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Abstract

The new-style currency crises that have inflicted a number of developing and emerging economies of late are characterized by sudden stops in capital inflows and adverse balance sheet effects. Given the potential high costs of these crises, there remains an ongoing debate on how they might best be *managed* when they do arise. This paper argues that the age-old Swan diagram, appropriately modified, is able to provide useful insights into how a country might manage a new-style crisis via a combination of adjustment (which involves expenditure switching and reducing polices) and financing.

Keywords: *Adjustment, Expenditure Reducing, Expenditure Switching, Financing, Internal balance, External balance, Swan diagram*

1. Introduction

The intensity and suddenness of recent currency crises has inspired a "third generation" crisis literature that focuses on: (a) sharp increases in the domestic value of foreign currency debt (so-called "balance sheet effects") which adversely affect a country's *solvency* position and (b) "sudden stops" in capital inflows (including outright reversals) which negatively influence a country's *liquidity* position.[1] As Dornbusch (2001) notes:

> A new-style crisis involves doubt about credit worthiness of the balance sheet of a significant part of the economy.. and the exchange rate…(W)hen there is a question about one, the implied capital flight makes it immediately a question about both… (The) central part of the new-style crisis is the focus on balance sheets and capital flight…(T)hey involve a far more dramatic impact on economic activity than mere current account disturbances…both in terms of magnitude of the financial shock as well as disorganization effects stemming from illiquidity or bankruptcy.

Using a sample of 49 middle and larger income countries over the period 1992-99, Stone and Weeks (2001) find that the curtailment of private capital flows and adverse balance sheet effects are among the most important factors determining the intensity of currency crises (defined as loss of real GDP relative to pre-crisis trend, conditional on the occurrence of a crisis). Using a sample of 24 developing and emerging economies over the period 1975-97, Hutchison and Noy (2002) find that while currency crises are associated with declines in investments and overall output in the short run, the real sector contractions are particularly marked in cases where currency crises occur simultaneously with current account reversals (Table 1). These current account reversals could either be because of a cessation of private capital flows per se (liquidity crunch) or adverse balance sheet effects (solvency crunch).[2]

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[1] For a discussion of the economic consequences of sudden stops in capital inflows, see Calvo and Reinhart (2000).

[2] While Hutchison and Noy (2002) opine that the coincidence of current account reversals and currency crises are due only to a curtailment in capital flows ("sudden stops"), these current account reversals may occur if there are significant domestic insolvencies, leading to a curtailment of imports, for instance.

Distinguishing between the *probability or warning signs of a crisis*, on the one hand, and the *intensity or depth of a crisis*, on the other, is consistent with Calvo and Mendoza (1996) and Rajan (2001) who suggest that new-style crises in developing and emerging economies ought to be seen as involving two stages: (a) an initial currency crisis/speculative attack which can either be self-fulfilling or fundamentals based and (b) the post-crisis output dynamics. While the first two generation of crisis models are well-equipped to handle the first issue (i.e. why does a crisis occur in the first instance?), the third generation crisis models are more pertinent to examining the second issue (i.e. what happens after the actual speculative attack?).[3]

Given the potential high costs of these new-style or "capital account" crises, there remains an ongoing debate on how they might best be *managed* when they do arise. While some popular International Economics textbooks continue to include brief discussions of the age-old Swan diagram, they have not used it to discuss new-style crises and appropriate crisis management policies.[4] Another obvious limitation of the Swan diagram -- as it is conventionally presented -- is the lack of good microfoundations. This in turn may partly explain why its popularity has dwindled substantially over the last few decades.

The objective of this paper is to contribute to resuscitating the use of the Swan diagram in the classroom and in policy discussions on crisis management. The next section briefly reviews the traditional framework of internal and external balance. Section 3 revisits the external balance (EB) schedule and shows how it might be reinterpreted as the financial side of the economy. Section 4 revisits the internal

[3] Also see Mulder, Perrelli and Rocha (2002). For recent literature reviews on the first and second generation crises models, see Flood and Marion (1999), Jeanne (2000) and Rajan (2001) in the context of the Thai crisis of 1997-98. Caves, Frankel and Jones (2003, Chapter 24) describe third generation models as being moral hazard driven at the national level *a la* Dooley (2000). However, the Dooley "insurance" model is more appropriately seen as being part of the first generation family pioneered by Krugman (1979).

[4] For instance, there is an interesting but rather general and wide-ranging discussion of crises in developing and emerging economies in Chapter 24 of Caves, Frankel and Jones (2003). However, the authors make little attempt to relate the discussion to the analytics of the Swan diagram introduced in Chapter 18 of their book. Also see Salvatore (2003, Chapter 18).

balance (IB) schedule and offers a simple model of the real side of the economy to explain why real devaluations might be *contractionary* rather than *expansionary*. Focus is on the open economy balance sheet approach -- i.e. corporate leverage in unhedged foreign currency terms -- which is taking on increasing significance in the IMF's policy analysis and prescriptions (for instance, see Allen et al., 2002 and IMF, 2003a).[5] The penultimate section discusses the desirable policy mix in response to stylized shocks and different scenarios. The final section concludes the paper with a brief discussion of how a country might reduce its vulnerability to adverse balance sheet effects.

2. Internal Balance (IB) versus External Balance (EB): Conventional Theory

The typical Swan diagram plots real exchange rates against real income or absorption. Policies to affect real absorption can either be fiscal or monetary. For instance, Krugman (1998) focuses on fiscal policy as the sole absorption or expenditure-reducing tool. The Swan diagram is also sometimes discussed in the context of monetary policy vis-à-vis fiscal policy, with the implicit assumption of a fixed exchange rate (e.g. Salvatore, Chapter 18, pp.640-2). The approach used in this paper -- inspired by Frankel (2001) -- considers a "modified" Swan Diagram with real interest rates (i_t) on the vertical axis and real exchange rates (e_t) on the horizontal axis. We ignore fiscal policy altogether. Why?

The issue of appropriate fiscal policy stance during a crisis broadly involves conflicting pressures and tradeoffs. On the one hand, given the implicit or quasi deficits of the government (because of their blanket guarantees on banks, sterilization costs, etc), there is inevitably a need for considerable fiscal consolidation by the crisis-hit country. In addition, tight fiscal policy might be seen as a positive signal to international capital markets. On the other hand, the social damage of the

[5] Recent theoretical contributions in this area are by Aghion, Bacchetta and Banerjee (2000, 2003), Cespedes, Chang and Velasco (2000) and Krugman (2003), among others.

crisis necessitates looser fiscal policy.[6] More importantly, fiscal policy is generally not a very flexible instrument to influence economic activity in the short run. This was made apparent during the Asian crisis of 1997-98 (see Boorman and Associates, 2000).

The External Balance (EB) schedule which assumes that the balance of payments is in "equilibrium", is downward sloping. This is so as, other things equal, a fall in the real exchange rate (a real appreciation), leads to a loss of export competitiveness and a consequent worsening of the current account. This requires a rise in real interest rates to improve the capital account balance so as to ensure that the balance of payments regains "equilibrium", i.e. $\Delta R_t = k$ (where $R_t =$ international reserves and k is some target reserve level).[7] Points above and below the EB line depict balance of payments surplus and deficit, respectively.

The Internal Balance (IB) schedule, which assumes that the economy is operating at full employment ($y_t = y*$) , is upward sloping. This is so as a fall in the real exchange rate leads to a loss of export competitiveness and consequent decline in output below full employment, hence requiring lower real interest rates to stimulate domestic demand (investment and interest sensitive consumption). Points above and below the IB schedule indicate recessionary conditions and overheating, respectively.

The EB and IB schedules thus divide the diagram into four zones or quadrants (Figure 1a). The Swan diagram nicely illustrates that one needs two instruments (interest rates and exchange rates) in order to attain both internal and external balance simultaneously (i.e. "Tinbergen's Targets instruments approach").

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[6] See Kopits (2000) for a detailed discussion of the role of fiscal policy during a crisis and Heller (1997) for a more general discussion of fiscal policy management under open capital regimes. Heller (2002) offers an overview of the IMF's perspective on "sound fiscal policy".

[7] Recall that in the typical Keynesian setting – which is the implicit assumption behind the Swan diagram – prices are sticky, such that real exchange rate changes are largely due to nominal exchange rate changes (i.e. we abstract from the deflationary effects). We return to this issue later.

Two criticisms of the Swan diagram come to mind immediately. First, in the presence of an open capital account, does not the assumption of exchange rates and interest rates as independent policy instruments violate the "Impossible Trilogy" hypothesis? Second, even ignoring the impossible Trilogy, *at the time of a crisis*, how much control does a country really have on its exchange rate as an independent policy instrument? In particular, while encouraging or engineering a currency depreciation (over and above a freely functioning market rate) is easy enough to do (either via verbal interventions, i.e. talking down the currency, or stockpiling of reserves), what about a currency appreciation?[8]

The first question is easily answered by either assuming away perfect asset substitutability (Bansal and Dahlquist, 2000)[9], or by recognizing that the Impossible Trilogy does not on its own imply that an intermediate regime is unviable. A country could pursue a policy of a managed float and retain a degree of monetary policy autonomy (Frankel, 1999 and Rajan, 2002 and Rajan, 2003, Chapter 4).[10]

With regard to the second criticism, in the context of crisis management, apart from affecting the exchange rate via varying the interest rate, anther way of thinking about appreciating versus depreciating a currency during a crisis would be in terms of adjustment versus financing. Specifically, while currency depreciation can be seen as a type of adjustment policy, attempting to maintain the strength of the currency can be brought about via regional or multilateral financing (that is sterilized so as not to undermine the underlying monetary policy stance). Thus, the Swan diagram is not only able to aid in the discussion of the issue of *expenditure switching* versus

[8] The implicit assumption here is that the country has a very limited stock of reserves. Of course, this may be one of the reasons why many countries in Asia have recently begun to stockpile reserves after having gone through the regional crisis of 1997-98 (Aizenman and Marion, 2003, IMF, 2003b, Rajan, 2004, Rajan, Siregar and Bird, 2005).

[9] Indeed, there is evidence suggesting that sterilization *is* effective in many developing and emerging economies.

[10] In any event, as will be discussed below, the risk adjusted uncovered interest parity is never violated.

expenditure reducing (two forms of adjustment), it also implicitly provides some insights into the *adjustment* versus *financing* debate in the event of a crisis.[11] It is reasonable to expect that an external crisis that is permanent or intense -- especially a terms of trade one -- requires a real devaluation to regain competitiveness. In such an event, the following discussion (Section 5) can be viewed as pertaining to what happens post-devaluation, i.e. does one attempt to regain currency stability or allow it to decline even further?

3. Revisiting the EB Schedule: The Financial Side

In view of the importance of sudden stops in new-style crises (the balance sheet effects are discussed in Section 4), the first obvious modification to the Swan diagram would be to interpret the EB schedule as solely depicting the *non-official* capital account balance. Indeed, it is the capital account that tends nowadays to be the focus of crisis management policy. The reason for considering only the non-official component of capital flows is that it allows us to keep the liquidity effects of official financing distinct from the movements of the EB schedule. From a policy perspective this can be justified by assuming that appropriate adjustment policies must be seen as being independent of financing (i.e. prevent moral hazard problems).

By separating the financial and the real sides of the economy (EB versus IB, respectively) one is able to isolate the effects of distinct shocks. For instance, while an export shock would have affected both the EB and IB schedules conventionally defined, in the current framework it has no direct influence on the EB which is capital account driven; only the IB schedule is affected (see Section 5).

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[11] As Krugman (1998) notes, more effective would be a combination of large-scale official financing (which should be front-loaded), combined with rollovers, standstills and other sorts of coordinated private sector involvement to reduce moral hazard effects (i.e. "bailing in" versus "bailing out"). We do not delve into these issues here. See for instance, Boorman and Associates (2000), IMF-IEO (2003), Roubini (2001) and Willett (2002).

3.1 Simple Theory

In the context of a small and highly open economy, the EB schedule might be reinterpreted in terms of the modified risk-adjusted, uncovered real interest parity (UIP) condition[12]:

$$\rho(i_t)(1+i_t) = (1+i^*)\frac{e^e_{t+1}}{e_t} + rp(i_t) + \Omega_t \qquad (1)$$

where: i^* = foreign real interest rates, $rp(i_t)$ = currency risk premium and $\rho(i_t)$ = probability of no default risk. Eq. (1) incorporates perverse feedback or Laffer curve effects, i.e. $\rho' < 0$. In other words, a rise in real interest rates could worsen anticipated net returns by lowering the probability of repayment.[13] In addition, assuming risk aversion, $rp > 0$ and $rp' > 0$.[14] Thus, Eq. (1) is an interest arbitrage condition that incorporates both default and currency risk. The last term (Ω_t) denotes a wedge that might prevent risk adjusted interest arbitrage for holding perfectly. (We elaborate on this at a later stage below.)

> Radelet and Sachs (1998) explain these perverse effects as follows:
>
> (In) the unique conditions of the midst of a financial panic, raising interest rates could have the perverse effect of weakening the currency.. Creditors understood that highly leveraged borrowers could quickly be pushed to insolvency as a result of several months of high interest rates. Moreover many kinds of interest-sensitive market participants, such as bond traders, are simply not active in Asia's limited financial markets. The key participants were the existing holders of short term debt, and the important question was whether they would or not roll over their claims.

[12] For instance, see Basuro and Ghosh (2000), Dekle, Hsiao and Wang (2002), Furman and Stiglitz (1998), and especially Goldfajn and Baig (1999) and Montiel (2003).

[13] Default can be defined generally as including partial or delayed payments. In addition, $\rho'' < 0$. Note that this is not the only type of Laffer curve mechanism in international finance. For instance, see Krugman (1989) for a discussion of the debt relief Laffer curve.

[14] Two points should be noted. One, it is also possible that expected exchange rates could change, i.e. "elastic expectations of change" *a la* Charles Kindelberger (2001). Also see Montiel (2003). Ignoring the Laffer curve effects, Fama (1984) has shown that a necessary condition for there to be a perverse relationship between i_t and e^e_{t+1} is if there is a negative correlation between risk premia and expected exchange rate changes. Two, the focus here is on risk *perceptions*. The actual impact of interest rate hikes on the real economy pertains to the EB schedule which is explored in Section 4.

> High interest rates did not feed directly into these existing claims …It is possible, however, that by undermining the profitability of their corporate customers, higher interest rates discouraged foreign investors from rolling over their loans.

However, Drazen (2003) questions the direct interest rate effects (perverse or otherwise) on exchange rates during a crisis period. As he notes:

> If the horizon over which a devaluation is expected is extremely short, interest rates must be raised to extraordinarily high levels to deter speculation when there is even a small expected devaluation. For example, even if foreign currency assets bore no interest, an expected overnight devaluation of 0.5 percent would require an annual interest rate of over 500% $(1.005^{365} - 1)*100 = 517$ to make speculation unprofitable...Though the "arithmetic problem" suggests why spectacular defenses may have only limited effects, this reasoning leaves other questions unanswered. First, why…might an interest rate defense..lead to even greater spectacular pressures against the currency? That is, why would there be *perverse* feedback from raising interest rates to speculative pressures? Second, even in the absence of perverse feedback effects, the "arithmetic problem" raises the question of why they ever work. How can an effectively minor change in the cost of speculation have such significant, and one might say, *disproportional* effects?

Drazen (2003) argues that the impact of short term interest rate changes on the exchange rate may be more due to their informational content (i.e. "signals") rather than simply the costs of borrowing or investing (also see Drazen, 2000). In particular, on the one hand, a rise in real interest rates could be a positive signal to market participants who infer that the monetary authority is willing and able to make tough decisions, as well as highlights the authority's degree of commitment to the peg. On the other hand, poor fundamentals could signal a loss of reserves or desperation of policy makers in the face of persistent speculative attacks or the unsustainability of the high interest rate policy (given its high costs on the overall economy).

There are others reasons why the risk premium term may co-vary positively with interest rates. For instance, a tight interest rate policy could raise the government's contingent fiscal deficits (Flood and Jeanne, 2000). This in turn might spook international capital markets hence further weakening the currency. If the perverse effects are significant, the EB schedule -- which now depicts the capital

account balance more narrowly -- becomes fairly steep.[15] While it is theoretically possible for the EB schedule to be upward sloping, it is generally acknowledged that this is highly unlikely (Frankel, 2001).[16]

There is a burgeoning empirical literature on the exchange rate-interest rate nexus with conflicting/inconclusive results (see the recent literature review by Montiel, 2003; also see Boorman and Associates, 2000). This is not surprising in view of the different model specifications, methodologies, sample frequencies and country coverage of the studies. A more promising line of research appears to involve concentrating on a narrower set of issues in relation to Eq. 1 rather than the general nexus between exchange rates and interest rates. For instance, Basuro and Ghosh (2000) find little evidence that higher real interest rates lead to increased estimated risk premia in the crisis-hit East Asian economies of Indonesia, Korea and Thailand. Similarly, with regard to signalling effects, empirical analysis suggests that these effects are generally positive in the short term but perverse if persistent (Drazen and Hubrich 2003).

In any event, since the reformulation of the EB schedule is based on the interest parity condition, points off the EB schedule arise due to a wedge between exchange rates and interest rates (Ω_t). Specifically, points above the EB schedule could either denote persistent reserve accumulation (which are assumed to be sterilized) or the fact that controls on reserve flows are in place. So high interest rates could be sustained at a given exchange rate if capital controls on inflows are stiffened or reserves are accumulated. Points below the EB conversely denote

[15] Thus, any point above the EB schedule implies a non-official capital account surplus, while that below implies a capital account deficit. If one assumes that the current account adjustments are relatively sluggish, this corresponds to a BOP surplus and deficit, respectively.

[16] Krugman (1999) has noted:

> I have heard some people propose what amounts to a sort of foreign exchange-interest rate Laffer curve: if you cut interest rates this will strengthen the economy, and the currency will actually rise. This is as silly as it sounds.

reserve depletion (which of course, cannot be sustained) or controls of capital outflows that can be fairly effectively maintained (Figure 1b)

4. Revisiting the IB Schedule: The Real Side

As discussed above, while the EB schedule characterizes the financial side of the economy, the IB depicts the real side of the economy. The IB schedule (di/de) can be re-written as follows:

$$di/de = -[(\partial y/\partial e)/(\partial y/\partial i)]\,|_{\,y\,=\,y^*} \qquad (2)^{17}$$

where y* = full employment. In other words, as noted, the EB schedule denotes all combinations of *i* and *e* such that output remains at its full employment level. There is little controversy about the denominator in equation 2 which is negative. What about the numerator? The conventional view is that the numerator is unambiguously positive (due to the pro-competitiveness effects). Thus, if real interest rates rise, real exchange rates must rise as well to maintain internal balance, hence deriving an upward sloping IB schedule.

"New Structuralists" challenged both this analysis and the policy prescription that followed on from it (Taylor, 1981). They argued that devaluation would be contractionary and that IMF programs were stagflationary. The New Structuralists have outlined various routes via which devaluation may, in principle, have a contractionary effect spanning both aggregate demand and aggregate supply. These contractionary channels have been extensively discussed elsewhere and will therefore not be detailed here (for instance, see Agenor and Montiel, 1999, Bird and Rajan, 2004, Caves, Frankel and Jones, 2003, Chapter 24 and Lizondo and Montiel, 1989). Suffice it to note that by and large, the New Structuralists literature has

[17] Eq. (2) is easily derived as follows: $dy = (\partial y/\partial e)de + (\partial y/\partial i)di = 0$.

focused on the demand side and the "real sector". However, as indicated by the Dornbusch quote in Section 1, the emphasis of new-style or capital account crises is on the financial or balance sheet side of the economy. Indeed, it is unlikely that the "conventional" contractionary effects of devaluation via the current account can explain the *magnitude* and *ferocity* of some economic contractions following devaluation.

4.1 Assumptions

In view of the importance of the balance sheet effect in recent crises in developing economies it would be useful to consider a simple formalization of the issue based on a variant of the framework initially outlined by Aghion, Bachetta and Banerjee (2000).

In its simplest form the model extends over two periods, assumes a single tradable good, and the economy is made up of identical entrepreneurs/firms which are credit constrained *a la* Bernanke and Gertler, 1989 and Bernanke, Gertler, Gilchrist, 1998). Prices in each period are fixed/preset at the beginning of period (assumed to equal to 1) such that monetary policy does have temporary real effects.[18] Purchasing power parity (PPP) holds in the second period (*ex-post* deviations are allowed in the first period when there is an external disturbance). In other words, the effects of external shocks disappear in the second period. Risk adjusted UIP holds imperfectly (perverse effects are ignored).

4.2 Basic Model Structure of Real Side of Economy

$$y_t = \sigma k_t + x(e_{t-1}) \quad \text{and} \quad x'(.) > 0 \tag{3}$$

[18] This could arise because of menu costs or other frictions. Empirical analysis on currency crises in developing and emerging economies suggests that the impact of devaluations is deflationary rather than stagflationary, i.e. inflation does not rise following a large devaluation (for instance, see Burstein, Eichenbaum and Rebelo, 2002 and Goldfajn and Werlang, 2000).

$$k_t = w_t + d_t \quad (4)$$

$$d_t = \eta_t w_t \quad (5)$$

$$\eta_t = \eta\,(i_{t-1}\,,\ e_{t-1}) \qquad \text{and} \qquad \eta_1\,(.) < 0,\ \eta_2\,(.) < 0 \quad (6)$$

$$\pi_t = y_t - c_t \quad (7)$$

$$c_t = (1+ i_t)\, d^{c} + (1+ i^{*})(e_t / e_{t-1})(d_t - d^{c}). \quad (8)$$

where: y_t = real output; k_t = real capital stock; x_t = export function; w_t = domestic wealth in real terms; π_t = profit function in real terms; c_t = costs in real terms; d_t = total debt in real terms; d^{c} = domestic debt in real terms (assumed to be fixed); (d_t - d^{c}) = unhedged foreign debt in real terms.

Eq. (3) states that in the long run sustainable output is characterized by linear production technology with capital as the sole input. However, output in the short run could deviate from the sustainable level in the case of export demand shocks. Exports in turn are positively related to real exchange rate variations (i.e. real depreciation boosts exports and output).[19]

Eq. (4) states that the capital stock is financed by available wealth ("entrepreneurship") as well as by debt/borrowing. Capital stock is assumed to depreciate fully in one period.

Eq. (5) states that the amount of borrowing to finance capital spending is proportional to available wealth (η_t). In other words, financial markets are imperfect; firms are credit constrained and the total amount of borrowing is limited by available collateral. Table 2 summarizes available evidence on the extent of leverage of Asian corporations prior to the 1997-98 crisis.

[19] We abstract from the New Structuralist reasons as to why devaluation might be contractionary. Aghion-Baccheta-Banerjee do not incorporate the export demand effect. Neither do they allow for the bank crisis channel.

Eq. (6) state that η_t falls with domestic interest rate hikes or currency depreciations, i.e. $\eta_1(.) < 0$ and $\eta_2(.) < 0$.[20] Intuitively, as interest rates in the economy increase or the currency devalues, other things being equal, the greater the probability of corporate bankruptcies and a consequent worsening of the credit position of the banks (i.e. a rise in the share of non-performing loans). This could lead to an outright banking crisis and an economy-wide credit crunch.[21] Using a sample of 19 developing and emerging economies over the period 1991-91, Mulder, Perrelli and Rocha (2002) find that corporate balance sheet variables (such as leveraged financing and high short term debt to working capital) affect the depth of a crisis (measured as the weighted loss of exchange rates and reserves), particularly when they interact with the total size of bank credit. This suggests that crises tend to be most intense when "corporate weaknesses are transmitted through the banking system" (p.15).[22]

Eq. (7) is simply the profit function (revenues less costs) for the typical firm; and Eq. (8) is the firm's cost function. The only cost considered here is that on interest incurred on borrowing. Specifically, the first term on the right hand side (r.h.s.) of Eq. (8) is the real interest cost on domestic debt, while the second term on the r.h.s. is the real interest cost on foreign debt that is accumulated in the beginning of the period or at the end of the previous period. While foreign interest rates are assumed to be fixed, the interest on domestic debt is assumed to be floating or

[20] Aghion, Baccheta and Banerjee (2003) implicitly assume that $\eta_2(.) = 0$.

[21] An obvious limitation of the above framework is the absence of a banking sector. Aghion, Baccheta and Banerjee (2003) extend their original (2000) model to incorporate a competitive banking sector. Kiyotaki and Moore (1997) investigate the transmission of shocks following declines in asset prices and falls in collateral values (leading to bankruptcies and credit crunches). Also see Krugman (2003) who refers to the incorporation of asset prices and balance sheet effects as "fourth generation" crisis model.

[22] Eichengreen and Arteta (2002, Table 1) succinctly summarize the principal empirical studies on banking crises. Their comprehensive empirical investigation finds rapid domestic credit growth to be one of the few robust causes of banking crises.

variable.[23] We do not concern ourselves here with how and why firms might choose the mix between domestic and foreign currency debt (See Section 6).

With appropriate substitutions we have:

$$\pi_t = y_t - [(1 + i_t) d^c + (1 + i^*)(e_t / e_{t-1})(d_t - d^c)]. \quad (9)$$

Assume α is a proportion of profits that is retained by the firm (assume they are consumed or distributed for simplicity).[24] Thus, wealth holdings (which acts as collateral) can be written as follows:

$$w_{t+1} = (1 - \alpha)\pi_t + w_t \quad (10)$$

The question we are interested in here is what is the impact of a change in e_1 on y_2? From Eq. (10), we have:

$$w_2 = (1 - \alpha)\pi_1 \quad (11)[25]$$

So, $$y_2 = \sigma(1 + \eta(.))w_2 + x(.)$$

$$= \sigma(1 + \eta(.))(1 - \alpha)[y_1 - (1 + i_1) d^c - (1 + i^*) e_1 (d_1 - d^c)] + x(.) \quad (12)[26]$$

Note that $dy_2 / de_1 = (\partial y_2 / \partial e_1) + (\partial y_2 / \partial i_1)(\partial i_1 / \partial e_1)$ (13)
(a) (b) (c)

[23] Aghion-Bacchetta-Banerjee assume that the interest rate on domestic debt is on fixed terms, thus ignoring this interest rate channel.

[24] In a fuller general equilibrium model this would need to be modeled explicitly.

[25] Note that $w_1 = 0$.

[26] Note that $P_1 = e_0 = 1$.

4.3 Output Effects of Real Devaluation: Theory

Referring to Eq. (13), (a) and (b) essentially denote the IB schedule (see Eq. 2); (c) is the EB schedule (see Eq. 1) which is unambiguously negative (ignoring strong perverse Laffer curve or signalling effects). Our focus here is on the IB schedule.

(b) is unambiguously negative. Why? First is the "credit easing" channel: $\eta_1(.)$ < 0. Second is the "lower interest burden" channel: $(1 + i_1)d^c$ < 0.[27]

(a) cannot be signed *a priori*. Why? There are three channels that need to be considered. First is the "pro-competitiveness" channel which is positive: $x'(.) > 0$. Second is the "bank crisis" / "credit crunch" or "illiquidity" channel which is negative: $\eta_2(.) < 0$. Third is the balance sheet or "insolvency" channel: -[$(1 + i^*)(d_1 - d^c)$] which is also negative, i.e. a real depreciation leads to a rise in the domestic value of existing unhedged foreign debt due to currency depreciation and reduced profits (we explore this issue in Section 6). Some might question why the valuation effects involve *real* rather than *nominal* depreciation. While the assumption of price rigidity makes this distinction irrelevant here, more importantly, the appropriate comparison is not nominal devaluation versus doing nothing. If a real depreciation is called for and nominal exchange rates are rigid, the result will be domestic deflation and a rise in the country's risk premium in anticipation of expected devaluation at a later stage.[28] This in turn will raise the country's level of indebtedness even absent a nominal devaluation (Cespedes, Chang and Velasco, 2000).

This simple model highlights a number of channels via which devaluation may affect output and provides the microfoundations for the IB schedule. If the pro-competiveness channel outweighs the other two channels, we have the conventional

[27] While not discussed in this simple supply-side model, there is the possibility of the conventional Keynesian demand channel which works in the same direction.

[28] Recent examples in this regard have been Argentina and Hong Kong to a lesser extent (Rajan, 2003, Chapter 4).

effect, viz. $\partial y_2 / \partial e_1 > 0$ and an upward sloping IB schedule[29]; else the IB schedule is downward sloping.[30] Regardless of the slope of the IB schedule, as discussed, points above the schedule denote recession or output operating at below capacity, while points below denote overheating or output running at above capacity (Figure 1b).

4.4 Output Effects of Real Devaluation: Empirics

There has been a large and growing empirical literature testing the output effects of real devaluation. Results have been rather inconclusive, with suggestions of devaluations being contractionary in short run but not over time after controlling for various factors including monetary and fiscal policies (for instance, see Kamin and Klau, 1998). This gives rise to the oft-noted "V-shaped" post-crisis output dynamics.

Rajan and Shen (2003) find that there exists a difference between crisis and non-crisis periods, i.e. "state contingent" devaluation. Using annual data from 24 countries over the period 1981 and 1999 they find that real devaluation in "normal" times is *not* contractionary. Only "crisis-induced" devaluations appear to be contractionary.[31] While there are a number of possible factors driving this result (including concerns about spurious correlation and reverse causality), one reason for this might have to do with the size of depreciations. Specifically, with "small"

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[29] For instance, Goldstein (1998) has noted:

> When market participants lose confidence in a currency and attach a high probability to further falls, it is difficult to induce them to hold the currency without higher interest rates…Moreover, halting a free fall of the currency takes on added importance when banks or corporations in the crisis country have large foreign currency obligations coming due in the short term.

[30] Cespedes, Chang and Velasco (2000) present a dynamic stochastic model that allows for the default risk premium (the ρ term in Eq. 1) to be endogenously determined by the net worth of the corporate sectors. One could also assume that risk premium is procyclical for various reasons. For instance, risk perceptions could rise with dimming export growth prospects. Conversely, one could assume that changes in *rp* directly influence the size of external debt (d_t - d^c). Either of these complicates the analysis as it implies dynamic interlinkages between the EB and IB schedules which can no longer be seen as independent.

[31] Their definition of currency crisis is based on and output Goldstein, Kaminsky and Reinhart (2000). They consider both actual devaluations as well as exchange market pressure that does not lead to an actual devaluation. They measure output as deviations from a trend.

exchange rate changes (i.e. during "normal" periods) the pro-competitiveness effect might dominate, while for "large" ones (i.e. during "crisis" periods) the balance sheet and bank crisis channels may dominate (Aghion, Bacchetta and Banerjee, 2000 and Krugman, 2003).[32] Graphically this corresponds to an IB schedule that is positively sloped but backward bending for large devaluations (discussed in Section 5). Lahiri and Vegh (2001) suggest a non-linear or "fear of floating" rule, whereby authorities should allow the currency to float in response to a "small shock" but should try and avoid any large real exchange rate changes.

Given the possible difference between crises and non-crises periods, Gupta, Mishra and Sahay (2001) focus specifically on 195 crisis episodes across 91 developing countries between 1970 and 1998.[33] They find that the size of the export sector is positively associated with short run growth, while short term debt to reserves and nominal debt burdens are both negatively associated to growth, though the latter is statistically insignificant. The study also finds that output contractions post-crisis are more likely the greater the initial (i.e. precrisis) capital inflows into the country and the more liberal the country's capital and current account transactions. In addition, contractions are more likely if trade competitors devalue as this negates the pro-competitiveness effects of any single country.

There is a small but growing literature investigating the effect of sharp devaluations on individual firms rather than aggregate macro variables. For instance, Forbes (2002) uses a database from Worldscope covering over 13,500 non-financial companies in 42 countries between 1997 and 2000. On examining events of large

[32] Two other reasons for this may be the sharp curtailment of private capital inflows during a crisis period (captured by the EB schedule), or contagion which limits the pro-competitiveness effects of devaluation in any single country.

[33] The authors use a number of standard definitions of crisis, including that based on Goldstein, Kaminsky and Reinhart (2000). They measure output as the difference in average growth in the crisis and the first post-crisis periods and the average growth in three pre-crisis tranquil periods.

depreciations in 12 countries (with the other 30 countries used as a control group),[34] she found that in the year after the depreciation, firms generally experience a rise in market capitalization but a decline in growth in net income (in local currencies). This suggests to the author that depreciations in general lower immediate income but raises future expected profit. In other words, large or crisis-induced devaluations appear to be contractionary in the short run but not over time. Turning to firm characteristics, the findings indicate that firms with higher debt ratios tend to have lower income growth, while firms with greater foreign sales exposures performed notably better after depreciations. This is broadly consistent with the stylized model discussed above.

5. Implications for Crisis Management: Stylized Examples

What are the implications of the preceding discussion for crisis management? As a first step, it is useful to note that, as with the conventional Swan diagram, there are four distinct quadrants off the EB and IB schedules (Figure 1a). To return to internal and external balance simultaneously requires a combination of policies. Optimal policy combinations could differ depending on whether the IB is positively or negatively sloped, and if the latter, whether it is steeper or flatter than the EB schedule. Consider the conventional case where the EB schedule is negatively sloped and fairly elastic (i.e. highly interest sensitive) and the IB schedule is positively sloped. We refer to this as Case 1a (Figure 2). If the bank crisis and balance sheet channels dominate the pro-competitiveness effects, the IB schedule is downward sloping. Assuming that the EB schedule remains downward sloping but is fairly inelastic (due to the significance of perverse Laffer curve and signalling effects), there are two other possible cases. Case 1b (Figure 3) is where the IB schedule is

[34] The twelve events are: Thailand (July 1997), Philippines (July 1997), Indonesia (August 1997 and January 1999), Malaysia (September 1997), South Korea (November 1997), Czech Republic (February 1998), Greece (March 1998), South Africa (June 1998), Mexico (August 1998), Pakistan (August 1998), Israel (October 1998) and Brazil (January 1999).

steeper than the EB schedule. Case 1c (Figure 4) is where the EB schedule is steeper than the IB schedule. Rather than examine all policy combinations for all quadrants for all cases, we instead focus on stylized cases when an economy is initially in equilibrium (internal and external balance) but is then hit by a (negative) external shock. This is justifiable by the fact that the reason for the reformulation of the Swan diagram in the first instance has been to examine optimal policy combinations in the event of a crisis. We consider two stylized shocks below, viz. risk premium shock and export shock as well as a combination of both.

5.1 Adverse Risk Premium Shock

Consider the case of a negative exogenous risk premium shock which leads to a sudden stop in capital flows. This can be depicted by a rightward shift of the EB schedule.[35] What mix of policies is needed to maintain both internal and external balance? In Case 1a there is a need for the IMF's conventional policy mix of real exchange rate depreciation and higher interest rates, i.e. expenditure reducing plus expenditure switching. In Case 1b the external shock requires tighter monetary policy but real exchange rate appreciation, i.e. expenditure reducing plus financing which is frontloaded. The intuition is straightforward. A rise in risk premium disturbs the capital account balance and requires a rise in interest rate to regain equilibrium. The rise in interest rates causes output to fall below full employment level, hence necessitating an exchange rate depreciation (adjustment) in Case 1a and an appreciation (financing) in Case 1b. In Case 1c the external shock requires a combination of real depreciation and looser monetary policy, i.e. expenditure increasing plus expenditure switching policies. The intuition here is as follows. Given that the EB schedule is more interest elastic than the IB schedule, the principle of effective classification

[35] Of course, as noted in Section 4, risk perceptions might not be entirely exogenous, e.g. they could be pro-cyclical.

suggests that the external balance is best regained via currency devaluation. This in turn leads to a domestic contraction, hence requiring a monetary expansion.

5.2 Adverse Export Shock

A similar exercise can be carried out in the event of a negative export shock. In such a case the IB schedule shifts down. Once again we have three cases (2a-c). In Case 2a if the IB schedule is positively sloped (the EB is always assumed negatively sloped), the policy mix to regain internal and external balance would be to lower interest rates and a depreciated currency (Figure 5). In Case 2b with a negatively sloped IB schedule, and as long as it is steeper than the EB schedule, the appropriate policy combination is tighter interest rates and a stronger currency. In Case 2c where the EB schedule is steeper than the IB schedule, the policy mix to simultaneously regain internal and external balance would be to loosen monetary policy and permit the currency to depreciate, just as in Case 2a. Table 3 summarizes the foregoing results.

5.3 Combination of Shocks and Policy Complexities

What if the economy were to be hit by a combination of adverse risk premium and export shocks? It is easy to see that in the case of a conventionally sloped upward sloping IB schedule (Cases 1a-2a), the appropriate policy response is to allow the currency to depreciate, though the direction of interest rate policy is ambiguous. However, in the other two cases (i.e. Cases 1b-2b and Case 1c-2c) the crisis management policies remain unchanged.

Appropriate policy combinations could become especially complicated if one assumes that the slope of the EB schedule is generally upward sloping but then switches to being downward sloping in the event of sharp depreciations. As Figure 8 shows, in the event of an adverse risk premium shock, it is unclear as to what the optimal combination of adjustment versus financing policies would be (points 1^0 and

1^2). Indeed, there could also be circumstances where there is a non-intersection of the EB and IB schedules such that there would be no combination of policies that attain external and internal balance simultaneously (point 1^1).[36] Note that in such an event, there is a need for a third instrument such as fiscal policy (which will shift the IB schedule up) if both internal and external balance is to be regained. Intuitively, *ceteris paribus*, expansionary fiscal policy requires tighter interest rates to keep output at full employment, hence shifting the IB schedule upwards (also see Krugman, 1998).

As the preceding analysis emphasizes, the optimal combination of policies is subject to a lot of "ifs and buts" depending on the type of external shock and the exchange and interest rate elasticities of internal and external balance curves. This ambiguity nicely captures the policy debate that has been rife at the IMF and elsewhere on dealing with new-style crises.[37] For instance, consider the following description of the internal debate within various IMF departments on the appropriate monetary policy stance to deal with the crisis in Indonesia (The three departments involved were the PDR or Policy Development Review, MAE or Monetary and Exchange Affairs Department and RES or Research department):

> The..PDR..and MAE argued for tight monetary policy with high interest rates. PDR argued that the corporate and banking sectors could not bear the added costs from any further depreciation...On the other hand,..(the research RES and APD argued against further tightening monetary policy and raising interest rates. RES was concerned that an interest rate defense was not feasible with a weak banking system and a vulnerable corporate sector. It pointed out that if confidence remained low.. higher interest rates would damage the corporate and banking sectors, thereby further eroding confidence…(IMF-IEO, 2003).

This example is as good a reminder as any that in most cases the appropriate answer to many a macroeconomic question is "it depends on the circumstances at

[36] This could also occur if the EB and IB schedules are more or less parallel and hence do not intersect (Frankel, 2001).

[37] Indonesia was the worst impacted by the Asian crisis of 1997-98, experiencing an output contraction of almost 30 percent of GDP.

hand". When determining appropriate crisis management policies, policy makers need to be cognizant of (a) the potential perverse effects of capital flows in response to interest rate changes; (b) the extent of leverage of the corporate sector (in terms of aggregate size, currency denomination and maturity structure); (c) the extent of financial sector vulnerabilities; and (d) the possible influences of exchange rate and interest rate changes on the corporate and financial sectors and their repercussions on the overall economy.

6. Concluding Remarks

The new-style currency crises that have inflicted a number of developing and emerging economies of late are characterized by sudden stops in capital inflows (flow issue) and adverse balance sheet effects (stock issue). This paper has argued that the age-old Swan diagram, appropriately modified, is able to provide quite useful insights into how a country might manage the crisis via a combination of expenditure switching and reducing polices (adjustment) and financing.

Given the uncertainties with regard to management of new-style crisis noted above (also see Boorman and Associates, 2000), it is all the more important to try and minimize the chances of such crises occurring in the first instance. While a detailed elaboration on steps to strengthen crisis prevention is well beyond the scope of this paper (see Bird and Rajan, 2002 and Rajan, 2003, Chapter 3), the issue of liability dollarization warrants exploring. After all, it is this factor that plays a significant role in determining the slope of the Internal Balance schedule and accordingly, raises challenges and uncertainties with regard to what constitutes an optimal policy mix.

What steps need to be taken to reduce vulnerability due to uncovered foreign currency borrowing? There are two closely related questions. Why are emerging economies *unable* to borrow overseas in their own currencies especially long term,

and therefore unable to hedge, i.e. "original sin" phenomenon. (Eichengreen, Hausmann and Panizza, 2003). As Hausmann (1999) notes:

> if a country cannot borrow in its own currency, it cannot hedge the exposure to its foreign debt. To do so, foreigners would have to take a long position in pesos, and that is equivalent to assuming that the country can borrow abroad in pesos" (p.144).[38]

Of course, there is always a price at which lenders will be willing to lend in a foreign currency, i.e. at an interest premium.[39] Insofar as the premium that is generated in emerging market interest rates reflects currency and country risk perceptions, a closely related question is, why are domestic borrowers (in the emerging economy) *unwilling* to pay that premium and instead choose to borrow in foreign currency despite the inherent riskiness of these actions? At least two possible reasons come to mind.

One, there could be an asymmetry in the risk perception of the domestic agents (potential borrowers) and foreign creditors, with the former's risk perceptions being less than the latter's. This could arise because of different information sets or the domestic agents expecting a bailout by the government in the event of an adverse shock. If this is the case, the only willing borrowers at high interest rates will be those least likely to repay the loans. This adverse selection problem in turn raises the risk premium levied by foreign lenders, which could become prohibitively high.

Two, if domestic agents in the emerging economy are concerned about the possibility of being hit by random real shocks which might affect their cash flow and thus their ability to repay the high interest, on the one hand, and if there are nontrivial costs of defaulting interest payments during downturns, on the other, rational cost-benefit calculus may lead domestic agents to opt for "cheaper" foreign currency borrowing. This point is formalized by Jeanne (2002).

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[38] Slavov (2003) explores the issue of hedging in emerging economies in some detail with particular reference to Asia.

[39] For bank-based explanations of the persistent interest premia offered by emerging economies, see Bird and Rajan (2001).

How might a country overcome the original sin phenomenon short of imposing outright restrictions on foreign borrowing (quantitative or otherwise)? Returning to the reason for the risk premium required to induce foreign creditors to hold the emerging economy's currency at the margin, while part of *default* risk premium has to do with concerns about creditworthiness of the country (i.e. risk of non-payment), part of the *currency* risk premium has to do with the lack of credibility of the monetary authorities.

The *default risk* premium could possibly be reduced if the government or international agencies (such as the World Bank) act as guarantors for at least a portion of the country's debt, though this could lead to concerns about moral hazard. With regard to the *currency risk* premium, the concern about investing in the country's currency is that there is the possibility that the monetary authority may choose to opportunistically inflate the economy / devalue the currency. Thus, the argument has recently been made that a precondition for foreigners to be willing to hold the emerging economy's assets is that it be widely held by domestic agents. The rationale is that with a wide holding of the domestic assets by domestic residents it is much less likely that the government will be tempted to erode the real value of the debt.[40] In this regard, countries should actively foster the development of well-functioning and vibrant domestic and regional bond markets, a policy recommendation that many developing countries in Asia and Latin America appear to have taken on board.

[40] Closely related to this risk-of-inflation (i.e. expropriation) argument, McLean and Shrestha (2001) have suggested that the development of a euro bond market is also a means of overcoming the original sin phenomenon. They find evidence that this was the case in Australia, New Zealand and South Africa, none of which appear to be plagued by the original sin problem.

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Figure 1a
Four Quadrants of the Conventional Swan Diagram

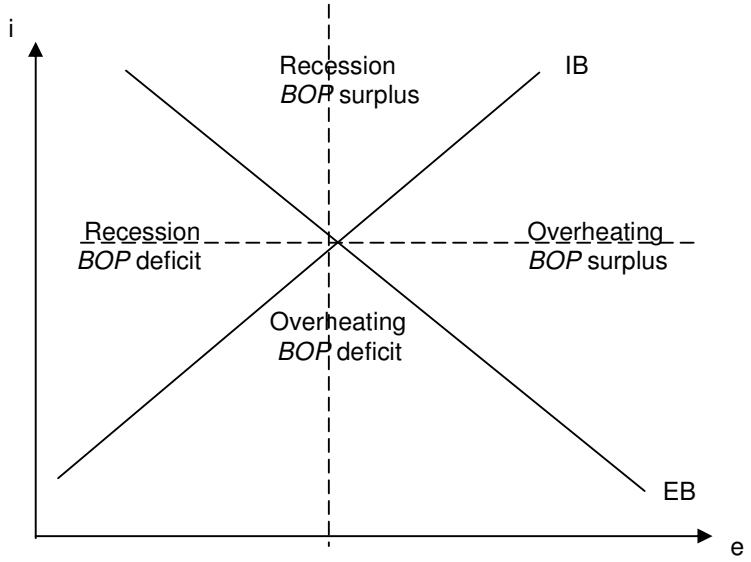
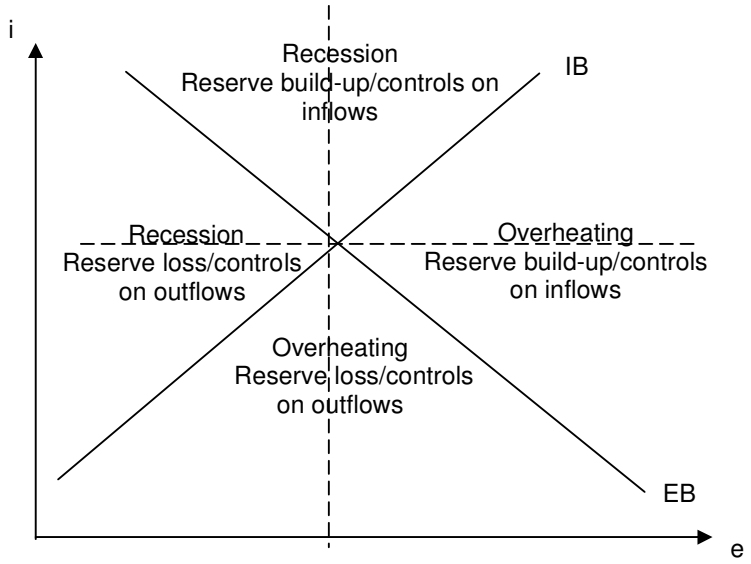


Figure 1b
Four Quadrants of the New-Style Swan Diagram[1]



Note: [1] The assumption here is that the IB schedule is upward sloping. As noted, the IB schedule could also be downward sloping. However, the general conclusion, viz. points above the IB schedule denote recession and points below denote overheating, remain valid.

Figure 2
Crisis Management Following an Adverse Risk Premium Shock: Case 1a

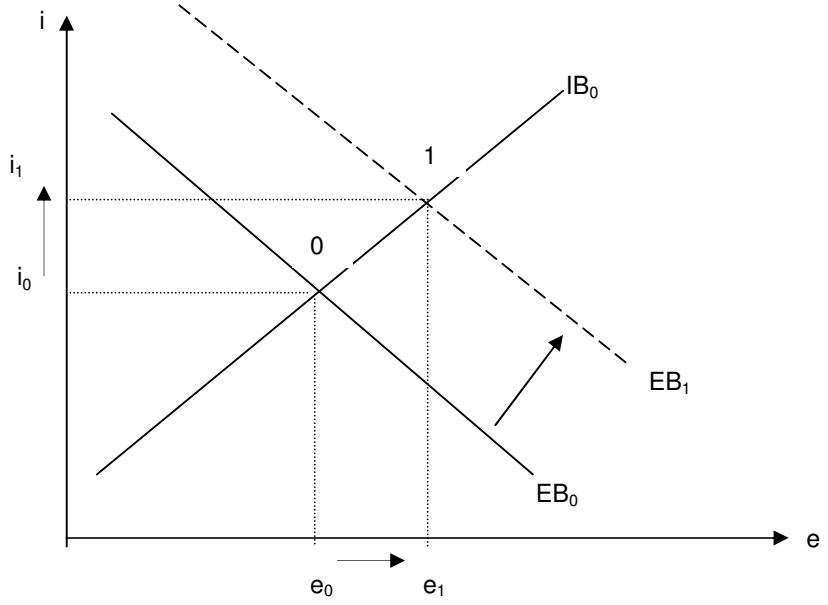


Figure 3
Crisis Management Following an Adverse Risk Premium Shock: Case 1b

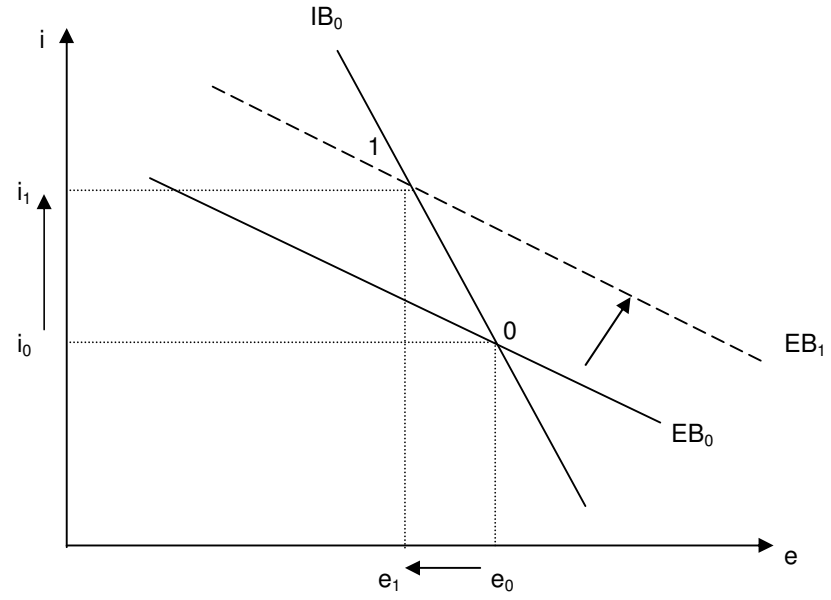


Figure 4
Crisis Management Following an Adverse Risk Premium Shock: Case 1c

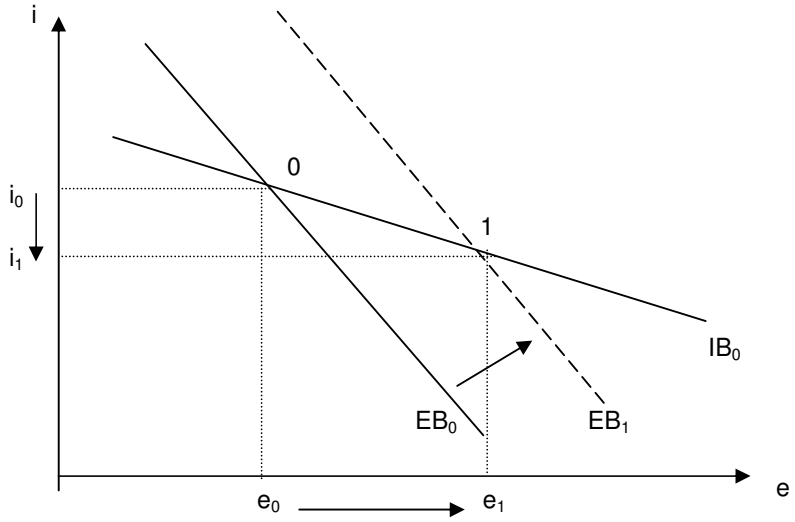


Figure 5
Crisis Management Following an Adverse Export Shock: Case 2a

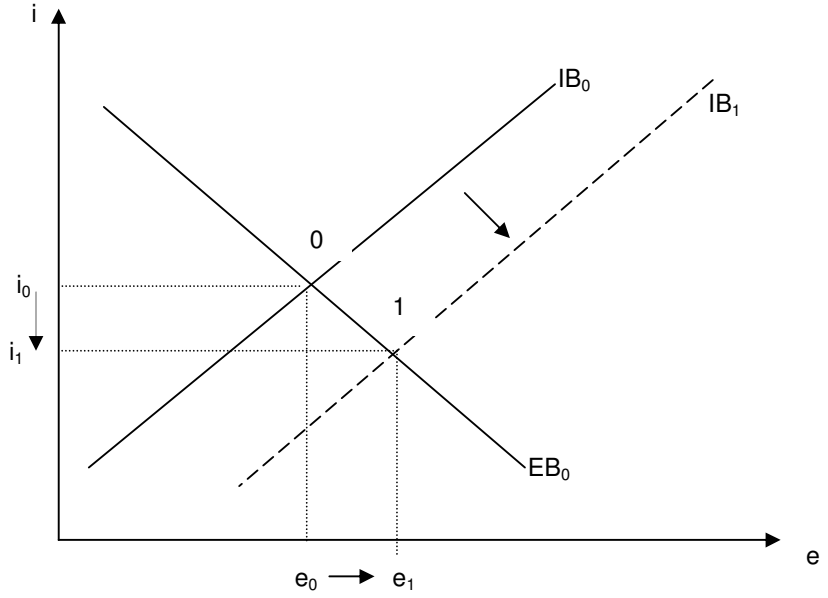


Figure 6
Crisis Management Following an Adverse Export Shock: Case 2b

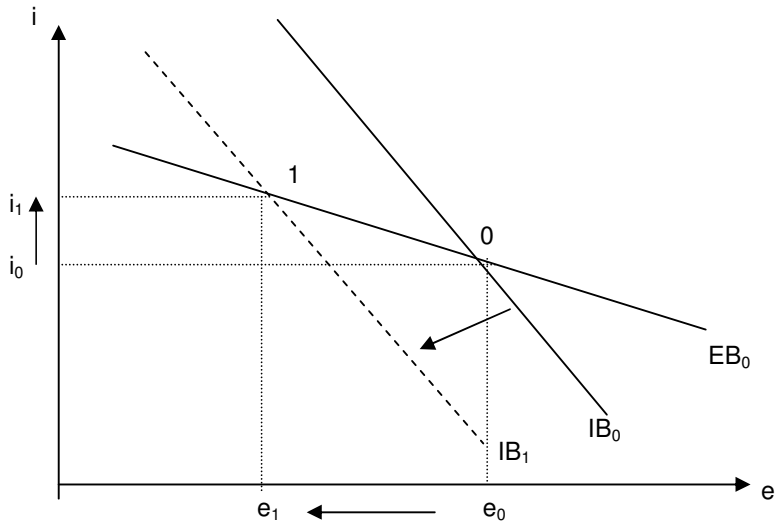


Figure 7
Crisis Management Following an Adverse Export Shock: Case 2c

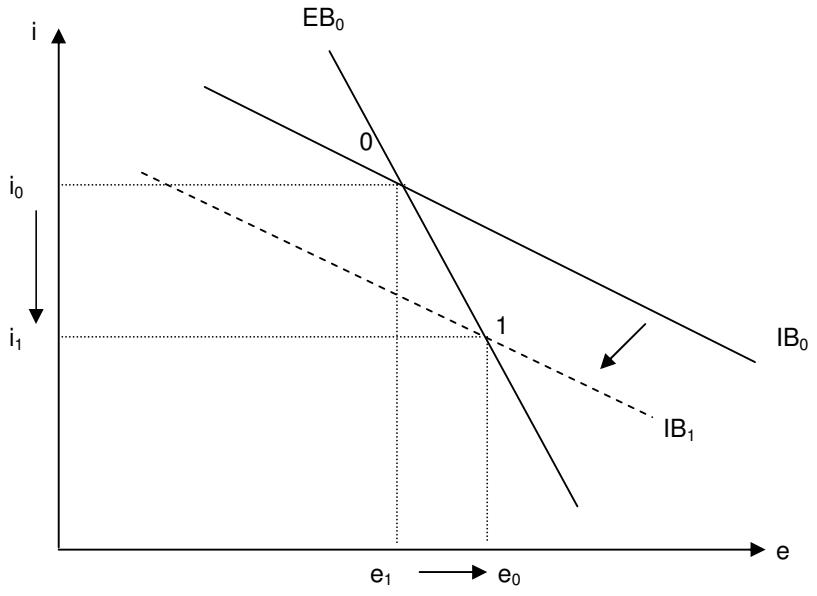


Figure 8
Crisis Management Following Adverse Risk Premium Shock: Multiple Equilibra Case

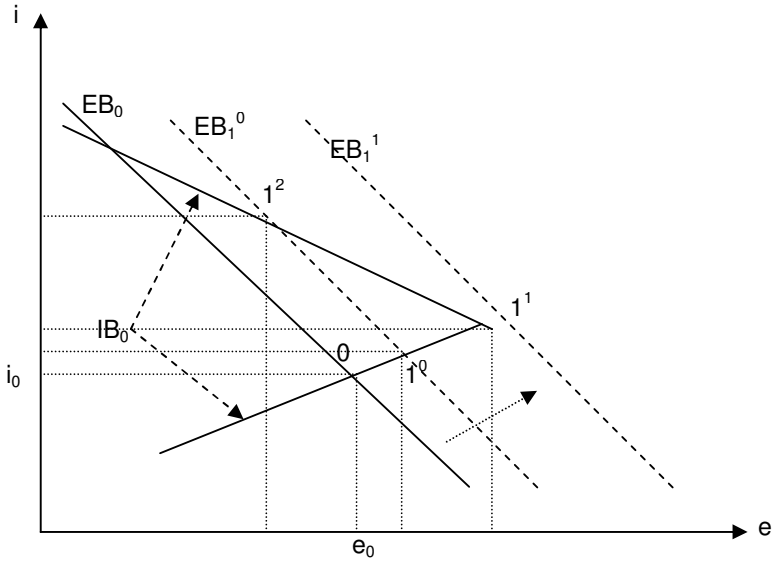


Table 1
Sudden Stops: Number of Events (% of sample)

"Standard" Currency Crises and Current Account Reversals[a,b,c]		
	Currency Crisis	No Crisis
Current Account Reversal	24 (6%)	65 (16%)
No Current Account Reversal	25 (6%)	300 (72%)
"Major" Crises and Current Account Reversals[a,b,c]		
	Currency Crisis	No Crisis
Current Account Reversal	18 (4%)	35 (9%)
No Current Account Reversal	22 (5%)	339 (82%)

Notes: a) A "standard" ("major") currency crises is defined as a deviation of the exchange market pressure index (based on Glick and Hutchison (2001) of more than 2 (3) standard deviations from the country-specific mean.
b) A "standard" ("major") current account reversal is defined as a change in the current account to GDP ratio of more than 3 (5) percentage points.
c) Number in parenthesis refer to the proportion out of country years in sample
Source: Hutchison and Noy (2002)

Table 2
Extent of Leverage in Selected Developing Asian Economies (Debt to Equity), 1990-96

Economy	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Hong Kong	1.783	2.047	1.835	1.758	2.273	1.980	1.559
Indonesia	n.a.	1.943	2.097	2.054	1.661	2.115	1.878
Korea	3.105	3.221	3.373	3.636	3.530	3.776	3.545
Malaysia	1.010	0.610	0.627	0.704	0.991	1.103	1.176
Philippines	n.a.	0.830	1.186	1.175	1.148	1.150	1.285
Singapore	0.939	0.887	0.856	1.102	0.862	1.037	1.049
Taiwan	n.a.	0.679	0.883	0.866	0.894	0.796	0.802
Memo Items (Industrial Countries):							
Japan	2.871	2.029	2.042	2.057	2.193	2.367	2.374
Germany	1.582	1.594	1.507	1.534	1.512	1.485	1.472
US	0.904	0.972	1.059	1.051	1.066	1.099	1.125

Source: Claessens, Djankov and Xu (2000)

Table 3
Optimal Monetary and Exchange Rate Policy Mix

	Adverse Risk Premium Shock	**Adverse Export Shock**
Upward sloping IB schedule	Case 1a higher interest rate (*expenditure reducing*) and real exchange rate depreciation (*expenditure switching*)	Case 2a lower interest rate (*expenditure increasing*) and real exchange rate depreciation (*expenditure switching*)
Downward sloping IB but steeper than EB	Case 1b higher interest rate (*expenditure reducing*) and real exchange rate appreciation (*financing*)	Case 2b higher interest rate (*expenditure reducing*) and real exchange rate appreciation (*financing*)
Downward sloping IB but flatter than EB	Case 1c lower interest rate (*expenditure increasing*) and real exchange rate depreciation (*expenditure switching*)	Case 2c lower interest rate (*expenditure increasing*) and real exchange rate depreciation (*expenditure switching*)