressed investment on GDP, taking exports as pre-determined in the short run. In support of this Keynesian specification of demand determination, note that firms are in any case *credit-constrained* in the ABB model; and that, if devaluation is accompanied by a banking crisis (“twin crises”), both consumers and producers will typically be denied access to new credit.

In the main text, we plot this in a graph with aggregate *demand* at the time of crisis shown as a decreasing function of the exchange rate (because of balance sheet effects); and we discuss how this aggregate demand curve will shift will contract further in a “twin crisis”.

### *When is it safe to raise interest rates in a crisis?*

It is safe to raise the domestic interest rate to strengthen the currency only if the negative impact on aggregate supply is relatively small. *When output in the crisis is demand-determined, however, increasing the interest rate will have a greater negative impact on supply than ABB allow for. So the efficacy of tight money for defending the currency is weakened.* Showing that current monetary tightening would stabilise the exchange rate assuming full employment is no guarantee that it will do so when demand collapses.

### *The challenge for policy*

What if the condition for tight money to work at full employment is satisfied, but will fail if there is demand deficiency? Is recession inevitable? Our answer proceeds in a round-about fashion. We show initially that the first-best policy is to tighten money in *the future* and not when the shock occurs. Assuming this is ruled out, we consider how high interest rates in the crisis may be *complemented* by fiscal easing to maintain demand. Then we discuss policy options to protect the supply-side from the adverse effect of high interest rates.

To show that tightening future money is an appropriate policy in the ABB model is straightforward. Absent demand failure, the shock has no effect on current output, but lowers future output, so future money must be lowered in line with reduced supply to avoid a future fall in the currency. The effect is to contract the asset market schedule to the left in line with

the aggregate supply *without* the second round effects of raising interest rates in the crisis. So, in principle, output will contract in line with productivity at the pre-existing exchange rate. But this policy involves doing nothing in the crisis, while promising to take action in the future! So it may not be credible. Assume that this first-best policy is not implemented, and interest rates are raised at the time of the shock. What about the risk of demand collapse?

*(i) Maintaining demand*

The dilemma for the monetary policy arises from having two objectives – to strengthen the currency and protect the economy – with only one instrument, the nominal interest rate. Tinbergen's principle would suggest looking for another policy instrument. What if tight money is complemented by an easing of fiscal policy? The logic in support of this is straightforward. If fiscal policy is used to stabilise aggregate demand in the way that exports would have (if they had time to adjust), then there will be no demand shortfall and ABB's analysis applies.

So we conclude that the condition derived by ABB is appropriate *either* if demand for the output of a small open economy in crisis is inherently stable, *or* if fiscal policy action is taken to achieve the same result. Otherwise, there is a clear risk that unmitigated tight money will cause serious recession. Is this not the point being made by observers – like Joseph Stiglitz – who criticised the IMF policy recommendation of tight money and tight fiscal policy in the midst of the East Asia crisis?

*(ii) Protecting supply*

Demand stabilisation in a crisis may help avoid recession but the outcome is still second best: high interest rates have undesirable supply-side effects that were in principle avoided by the first-best monetary policy discussed above. Can one get to first-best *despite raising interest rates*? There are policy initiatives that should help.

(a) Emergency credit and/or fiscal transfers to stabilise aggregate supply

Given that the firms are credit-constrained, increasing cash flow could also help. Thus the government could try to ensure that banks keep current credit lines open; or it could provide temporary finance itself, e.g. extra lending via an emergency government loan programme might be considered.

If firms still want to invest despite the high interest rates, *fiscal devices* in the form of temporary investment allowances and/ or accelerated depreciation might be used. To protect

commercial firms from the higher cost of borrowing, interest rate subsidies could be employed.

(b) Capital controls to protect the currency

An alternative policy is to drive a wedge between the rate needed to reassure external investors and the domestic rate relevant to corporate investment by imposing temporary controls on capital, as recommended on a temporary basis by Paul Krugman in an 'Open letter to President Mahatir' in September 1998. Krugman's article in Fortune was entitled 'It's Time to Get Radical' because the IMF at that time was very much committed to capital account liberalisation.

A creditor standstill was implemented in Korea in December 1997, for example, when IMF and G7 funding was insufficient to meet anticipated withdrawals until key banks were persuaded to rollover their credit lines. But it was Malaysia that put Krugman's counsel to the test; with results reckoned ex post to be positive.

In principle, temporary capital controls could be used to implement the first-best monetary policy. Assuming that, in the period of the crisis, the announcement of future tight money is not credible, higher interest rates for overseas investors in domestic currency would normally be needed to keep the current value of the dollar below its (higher) future expected level. But the domestic economy can be protected from rising interest rates by capital controls which tax the proceeds of investing in dollars, see chapter 5 of the Clarendon lectures by Aghion and Banerjee for further discussion.

Capital account liberalisation allows for high speed movements; such controls act like emergency brakes. Whether governments can switch capital controls on and off in this fashion without losing credibility is an interesting question, on which the East Asian experience may throw some light.

(c) Debt restructuring to offset adverse balance sheet effects

As the dollar-denomination of debt lies at the heart of the balance sheet problem for private firms, relieving them of this debt burden should help. In terms of the model being discussed, it is dollarisation of corporate debt that gives a negative slope to the S-curve: consequently de-dollarisation makes the S-curve vertical, i.e. independent of the price of the dollar, and reduces the risk of financial collapse.

**Alternative perspectives**



Imagine, nonetheless, that the necessary demand management policies had in fact been put in place. The result could have been the delayed step-down shown in potential supply, without the immediate drop in output. But there are other possibilities that could be considered in future research. First that insulating domestic capital markets may help ensure macroeconomic stability; second that this may be at the cost of lower long-run growth. Both possibilities are illustrated in the paper using GDP data from India.

## **Conclusion**

Aghion, Bachetta and Banerjee (2000) trace the impact of devaluation on domestic investment and the supply-side of the economy via the balance sheets of credit-constrained firms: and the possibility of self-fulfilling crisis they uncover could help explain why many emerging markets live in “fear of floating”. Exclusive focus on supply-side economic contraction is an unnecessary limitation of their analysis. Demand failure may also be part of the story, due to a lag in export demand substituting for a falling investment orders in the midst of regional turmoil, for example; or to a credit crunch for a country suffering a ‘twin crisis’.

If this is the case, Tinbergen’s principle suggests complementing tight money with fiscal easing to maintain demand. In fact, first best policy in the ABB model requires credible promises of future tight money *without* high interest rates during the crisis. If this is not credible, fiscal and financial transfers and capital controls may be appropriate to shield the domestic economy from the impact of high rates. Here again we are appealing to Tinbergen’s principle, not arguing for lax monetary policy.

## Supply shocks and currency crises: the policy dilemma reconsidered

### Introduction

Key features of recent currency crises include a sharp output contraction coming hard on the heels of devaluation and the adverse effects of liability dollarisation threatening the solvency of commercial enterprises. The “third generation” approach developed by Aghion, Bacchetta and Banerjee (2000), hereafter ABB, demonstrates how liability dollarisation can trigger a fall in output as devaluation disrupts the *supply-side* of the economy;<sup>1</sup> and the possibility of multiple equilibria implies a risk of sudden collapse in the exchange rate. Their influential analysis applies beyond the region of East Asia for which the model was initially developed: ‘fear of floating’ in Latin America, for example, is widely attributed to such balance sheet effects, Calvo and Reinhart (2002), Calvo et al. (2003).

By contrast, in ‘analytical afterthoughts’ on the Asian crises, Paul Krugman (1999) adopted a *demand-side* account of a small open economy to argue that “a loss of confidence by foreign investors can be self-justifying, because capital flight leads to a plunge in the currency, and the balance-sheet effects of this plunge lead to a collapse in domestic investment.” In a more detailed framework, Céspedes et al. (2003) have shown that devaluation can lead to demand contraction in a highly-dollarised open economy, where adverse balance-sheet effects overwhelm gains in trade-competitiveness.

What do the data suggest? Can these two approaches be reconciled? What are the implications for policy? These are questions tackled in this paper. The data for South East Asia (SE-Asia) reviewed in the first section suggest that financial crises affect *both* demand and supply. The former shows up as a prompt of contraction output: the latter as a down-shift in the trend path of potential GDP. Assessing the adequacy of policy can only be conducted when both supply and demand are taken into account. If demand is at risk, a key part of financial management will be to maintain demand.

Exchange rate crises often face monetary policy-makers with a cruel dilemma: whether to raise interest rates to save the currency from collapse or to lower them to maintain investment and future output. In section 2, the policy dilemma that follows from an adverse productivity shock is illustrated using ABB’s graphical approach. In section 3 we outline an eclectic alternative framework that incorporates the demand effects of an exchange rate crisis and of a credit crunch. When is it appropriate to raise interest rates in a crisis? In section 4, we present the condition given by ABB and indicate how it is affected by demand recession. After discussing first-best policy in section 5, we consider how high interest rates in the crises may

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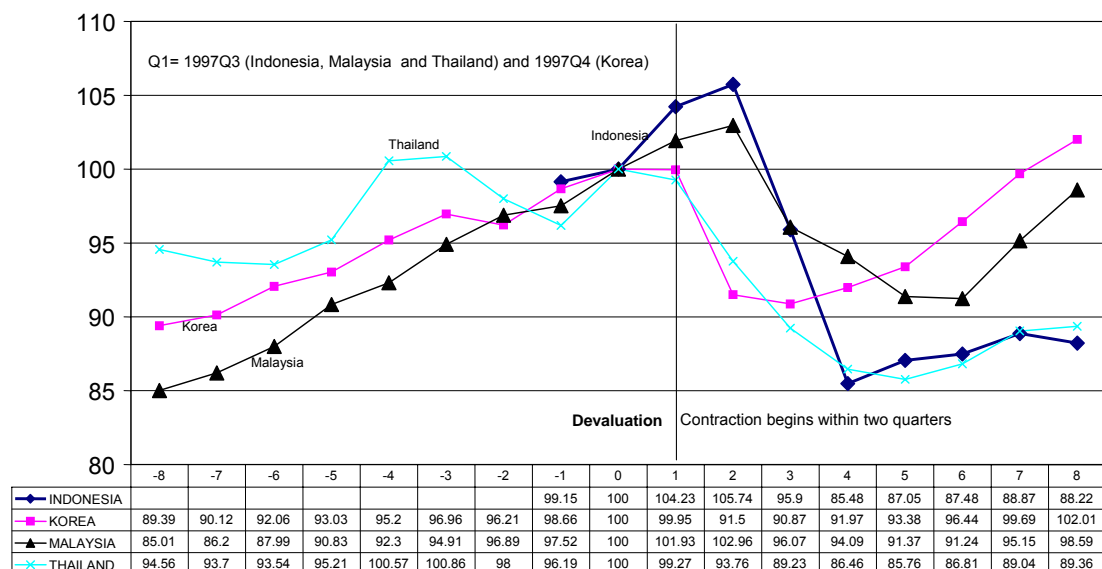
<sup>1</sup> While our analysis focuses on their initial basic model, notice is taken of subsequent developments published by the same authors wherever this is relevant.

be complemented by fiscal easing to maintain demand. We then discuss policy options to protect the supply-side from the adverse effect of high interest rates. After a brief consideration of alternative perspectives, suggested by data from India, the paper concludes.

## 1. Stylised facts of crises in South East Asia

The pattern of output contraction following sharp falls in the real exchange rate in four of the crisis countries in SE-Asia is shown in Figure 1, which plots GDP over 4 years for Indonesia, Malaysia, Korea and Thailand<sup>2</sup>. (The data are time-shifted to centre on the quarter before devaluation occurred, labelled as period 0; and output volumes in period 0 are normalised to 100.) Contraction typically begins in the two quarters following devaluation; and GDP reaches its lowest point within a year.

Figure 1: GDP in SE Asia (quarterly)



Source: IMF:IFS Note: the data are time-shifted to centre on the quarter before devaluation occurred, labelled as period 0; and output volumes in period 0 are normalised to 100. Seasonally adjusted using the independent pre-crisis and post-crisis trend lines shown for calculating residuals (excluding crisis-affected period from Q1 to Q4)

It is sometimes said that, for these countries, currency crisis abruptly changed the sign of the growth rate. The year-on-year fall in GDP in the four countries under discussion averages 10%, see Table 1, column 1.

<sup>2</sup> ABB cite Korea and Thailand as two possible case studies of their model.

Table 1: Falling Tigers: Changes in GDP and exports, 1997-1998

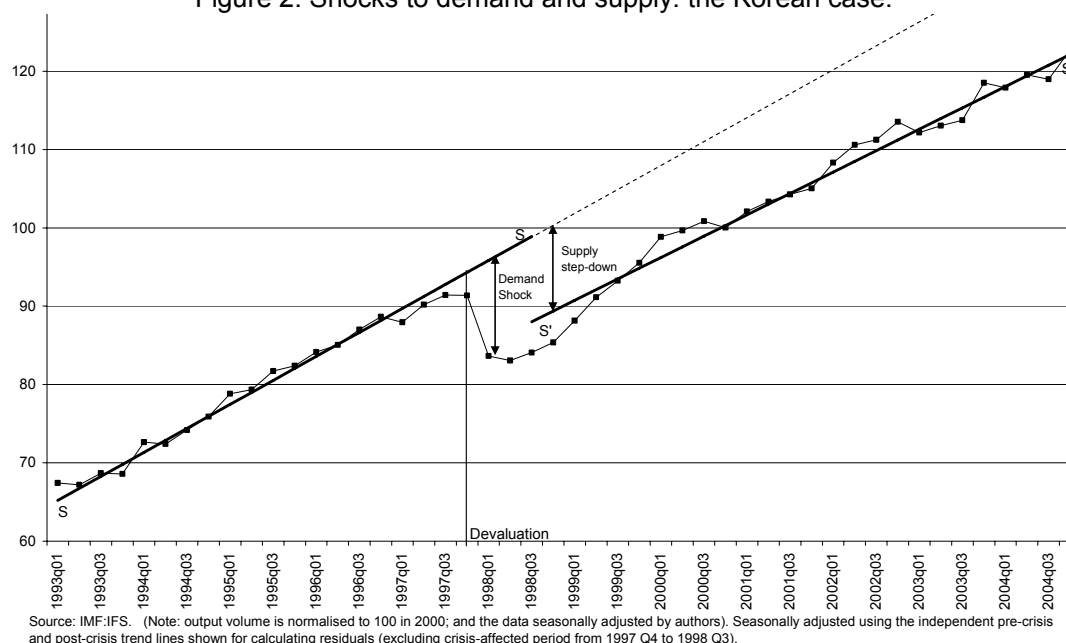
	Real GDP growth		Growth in export volume	
	1997-1998	Pre-crisis Trend	1997-1998	Pre-crisis Trend
Indonesia	-13%	7%	-7%	6%
Korea	-7%	7%	19%	13%
Malaysia	-7%	9%	7%	13%
Thailand	-11%	8%	8%	16%
<b>AVERAGE (unweighted)</b>	<b>-10%</b>	<b>7.75%</b>	<b>7%</b>	<b>12%</b>

Source: IMF:IFS.

For small open economies it is commonly assumed that exports will act promptly to stabilise overall demand in the economy. In volume terms, on average exports from SE Asia continued to grow year-on-year -- but below trend. This was clearly not enough to offset the collapse of domestic demand, particularly in the case of Indonesia, see Table 1.

A longer-run perspective of the impact of crises may be obtained by plotting realised output against an estimate of trend potential. This is what Aghion and Banerjee (2005) do for Indonesia in their Clarendon Lectures, using estimates of potential supply from Griffith-Jones and Gottschalk (2004). Repeating the exercise for Korea produces similar results, as shown in Figure 2, with the initial trend path (estimated using pre-crisis observations) labelled SS: output falls sharply, and then recovers to a lower trend path shown as S'S'. A matching analysis for Malaysia and Thailand, two other countries mentioned in ABB, is provided in Appendix A.

Figure 2: Shocks to demand and supply: the Korean case.



How is this data to be interpreted in terms of demand and supply? On the Blanchard and Quah (1989) criterion, where shocks to output are classified as demand or supply depending

on whether they are temporary or persistent, the Korean data in Figure 2 would seem to indicate a severe supply-side shock. But would supply-side effects set in so rapidly? And with such magnitude? In the ABB model, moreover, it is *future* output that falls due to a productivity shock (amplified it may be by reduced investment due to the crisis): but output at the time of crisis remains unchanged as it is *predetermined* by past investment and productivity.

A more plausible interpretation of the data in Figure 2 might be that the prompt initial fall in output reflects a temporary *demand* effect<sup>3</sup>: while the subsequent downshift from pre- to post-crisis trend indicates a fall in potential *supply*. To accommodate this interpretation, represented in highly stylised fashion in the Figure, one needs to blend the determinants of demand and supply. This is the objective of this paper.

## 2. Supply-side shocks and policy response

Policy makers in East Asia faced a cruel dilemma: whether to raise interest rates to reassure foreign investors or to lower them in order to protect domestic industry.<sup>4</sup> This policy dilemma is analysed by ABB who provide a formal condition which ensures that increasing domestic interest rates<sup>5</sup> will avoid collapse. Is their analysis robust to fluctuations in demand? After allowing for demand contraction, we find a new, more restrictive, condition. Before discussing this and its policy implications, we briefly describe the ABB model and how it illuminates the policy dilemma.

There is a dynamic supply-side model which focuses on the balance sheet effects of devaluation on the private sector in a small open economy. With liability dollarisation and one-period of price stickiness for the traded good, a rise in the price of the dollar generates adverse balance sheet effects; so investment is cut back, reducing productive potential in the next period. This “third generation” account offers a persuasive channel for the transmission of the exchange rate effects to the supply side; and the multiplicity of equilibria opens up the prospects of sudden shifts in the exchange rate. Key features of this widely cited two-period model may be summarised as follows.<sup>6</sup>

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<sup>3</sup>For Thailand, for example, Fischer (2001, Chapter 1, p.14) notes that “it became clear during September and October 1997 that the crisis was taking a much greater toll on *aggregate demand* than had previously been expected.” (Italics added.)

<sup>4</sup> It has also surfaced elsewhere: in Brazil in 2002 when markets took fright at the prospect of a Left-wing president to cite but one instance.

<sup>5</sup> In a later paper, the authors argue that “the correct policy response in this case is obviously to increase the interest rate  $i_1$  and/or decrease  $M_2$  so that the IPLM curve shifts downward.” ABB (2001, p. 1141). We explore this possibility in Appendix C.

<sup>6</sup> The relevant equations are given in Appendix B.

There is full capital mobility and uncovered interest parity holds. Purchasing Power Parity (PPP) for traded goods also holds, except in period 1 when an unanticipated shock leads to a deviation as prices are preset, but other variables — the nominal exchange rate in particular — are free to adjust. The actual timing of events in period 1 is: the price of traded output is pre-set according to the ex-ante PPP condition and firms invest; then there is an unanticipated shock<sup>7</sup>, followed by the adjustment of interest rate and the exchange rate; finally, output and profits are generated, with a fraction of retained earnings saved for investment in period 2. Together with investment funded by lending, this determines the level of production in the second period, when prices are flexible so PPP is restored.

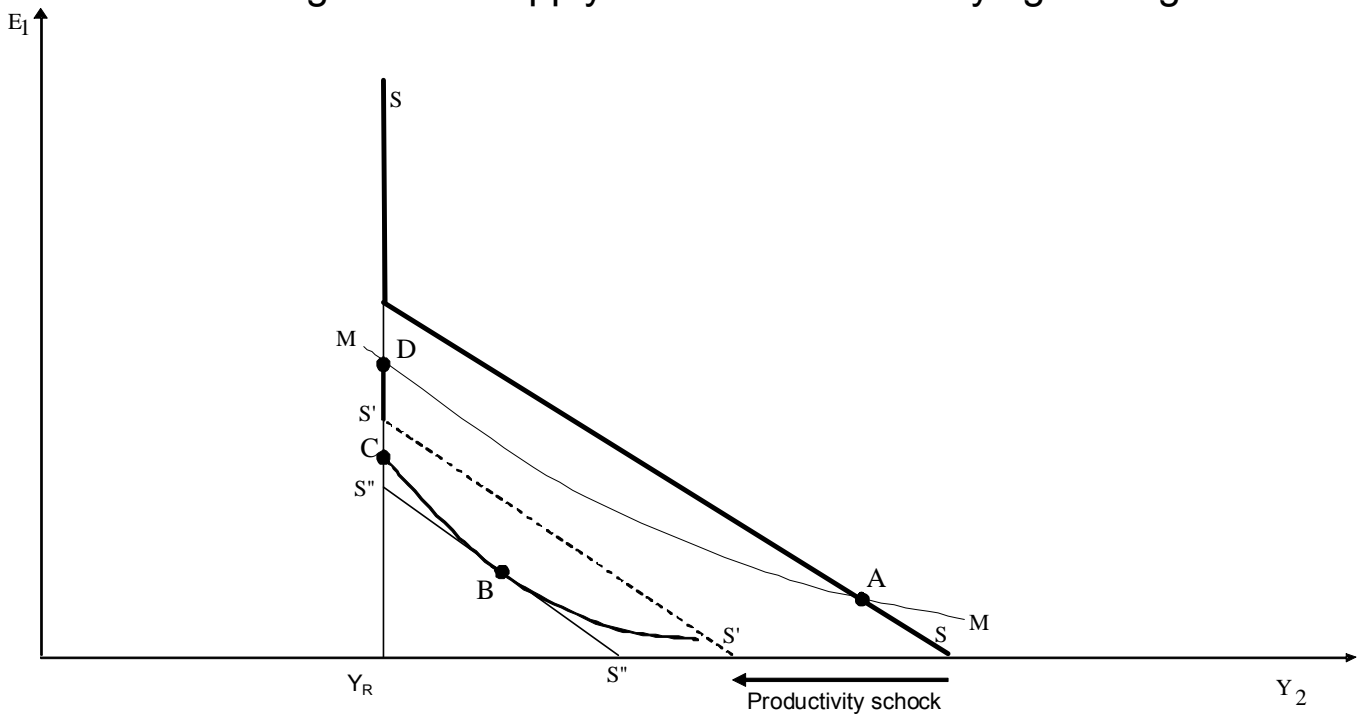
An attractive feature of this model is that the equilibrium can be found as the intersection of two schedules relating output and the exchange rate as in Figure 3. (Note that output is lagged one period behind the exchange rate, measured by the domestic currency price of a dollar; and that we have taken the liberty of using the more suggestive labels SS and MM in place of the labels W and IPLM in ABB.) First is aggregate supply, the S-curve, sloping downwards from a floor level at  $Y_R$ : this incorporates the adverse balance-sheet effects of liability dollarisation on investment and reflects the impact of productivity shocks. Second is asset market equilibrium, the M-curve, which captures the impact of foreign interest rates and post-crisis monetary policy. (Some factors impact on both schedules: the increase in interest rates when the shock occurs, for example.) The intersection of these two curves defines equilibrium, as shown at point A in the Figure.

These schedules highlight the dilemma faced by policy-makers after a significant, unanticipated decline in productivity. The negative shock moves SS down to S'S' threatening to lead to recession at D in Figure 3, where the M-curve intersects the floor on output denoted  $Y_R$ . "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?" ask ABB (2000, p. 736). Their answer is that "A standard recommendation (the IMF position) is to increase the interest rate ... this shifts down the Asset Market curve". As this induces a further contraction of supply, however, S'S' shifts further to the left. ABB go on to provide a condition that ensures that the M-curve moves to the left more than the S-curve as interest rates increase: if satisfied, higher interest rates will avoid recession and deliver equilibrium at a point such as B on S'S'.

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<sup>7</sup> If the shock is anticipated, the expected price adjustment eliminates the balance sheet effect, Becker (2006).

Figure 3: A supply shock with monetary tightening



### 3. Allowing for demand failure -- and “twin crisis”

The ABB analysis assumes that there is no aggregate demand failure resulting from the productivity shock. Investment may fall due to balance sheet effects, but this does not affect output at the time of the currency crisis. The demand for exports of a small open economy is typically assumed to be unlimited: so export demand would, in theory, provide an automatic stabiliser. The data, however, do not support this. Calvo and Reinhart (2000), for example, find that in the case of an emerging market currency crisis, exports typically *fall* before recovering to their pre-crisis levels: the lag before recovery is 8 months or, with a banking crisis, 20 months. In an investigation of devaluations in emerging economies, Frankel (2005, p.157) concludes “that devaluation is contractionary, at least in the first year, and perhaps in the second as well.” These observations, together with the data in Figure 1 above, suggest that excess supply may indeed be a problem at least in the short run.

To modify the supply-side approach and allow for demand contraction, the obvious step is to incorporate a multiplier effect of depressed investment on GDP, taking exports as pre-determined in the short run. To further justify the assumption that exports are slow to respond, note that the crisis in East Asia was spread across the region: so nearby markets were in no position to absorb extra exports. Other factors include contract lags and physical capacity constraints: the export response to the spectacular fall of the Indonesian currency in 1997/98 was considerably hampered by lack of container shipping capacity, for example. In support of the Keynesian specification of demand determination, note that firms are in any case *credit-*

*constrained* in the ABB model; and that if devaluation is accompanied by a banking crisis (“twin crises”), both consumers and producers will typically be denied access to new credit.

With demand-determined output, the fall of investment will cut current output and consumption. Specifically, let output in period 1 be determined as follows:

$$Y_1^D = A_0 + \gamma\beta(Y_1 - D_1^*) + (1 + \mu_2)(1 - \beta)(Y_1 - D_1^*) + \bar{X} - mY_1 \quad (1)$$

where  $D_1^*(E_1) = (1 + r_0)D^c + (1 + i^*)(E_1/P_1)(D_1 - D^c)$  is the total cost of debt services and  $Y_1$  is aggregate demand measured in constant prices. The first term,  $A_0$ , represents autonomous expenditure (which is not related to debt or current income). The second term indicates how consumption demand depends on income and debt, where  $\beta < 1$  is the labour share of income and  $\gamma < 1$  is the fraction spent on consumption. The third term is demand for investment with  $(Y_1 - D_1^*)$  representing corporate profits net of borrowing costs, and  $\mu$  the credit multiplier. The last two terms represent net exports, where export volumes are assumed fixed in the current period while imports vary proportionally with current income.

The failure of export volumes to stabilise demand means that a collapse of investment (due to balance sheet effects, for example) can reduce realized output in the current period (as well as supply potential in the next period), as can be seen from the solution for current output:

$$Y_1^D = \frac{A_0 + \bar{X} - D_1^*(E_1) [\gamma\beta + (1 + \mu_2(i_1))(1 - \beta)]}{1 + m - [\gamma\beta + (1 + \mu_2(i_1))(1 - \beta)]} = \frac{A_0 + \bar{X} - \xi D_1^*}{1 - \xi + m} < Y_1^S \quad (2)$$

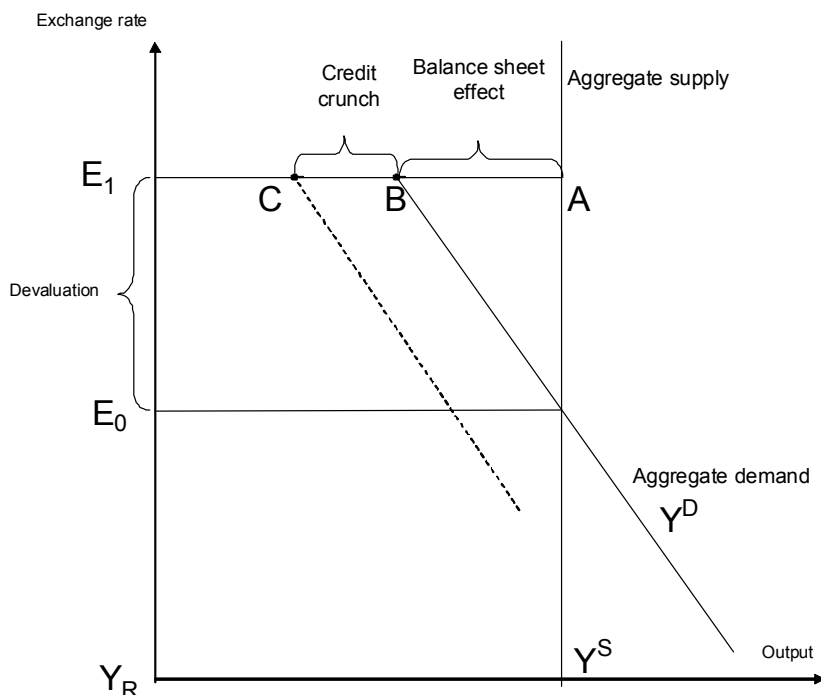
where  $\xi = \gamma\beta + (1 + \mu_{t+1})(1 - \beta)$  and  $1 > 1 - \xi + m > 0$ , and  $Y_1^S$  is the aggregate supply in the same period. The predetermined factors in the numerator include debt service and exports volumes; and the term  $1/(1 - \xi + m)$  is a Keynesian-style multiplier, where  $1 - \xi$  is the marginal propensity to save and  $m$  is the marginal propensity to import.

How demand failure can lead to prompt contractionary devaluation is indicated in Figure 4, with output in period 1 on the horizontal axis and the exchange rate in period 1 on the vertical. As it depends on output and interest rate in the previous period, aggregate supply appears as a vertical line  $Y_1^S$ . Aggregate demand, however, moves inversely with the current exchange rate due to the adverse balance-sheet effects of a devaluation which raises the price of a



dollar from  $E_0$  to  $E_1$  and increases  $D_1^*(E_1)$  in equation (2). At  $E_1$ , for example, demand has fallen by AB.

Figure 4: Aggregate demand and supply in period 1.



In a “*twin crisis*”, devaluation will be accompanied by demand failure as the credit crunch will reduce the multiplier  $\mu_2(i_1)$  in equation (2) and shift the aggregate demand schedule further to the left, as shown by the dotted line in the Figure.<sup>8</sup> So output could fall to C at  $E_1$ . As for the effects of raising interest rates to defend the exchange rate, they are demand-contractory: an increase in the period 1 interest rate will reduce  $Y_1^D$  as high interest rates impact adversely on the credit multiplier and so on investment.

In Table 2 we compare and contrast the standard ABB model, where output is supply-determined, with what occurs when exports are predetermined. For ABB, an adverse devaluation-induced shock to the balance sheet in period 1 has no effect on period 1 output (which is determined by previous period investment), but cuts it in period 2 via reduced capital accumulation, see column 1.

<sup>8</sup> Becker (2006) discusses the conditions under which a credit crunch will reduce output in this context.

Table 2: How demand recession modifies output levels.<sup>9</sup>

	ABB's Model	Our modification
$Y_1$	$Y_1^S(ABB) = \sigma [1 + \mu_1(i_0)](1 - \alpha)[Y_0 - D_0^*]$ $Y_1 = Y_1^S(ABB) = Y_1^D$	$Y_1^D = [\gamma\beta + (1 + \mu_{t+1})(1 - \beta)](Y_t - D_t^*) +$ $+ A_0 + \bar{X} - mY_t$ $Y_1 = Y_1^D < Y_1^S = Y_1^S(ABB)$
$Y_2$	$Y_2^S(ABB) = \sigma [1 + \mu_2(i_1)](1 - \alpha)[Y_1 - D_1^*]$	$Y_2^D = Y_2^S < Y_2^S(ABB)$

When there is excess supply in period 1, however, the impact of an anticipated currency collapse is more immediate and more damaging. Balance-sheet effects reduce investment in period 1 directly: but this triggers a contraction of income within the period, which in turn leads to even less investment as profits fall. The knock-on effect on period 2 means that future supply is less than predicted by the ABB model.<sup>10</sup>

An important issue addressed in the Clarendon lectures is whether the effect of high rates on bank lending will be offset by the anticipated adjustment of prices – whether  $\mu_2(i_1)$  should depend on the nominal or the real rate of interest. In theory, adjusting the nominal rate for expected inflation when price stickiness ends, will drastically diminish the prospect of crisis. In practice, however, nominal rates in crisis countries were pushed to extraordinarily high levels, much higher than subsequent inflation. When markets panic, it seems, real rates rise too and credit is cut back. For these reasons, we stay with the original ABB formulation where the S-curve slopes downwards.<sup>11</sup>

<sup>9</sup> Note that in table 2, we have followed ABB in assuming that output in period 2 is supply-determined. This does not mean that output in period 2 matches that of the ABB model, however: the contraction is greater because of the reduced investment associated with the fall in aggregate demand in period 1.

<sup>10</sup> Cutting  $\mu_1$ , credit multiplier corresponding to period 0, would have same effects on period 1 supply in both models.

<sup>11</sup> This is the crisis-prone intermediate case referred on pp. 1142-3 of ABB (2001): see Clarendon Lectures pp.117-21 for further discussion.

#### 4. When is it safe to raise interest rates in a crisis?

ABB provide a condition for when it is appropriate to raise interest rates in a crisis. We have seen graphically that it is appropriate to raise the domestic interest rate only if the negative impact of so doing on the S-curve is smaller than on the M-curve. Consequently, tighter money can lead to a non-collapse equilibrium. The formal condition, such that increasing interest rate  $i_1$  will avoid collapse of the economy is:

$$C_1: \quad -\frac{\mu'(i_1)P_1 \left[ Y_1 - (1+r_0)D^c - (1+i^*)\frac{E_1}{P_1}(D_1 - D^c) \right]}{(1+\mu(i_1))(1+i^*)(D_1 - D^c)} < \frac{E_1}{1+i_1}$$

see ABB (2000) page 736. So tight money is appropriate when there is substantial external debt and the credit multiplier is relatively insensitive to higher interest rates.

But what if there is a demand recession? In fact, we find that demand-determination of output in period 1 alters the conditions under which high interest rates can strengthen the currency. A general proposition summarising this is as follows:

**Proposition 1** *When period 1 output is demand-determined, as in (2) above, an increase in the period 1 interest rate will strengthen the domestic currency less than when output is supply-determined. (Proof in Appendix C.)*

Referring back to Figure 3, note that equilibrium at point B assumes that  $Y_1^D = Y_1^S$ . With exports slow to react, however, devaluation will be contractionary for output: and the knock-on effect of demand failure on future potential output would shift the supply curve for period 2 to the left of  $S''$ . With demand failure in period 1, there may thus be no intersection with the  $M'$ -curve until output in period 2 falls to depression level  $Y_R$  and the price of the dollar rises sharply, as at point C in Figure 3. In short, showing that current monetary tightening would stabilise the exchange rate in the absence of demand effects is no guarantee that it will do so when demand collapses.<sup>12</sup>

When output in period 1 is demand-determined, the condition that ensures that the M-curve moves leftwards more than the S-curve when  $i_1$  increases becomes:

<sup>12</sup> Of course, if exports fail to respond sufficiently promptly, output may also fall below supply in period 2 as well.

$$C_2: -\frac{\mu'(i_1)P_1 \left[ (A_0 + \bar{X}) - (1+r_0)D^c - (1+i^*)\frac{E_1}{P_1}(D_1 - D^c) \right]}{(1+\mu(i_1))(1+i^*)(D_1 - D^c)} \left[ \frac{(1+m-\beta\gamma)}{(-\beta + \beta\gamma - m + (1-\beta)\mu(i_1))} \right] < \frac{E_1}{1+i_1}$$

a condition clearly more restrictive than  $C_1$ .

## 5. The challenge for policy

The problems posed by capital account crises are quite subtle: how to maintain confidence in a currency when private creditors are fleeing; and how to do this without damaging the economy. This will surely require appropriate action both by local policymakers and the IFIs. Here we focus on policy in the country affected.<sup>13</sup>

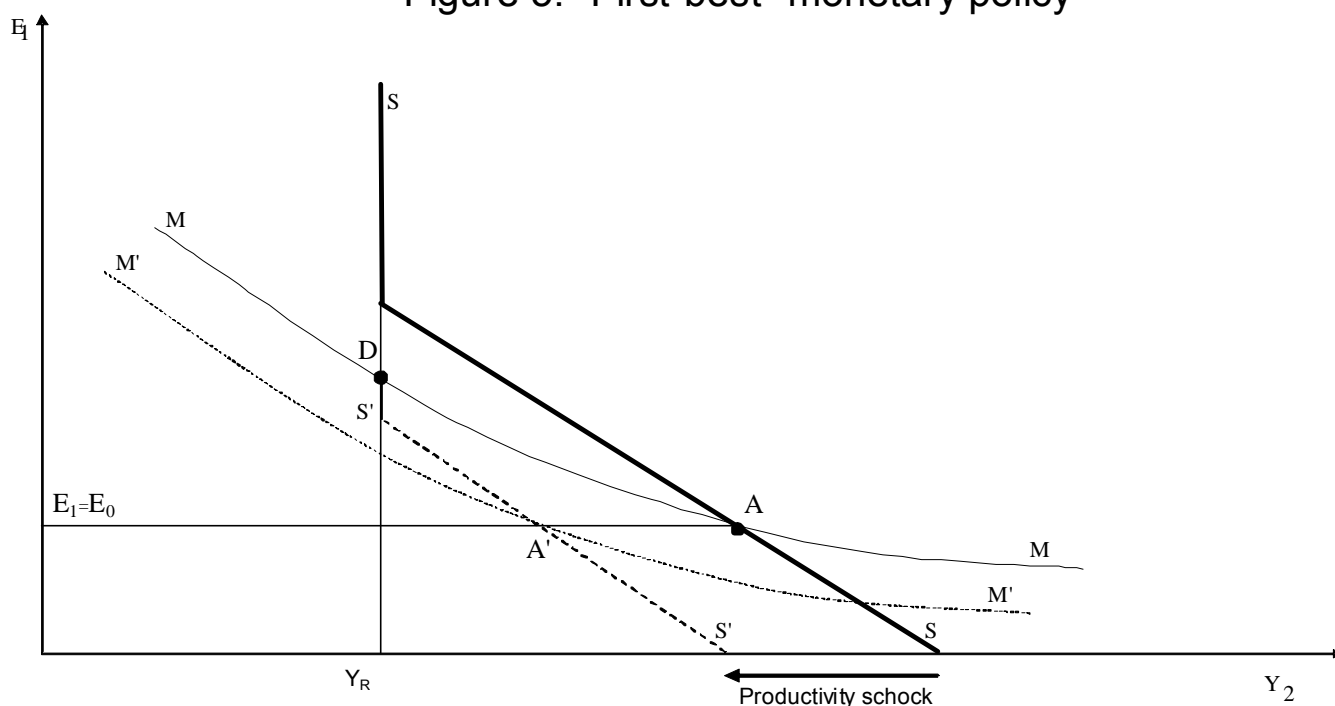
This section proceeds as follows. Initially, we show that the first-best policy in response to a supply-side shock that reduces future output is to tighten money in *the future* and not when the shock occurs. Second we consider how high interest rates in the crises may be complemented by fiscal easing to maintain demand. We then discuss policy options to protect the supply-side from the adverse effect of high interest rates.

To show that tightening future money is an appropriate policy in the ABB model is straightforward<sup>14</sup>. Absent demand failure, the shock has no effect on current output, but lowers future output. To avoid a rise in future prices - and the consequential rise in the dollar implied by PPP - future money must be lowered in line with reduced supply. That this will stabilise the exchange rate and so avoid the adverse balance sheet effects in the private sector can be seen from Figure 5: the new equilibrium is A' where output contracts in line with the productivity shock -- but no further. Appendix D shows that the exchange rate remains unchanged when the leftward shift in S-curve due to adverse productivity shock is matched by an appropriate reduction of the future money supply ( $M_2$ ).

<sup>13</sup> Woods (2006) focuses on the role of the IMF and World Bank.

<sup>14</sup> Notwithstanding the discussion at the end of ABB (2000, p.737), the authors observe in a later paper that "the correct policy response in this case is obviously to increase the interest rate  $i_1$  and/or decrease  $M_2$  so that the IPLM curve shifts downward." ABB (2001, p. 1141).

Figure 5: "First-best" monetary policy



This policy avoids at a stroke the need to raise interest rates at the time of the shock: but it means doing nothing in the crisis while promising to take action in the future, and this may not be credible. Assume that, for whatever reason, this first-best policy is not implemented, and interest rates are raised at the time of the shock. Will raising interest rates avoid recession?

To answer this question, we use the conditions  $C_1$  and  $C_2$  derived earlier. It may be that the degree of dollarisation and the interest elasticity of credit are sufficiently small so that *both* conditions are satisfied, as in column 1 of Table 3, so raising interest rates will help reassure investors in the foreign exchange market without throwing the economy into depression. (This is far from first best, however, as will become apparent presently.)

Table 3: Is it safe to raise interest rates ( $i_1$ ) in a crisis?

	Safe	Risky
$C_1  _{Y^D = Y^S}$	Satisfied	Satisfied
$C_2  _{Y^D < Y^S}$	Satisfied	Not satisfied

What if the condition  $C_1$  elaborated by ABB (on the assumption that demand matches supply) is satisfied, but  $C_2$  is *not* satisfied, as in column 2? In this case, interest rate effects on demand exacerbate the contraction of  $Y_2$  sufficiently so as to rule out equilibrium above  $Y_R$ . Is this recession inevitable?

(i) *Maintaining demand*

The dilemma for the monetary policy arises from having two objectives – to strengthen the currency and protect the economy – with only one instrument,  $i_t$ . Tinbergen's principle would suggest looking for another policy instrument. What if tight money is complemented by an easing of fiscal policy? The logic in support of this is straightforward. If fiscal policy is used to stabilise aggregate demand in the way that exports would have (if they had time to adjust), then condition  $C_2$  no longer applies, only  $C_1$ : and this is satisfied by assumption.<sup>15</sup>

We conclude that condition  $C_1$  derived by ABB is appropriate *either* if demand for the output of a small open economy in crisis is inherently stable, *or* if fiscal policy is eased sufficiently to achieve the same result. Otherwise, there is a clear risk that unmitigated tight money will cause recession. It is no surprise that IMF policy targets for fiscal *tightening* in the midst of the East Asia crisis attracted serious criticism.<sup>16</sup> In fact, as Fischer (2001Chapter 1, p. 15) notes in his Robbins Lecture on 'The First Financial Crises of the Twenty First Century', "The internal debate over appropriate fiscal policy, both within the staff and with the Board [of the IMF], intensified as the crisis worsened, and as outside criticisms increased. By early 1998, budget targets began to be eased".

(ii) *Protecting supply*

Demand stabilisation in a crisis may help avoid recession but the outcome is still second best: high interest rates have undesirable supply-side effects that were in principle avoided by the first-best monetary policy discussed above. Can one get to first-best *despite raising interest rates*? Let us consider policy actions to be taken at the time of crisis to maintain the supply of credit (and the level of investment).

(b) Emergency credit and/or fiscal transfers (to stabilise the S-curve)

To avoid the contraction of credit, the government could try to ensure that banks keep current credit lines open; or it could provide temporary finance itself, e.g. extra lending via an emergency government loan programme might be considered.<sup>17</sup> Absent further shocks, such loans should be repaid.

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<sup>15</sup> In terms of equation (2), it would be autonomous demand  $A_0$  that adjusts to prevent excess supply instead of exports,  $X$ .

<sup>16</sup> See for example Stiglitz (1999).

<sup>17</sup> Government actions taken in Thailand to help distressed firm stay in business are discussed in Luangaram (2003).

Given that the firms are credit-constrained, increasing cash flow could also help. If firms still want to invest despite the high interest rates, *fiscal devices* in the form of temporary investment allowances and/or accelerated depreciation might be used. To protect commercial firms from the higher cost of borrowing, interest rate subsidies could be employed. Let  $1 + i_1$  be the net-of-subsidy cost to firms that borrow in domestic currency and let  $\left(\frac{1 + i_1}{1 - s}\right)$  be the gross return to lenders, and let the subsidy  $s$  be chosen to stabilise the exchange rate i.e. to set  $E_1 = E_0$ .<sup>18</sup> Note that the supply of credit should not change if banks are aware of the subsidy, i.e. the credit multiplier will depend on the *post subsidy* of borrowing. Graphically, while high interest rates have moved the M-curve to the left, the impact on the S-curve has been avoided by the subsidy.

If the adverse impact of high interest rates on current investment could be completely offset by financial or fiscal assistance in this way, this would *ipso facto* solve the problem of maintaining demand. To achieve first best, future money supply would also need to be adjusted in line with reduced supply to avoid inflation and depreciation.

(b) Capital controls (to shift the M-curve)

An alternative policy is to drive a wedge between the rate needed to reassure external investors and the domestic rate relevant to corporate investment by imposing temporary controls on capital, as recommended on a temporary basis by Paul Krugman in an 'Open letter to President Mahatir' in September 1998. Krugman's article in Fortune was entitled 'It's Time to Get Radical' because the IMF at that time was very much committed to capital account liberalisation. (A year earlier, for example, in September 1997 after the Thai baht had been devalued Stanley Fischer had strongly supported changing the IMF Articles so as to mandate capital account liberalisation, Fischer, 2004, Chap 5).

A creditor standstill was implemented in Korea in December 1997, for example, when IMF and G7 funding was insufficient to meet anticipated withdrawals until key banks were persuaded to rollover their credit lines. But it was Malaysia that put Krugman's counsel to the test. The IMF Occasional Paper "Malaysia: From Crisis to Recovery" describes the initiatives taken as follows:

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<sup>18</sup> This requires that  $\left(\frac{1 + i_1}{1 - s}\right) = (1 + i^*) \frac{E_2}{E_0}$ , where  $E_2$  is the (higher) price of the dollar expected to prevail in period 2.

In September 1998, the Malaysian authorities launched a policy package designed to insulate monetary policy from external volatility. Measures included an exchange rate pegged to the U.S. dollar and selected exchange and capital controls, complemented by a fiscal stimulus package that stepped up capital spending. These measures permitted the subsequent lowering of interest rates. The authorities also pursued fundamental reforms in the financial and corporate sectors, including a bank consolidation program and an upgrading of prudential regulation and supervision in line with international best practices. (Meesook et al., 2001)

A time-shifted, differences-in-differences comparison of the course of events in Korea and Malaysia was conducted by Kaplan and Rodrik (2001). They note that Malaysia recovered swiftly from crisis after the imposition of capital controls and conclude that it grew faster than it would if it had adopted an IMF programme as in South Korea and Thailand.<sup>19</sup>

In principle, temporary capital controls could be used to implement the first-best monetary policy discussed above. Here is the logic. Assuming that, in the period of the crisis, the announcement of future tight money is not credible, higher interest rates for overseas investors in domestic currency would normally be needed to keep the current value of the dollar below its (higher) future expected level. But the domestic economy can be protected from rising interest rates by capital controls which tax the proceeds of investing in dollars, see Aghion et al. 2001 pp. 1131-2 for discussion. The arbitrage condition becomes:

$$1 + i_1 = (1 + i^*)(1 - c) \bar{E}_2 / E_1 \quad (3)$$

where  $\bar{E}_2$  to refer to the *expected* exchange rate in period 2 and  $0 < c < 1$  indicates the tax paid by domestic residents on their holdings of dollar assets.<sup>20</sup>

After substitution, the asset market equilibrium is defined by:

$$E_1 = (1 - c) \frac{1 + i^*}{1 + i_1} \frac{\bar{M}_2^s}{L(Y_2, i_2)} \quad (4)$$

where  $\bar{M}_2^s$  refers to the expected money supply in period 2. Appropriate choice of  $c$  will shift the M-curve to the left as shown in Figure 5, keeping  $E_1$  at its pre-crisis level without any increase in  $i_1$ . Subsequently, in period 2, capital controls can be removed and money credibly tightened. As  $c$  goes to 1, this will represent the extreme case of no capital mobility where the

<sup>19</sup> See also Schiffrin reference.

<sup>20</sup> Alternatively, dividing through (3) by  $1 - c$ , one could interpret  $1/(1 - c)$  as reflecting a subsidy, where  $1 + i_1$  is, as before, the net-of-subsidy cost of borrowing in domestic currency, while  $(1 + i^*)/(1 - c)$  is the higher gross rate received by lenders. In this case, capital controls permit the temporary rise in domestic rates needed to reassure foreign investors without affecting the domestic economy.



M-curve disappears (see Aghion et al. 2001, p. 1132) and the domestic authorities are free to set interest rates at any level and peg the exchange rate (as in Malaysia).

Capital account liberalisation allows for high speed movements; such controls act like emergency brakes. Whether governments can switch capital controls on and off in this fashion without losing credibility is an interesting question: on which East Asian experience may throw some light.<sup>21</sup>

(c) Debt restructuring (to make the S-curve vertical)

As the dollar-denomination of debt lies at the heart of the balance sheet problem for private firms, relieving them of this debt burden should help. This was the motivation for cancelling the gold clause in US commercial debt in the time of President Roosevelt. He persuaded Congress to cancel the Gold Clause in debt contracts when the US left the Gold Standard in 1933 and devaluation raised the dollar value of gold-denominated debt by about 70%; cancelling the Gold Clause kept dollar values unchanged.<sup>22</sup>

The operation of a “Super-Chapter 11” to provide across-the-board relief to corporations with dollar debts as advocated by Joseph Stiglitz would have much the same effect, as discussed in Miller and Stiglitz (1999). A contemporary illustration is the pesification of all dollar debts (up to a threshold of 100,000 dollars) promulgated by President Duhalde in Argentina in 2002 – an action taken in conscious imitation of President Roosevelt, Sturzenegger (2003, p.48-49). Baldi-Delatte (2005) argues that pesification played a key role in the post-crisis recovery of the Argentine economy.<sup>23</sup>

In terms of the model being discussed, it is dollarisation of corporate debt that gives a negative slope to the S-curve: consequently de-dollarisation makes the S-curve vertical, i.e. independent of the price of the dollar. This, of course, is why it mitigates the risk of financial collapse.

## 6. Alternative perspectives

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<sup>21</sup> The case for ex-ante inflow controls, like those used in Chile, has been articulated by Levy-Yeyati (2005) both as a pre-emptive measure to avoid the rapid build-up of speculative dollar liabilities and so that, in a panic, less-than-one-year investors cannot exit with all their assets.

<sup>22</sup> This abrogation was “a key part of Roosevelt’s first hundred days’, providing the foundation for much of the New Deal policies directed at deflating the economy including departure of the US from the gold standard”, Kroszner (2003, p.1).

<sup>23</sup> The Argentine case, however, provides a warning: relieving non-financial corporations of dollar debts at the cost of bank net worth may prove counterproductive by causing a credit crunch, Miller et al. (2005).

On ABB's assumption that countries of South East Asia suffered idiosyncratic supply-side shocks which would reduce output some time after the exchange rate crisis, we have discussed the need for fiscal easing to check the immediate deficient-demand-led fall of output. This is, of course, a counter-factual exercise: output did fall sharply as "the sign of the growth rates changed" in the countries concerned. Imagine, nonetheless, that the necessary demand management policies had promptly been put in place. The result could have been the delayed step-down shown by the trend lines in Figure 1, without the immediate drop in output.

There are, however, other possibilities that could be considered in future research. First that insulating domestic capital markets may help ensure macroeconomic stability; second that this may be at the cost of lower long-run growth. Both possibilities may be illustrated using GDP data from India, see Figure 6.

#### *Supply-side shock or capital-market crisis?*

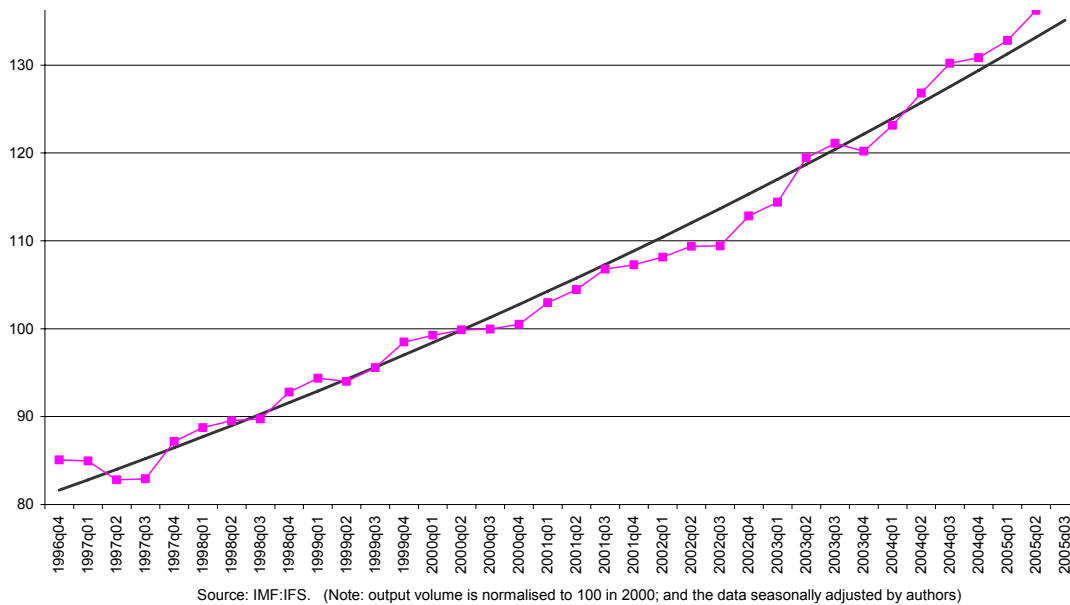
Indian capital markets were kept relatively closed during in the 1990s and the country escaped the currency and output shocks suffered by many of its neighbours, Williamson (1999). Figure 6 shows little sign of any shift of potential in India at the time of the SE Asian crisis, as a single exponential trend seems to fit the data. The Indian experience suggests that successful stabilisation of output could have prevented *any* step-down in trend GDP. Could the supply contraction identified on the Blanchard/Quah criterion be endogenous -- due to the lagged effects of low investment and bankruptcy in a severe demand recession?<sup>24</sup> On this interpretation, the contagion that spread from Thailand to Korea was not some irresistible strain of supply-side decline, but spreading exchange rate panic<sup>25</sup> which, properly handled, could have avoided the hysteresis effects of a recession. The calculations of the costs of the crisis by Griffith-Jones and Gottschalk (2004) are, we believe, based on such an assumption. Treating the initiating shock not as a fall in productivity but as credit contraction induced by financial contagion might be more appropriate in such circumstances, Aghion and Banerjee (2005, p.108 ).

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<sup>24</sup> There was, for example, a pronounced step-down in trend output in the US as result of the Great Depression.

<sup>25</sup> With respect to the crises in Indonesia and Korea, 'contagion seemed to play a dominant role. But the contagion hit economies with serious financial and corporate sector weaknesses.' Fischer (2001, chapter 1, p. 11). See also Fratzscher (2003).

Figure 6: Indian GDP



### *Crisis as the cost of progress?*

For some observers, however, capital market crises may be part of the cost of achieving faster growth. Ranciere et al. (2002, Abstract) note that ‘countries that have experienced occasional financial crises have, on average, grown faster than countries with stable financial conditions’; and they illustrate by comparing Indian trend growth with that of Thailand.<sup>26</sup> In their view, “financial liberalization policies that facilitate risk-taking increase leverage and investment: this leads to higher growth, but also to a greater incidence of crises.” Ennis and Keister (2003) provide an alternative analysis of financial development, financial crisis and long-run growth.

### **Conclusion**

Aghion, Bachetta and Banerjee trace the impact of devaluation on domestic investment and the supply-side of the economy via the balance sheets of credit-constrained firms: and the possibility of self-fulfilling crisis they uncover could help explain why many emerging markets live in “fear of floating”. Exclusive focus on supply-side economic contraction is an unnecessary limitation of their analysis. Demand failure may also be part of the story, due to a lag in export demand substituting for falling investment orders in the midst of regional turmoil, for example; or to a credit crunch for a country suffering a ‘twin crisis’.

<sup>26</sup> “GDP per capita grew by only 99% between 1980 and 2001 in India, whereas Thailand’s GDP per capita grew by 148%, despite having experienced a major crisis.” (Ranciere et al., 2002, p.1).

If this is the case, Tinbergen's principle suggests complementing tight money with fiscal easing to maintain demand – a conclusion that the IMF itself appears to have drawn from the East Asian crisis<sup>27</sup>. In fact, first best policy in the ABB model requires credible promises of future tight money *without* high interest rates during the crisis. If this is not credible, fiscal and financial transfers and capital controls may be appropriate to shield the domestic economy from the impact of high rates.<sup>28</sup>

The purpose of this paper is not to evaluate crisis management policies on the part of national governments or international agencies in the course of the SE-Asia crises of in 1997/8.<sup>29</sup> The aim is to develop an eclectic framework in which balance sheet effects can impact both supply and demand. The dilemma facing the monetary authorities is given sharper focus; as is the case for complementary policy actions.

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<sup>27</sup> “What lessons have been drawn from these episodes? Certainly, that fiscal contraction may not be necessary in all balance of payments crises. If debt sustainability is not an issue, and if the contraction of domestic demand... combined with devaluation will produce a sustainable current account, then fiscal policy can be used counter-cyclically.” (Fischer, 2001, Chapter 1, p15.).

<sup>28</sup> Note that we are again appealing to Tinbergen's principle and not simply arguing for lax monetary policy, Aghion and Banerjee (2005, p. 118).

<sup>29</sup> See the reports of the Independent Evaluation Office in the IMF for such analysis.

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## APPENDIX

### A. Malaysia and Thailand

Figure A.1: Malaysian GDP.

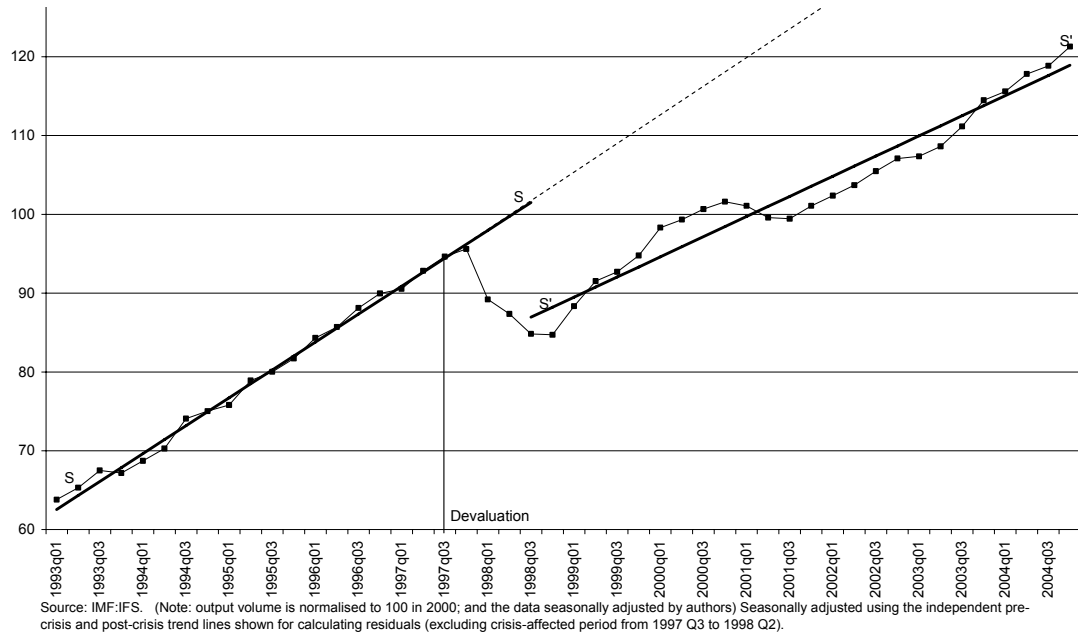
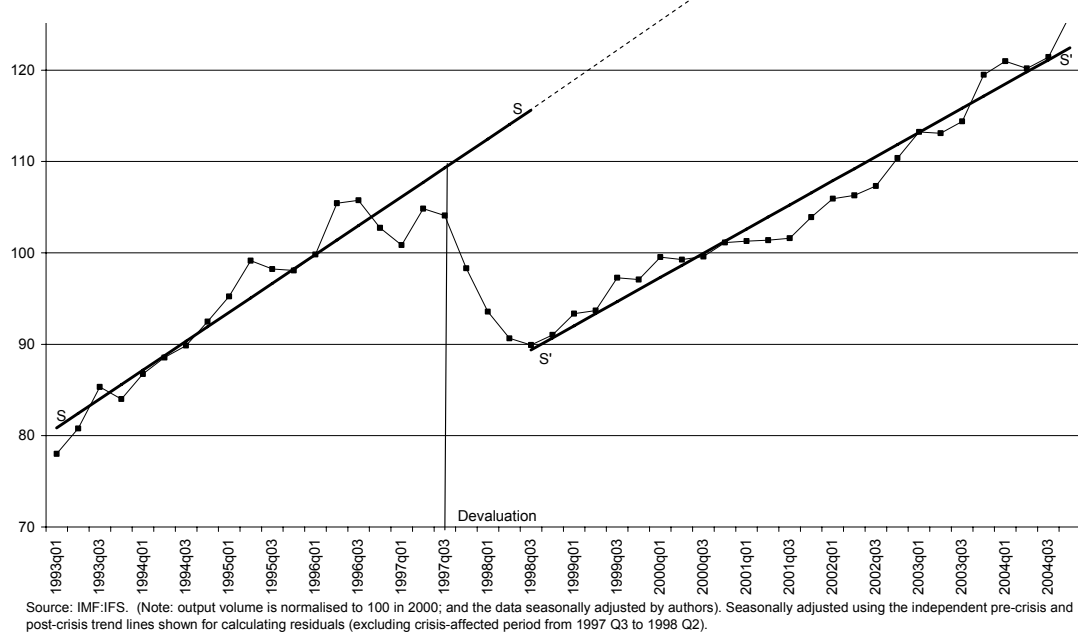


Figure A.2: Thai GDP



## B Asset Market and Aggregate Supply schedules

In more detail, the schedules are as follows. The M-curve – short for what ABB call the IPLM curve - is a combination of the Uncovered Interest Parity, money market equilibrium and the PPP condition for the second period. Formally, it is written as:

$$E_1 = \frac{1+i^*}{1+i_1} \frac{M_2^s}{L(Y_2, \bar{i}_2)} \quad (\text{B.1})$$

where  $E_1$  is the exchange rate for the first period,  $i^*$  is the foreign interest rate,  $i_1$  and  $\bar{i}_2$  are domestic interest rates for periods 1 and 2,  $M_2^s$  and  $Y_2$  are money supply and output in period 2, and  $L(Y_2, \bar{i}_2)$  is the money demand function. This M-curve is downward sloping in the  $E_1$  and  $Y_2$  space because higher output in the second period increases money demand (i.e., higher  $L$  given interest rate in period 2) and so strengthens the exchange rate (note  $M_2^s$  is given).

The S-curve characterizes the supply of output on the assumption that entrepreneurs are credit-constrained and corresponds to what ABB call the W-curve. (The production function is assumed to be linear in capital stock, which depreciates completely at the end of the period.) Total investment consists of last-period retained earnings together with borrowing (in both domestic and foreign currencies, with proportions given exogenously) which is limited to a given fraction  $\mu_t(i_{t-1})$  of the retained earnings. The introduction of  $\mu_t(i_{t-1})$  (with  $\mu_t' < 0$ ) captures credit market imperfection. The S-curve is specifically given by

$$Y_2 = \sigma (1 + \mu(i_1))(1 - \alpha) \left[ Y_1 - (1 + r_0)D^c - (1 + i^*) \frac{E_1}{P_1} (D_1 - D^c) \right] \quad (\text{B.2})$$

where  $\sigma$  is the productivity parameter,  $\alpha$  is the fraction of output consumed in each period,  $D_1$  is the total level of borrowing and  $D^c$  is its domestic currency component. The S-curve so constructed is a downward sloping straight line in  $E_1$  and  $Y_2$  space, for levels of output above recession<sup>30</sup>. Clearly, this formulation captures the contractionary effect of devaluation on the supply-side.

Finally, equilibrium  $(Y_2, E_1)$  is given by any intersection of (B.1) and (B.2). Note that, because of the non-linearity of both schedules, multiple equilibria may well exist.

## C. Proof of Proposition 1

<sup>30</sup> For convenience, ABB use  $Y_2=0$  to denote the recession level of output (which we label as  $Y_R$  in the text) and set  $Y_2 = 0$  if the right hand side of (B.2) turns out to be negative.



Let equilibrium  $(Y_2, E_1)$  under our specification be given by the intersection of (B.1) and (B.2), with  $Y_1$  in (B.2) being replaced by the Keynesian demand given in equation (2) in the text. Then the proposition is true if an increase in  $i_1$  induces more leftward shift to  $Y_2$  in our specification than for ABB. Since the interest rate effects on  $Y_2$  are negative in both cases, this requires:

$$\left. \frac{\partial Y_2}{\partial i_1} \right|_{MFZ} < \left. \frac{\partial Y_2}{\partial i_1} \right|_{ABB}$$

Differentiating  $Y_2$  in (B.2) with respect to  $i_1$  (with  $Y_1$  replaced by  $Y_1^D$  from (2)) yields

$$\left. \frac{\partial Y_2}{\partial i_1} \right|_{MFZ} = \frac{\mu_2'(i_1)}{1 + \mu_2(i_1)} Y_2 + \sigma (1 + \mu_2(i_1)) (1 - \alpha) \frac{\partial Y_1^D}{\partial i_1}$$

where the first term on the left hand side is what obtains for ABB's specification, and the second term gives the additional effect arising because the output in period 1 is demand determined. As it is clear from equation (2) in the text that  $\partial Y_1^D / \partial i_1 < 0$ , so the inequality above must hold.

#### D. Implementing "first best" monetary policy in ABB

Given that the money demand function satisfies:

$$\frac{dL(Y_t, i_t)}{dY_t} > 0; \quad \frac{dL(Y_t, i_t)}{di_t} < 0; \quad L(Y=0, i_t) > 0,$$

and that the productivity shock reduces output:

$$Y_2' = \sigma' (1 + \mu(i_1)) (1 - \alpha) \left[ Y_1 - (1 + r_0) D^c - (1 + i^*) \frac{\bar{E}_1}{P_1} (D_1 - D^c) \right] < Y_2$$

(where  $\sigma'$  is the productivity parameter after the shock);

then one can obtain  $M_2'$  implicitly from equation (B.1) as follows:

$$E_1 = \frac{1 + i^*}{1 + i_1} \frac{M_2'}{L(Y_2', \bar{i}_2)} = E_0$$

So  $M_2'$  is the expected money supply for period 2 which, if credibly announced in period 1, will keep the exchange rate stable at its pre-crisis level.

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