REAL SECTOR SHOCKS AND MONETARY POLICY RESPONSES IN A FINANCIALLY VULNERABLE EMERGING ECONOMY

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Abstract

When analyzing the appropriate response for monetary policy during a currency crisis it is important to keep in mind two distinct channels: (a) the impact of raising interest rates on exchange rates; and (b) the direct impact of exchange rate changes on output. The first pertains to the monetary side of the economy as given by the interest parity condition, while the second pertains to the real side of the economy. The interaction between these two legs of the economy derives the equilibrium output and exchange rate in the economy. This paper expands on the Aghion, Bacchetta and Banerjee (2000) monetary model, with nominal rigidities and foreign currency debt playing to examine the interaction between the real and monetary sides of the economy to analyze the impact of monetary policy on the real economy. To preview the main conclusion, we find that the impact of monetary policy on exchange rate and output depends largely on the shape of the W-curve, which is theoretically ambiguous. This in turn suggests that the appropriate monetary policy response could vary between countries at any point in time, or for a particular country between two different periods.

Keywords: balance sheet effects, currency crisis, exchange rate depreciation, monetary policy, Laffer curve effects.

1. Introduction

When analyzing the appropriate monetary policy response during a currency crisis, it is important to keep in mind two distinct channels: (a) the impact of changing interest rates on exchange rates; and (b) the direct impact of exchange rate changes on output. The first pertains to the monetary side of the economy as given by the interest parity condition, while the second pertains to the real side of the economy. The interaction between these two legs of the economy derives the equilibrium output and exchange rate changes in the economy. Thus, the net effect of monetary policy on output and exchange rate requires consideration of both dimensions of the economy.

With regard to the monetary side of the economy, the "orthodox" IMF view about the relationship between monetary policy and the exchange rate is that tight monetary policy strengthens the exchange rate by sending a signal that the authorities are committed to maintaining a fixed rate, as well as by providing the financial incentive for capital to remain in the country. Nevertheless, many doubts have been expressed about the direct exchange rate impact of a tight monetary policy stance during a crisis period. For instance, Stiglitz (1998) has noted:

> Although countries confronted with an exchange rate crisis have sometimes viewed themselves as facing a trade-off between the adverse effect of exchange rate depreciation and interest rate increases, if increases in interest rates lead to a decreased capital flow, there is no trade-off: higher interest rates weaken the economy directly and actually exacerbate the decline in the exchange rate.

But why might there be this perverse asset market response of an interest rate hike on exchange rates? As the East Asian crisis of 1997-98 made apparent, there are balance sheet effects at work given the large proportion of unhedged foreign currency debt that were accumulated (Bird and Rajan, 2004, Krugman, 1999 and Montiel, 2003). In such a case a tight monetary policy could raise the probability that a country will be unable to service its debt (the so-called "Laffer curve" effects of monetary policy), further swelling the share of non-performing loans (NPLs) held by

financial institutions. Thus, where tight monetary policy leads to increased concerns regarding "riskiness and destruction of collateral associated with the balance sheet effects of the crisis itself" (Boorman, *et al.*, 2000) it may prove to be counterproductive. Rather than domestic monetary policy neutralizing the recessionary effects of devaluation it may lead to additional capital outflows that intensify them.[1]

There has been a large and growing body of literature that has examined the exchange rate impact of interest rate changes, particularly following the East Asian crisis of 1997-98. Conclusions remain mixed at best. For instance, applying daily data to a bivariate VAR model for the five countries most heavily affected by the Asian financial crisis, viz. Thailand, South Korea, Malaysia, Indonesia and Philippines, Caporale, Cipollini and Demetraides, (2000) find that tight monetary policy does not help to stabilize the currencies under investigation. Using a standard monetary model of exchange rate determination, Basurto and Ghosh (2001) find that tighter monetary policy was associated with an appreciation of the currencies in Indonesia, Korea and Thailand. According to them there is little evidence of a "perverse" effect of a monetary tightening on the exchange rate. A priori this is not surprising in view of the fact that even if the direct impact of interest rate changes on the exchange rate is unambiguous, the net effect, which is what is implicitly measured by these studies, is far from apparent.[2]

With regard to the real side of the economy there is further ambiguity as to how interest rate changes impacts output. For instance, even if tight monetary policy does help to stablize the exchange rate it may not necessarily be optimal if it curtails domestic output sharply. Conversely, failure to stem exchange rate declines could

[1] There could be other reasons for this perverse asset market response of exchange rates to a change in monetary policy stance, including the role of signals *a la* Drazen and Hubrich (2003). For a nontechnical discussion of this and other channels, see Montiel (2003).

[2] Montiel (2003) offers a systematic though partial literature review of the empirical work relating exchange rate and interest rate changes during a crisis period.

itself negatively impact output for various reasons (for instance, see Bird and Rajan, 2004, Gupta et al., 2003, Hutchison and Noy, 2001). Thus, when considering the appropriate monetary policy stance it is critical to consider the interaction between both the real and monetary sides of the economy simultaneously.

Aghion, Bacchetta and Banerjee (2000) (henceforth A-B-B) develop a monetary model with nominal rigidities and foreign currency debt to examine the interaction between the real and monetary sides of the economy, hence allowing a determination of the net effects of monetary policy. As will be discussed, a significant advantage of A-B-B's model is that it lends itself naturally to graphical analysis. There are two schedules: (a) the interest parity-LM ("IPLM") curve or monetary side of the economy which directly links interest rate changes to exchange rate changes; and (b) the "W" curve which represents the real side of economy.

The remainder of the paper is organized as follows. Section 2 lays out and extends the basic A-B-B model to draw out the possible links between interest rates, exchange rates and output. Section 3 demonstrates the possibility of various equilibria situations (given by the intersection of the real and monetary sides of the economy) and goes on to analyze the impact of monetary policy on the real economy. To preview the main conclusion, we find that the impact of monetary policy on exchange rate and output depends largely on the shape of the W-curve, which is theoretically ambiguous. This in turn suggests that the appropriate monetary policy response could vary between countries at any point in time, or for a particular country between two different periods. The final section offers a few concluding remarks on policy issues.

2. The Basic Model

2.1 Assumptions

The basic framework and assumptions closely follow A-B-B. We consider a two-period small open economy model. Goods prices are determined at the

beginning of each period and remain fixed for the entire period. There is a single good and purchasing power parity (PPP) holds *ex-ante*, i.e., $P_t = E_t^e$ for each t, where P_t is the domestic price (which is preset beginning of the period) and E_t^e is the expected nominal exchange rate (domestic currency per unit of foreign currency at the beginning of period *t*). In period 1 the nominal exchange rate and the nominal interest rate will adjust, while there may be *ex-post* deviations from PPP because of unanticipated shocks.

2.2 The Monetary Sector

Assume the existence of the usual uncovered interest parity (UIP) condition:

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

where i_t is domestic interest rates, i^* is the foreign interest rate, which is assumed constant. E_t and E_{t+1}^e are respectively the current exchange rate and expected future exchange rate (in terms of foreign currency), and rp_t is the risk premium which is assumed to rise with interest rates. As we will discuss later, this is a simple way of capturing the possible existence of Laffer curve effects of interest rates.[3]

Assume a standard real money demand function, $m_t^d = L(Y_t, i_t)$. The function $L(Y_t, i_t)$ has the usual properties, viz. of $L_1(.) > 0$ and $L_2(.) < 0$. Assume $L(0, i_t) > 0$. The money market equilibrium is gives as usual:

$$M_t^s = P_t.L(Y_t, i_t) \qquad (2)$$

[3] For an alternative - more precise - way of modelling the Laffer curve effects, see Goldfajn and Baig (1998). The benefit of incorporating risk premium in this manner is that it allows for the interpretation of Laffer curve effects as either an erosion of investments due to probability of default or decline in investor expectations leading to outright capital flight.

where M_t^s and P_t is the nominal money supply and price level at time t.

Combining Eqs. (1) and (2), along with the assumptions that the second period interest rate is exogenously fixed and the PPP assumption ($P_2 = E_2$), derives:

$$E_1 = \frac{1+i^*}{(1+i_1 - rp(i_1))} \frac{M_2^s}{L(Y_2, i_2)} \tag{3}$$

Eq. (3) reveals a negative relationship between E_1 and Y_2 and is represented graphically in (E_1, Y_2) space (Figure 1). As noted, A-B-B refer to this curve as the "IPLM curve" (interest parity-LM) and is negatively sloped.[4] The IPLM curve may be shifted by changes in monetary policy in each period. For instance, a rise in M_2^s will lead to a rise in E_2 via PPP which in turn leads to a depreciation in the current period (rise in E_1). Similarly, a rise in M_1^s leads to a decline in i_1 -- and, ignoring the risk premium term in the first instance -- this necessitates a currency depreciation in the current period (E_1 rises) for a given output level. This implies a rightward shift of the IPLM.

However, if Laffer curve effects exist, there is the strong perverse effect, whereby a rise in M_1^s could lead to an exchange rate appreciation. However, the existence of "strong" Laffer curve effects must be questioned as they imply logically that a fall in interest rate will appreciate a currency. More likely to exist -- if at all -- are "weak" Laffer curve effects, i.e. there is little or no discernible change in the exchange rate for a given change in interest rates and thus no significant shift in the IPLM for a change in money supply. Indeed, while on the one hand a sharp interest rate hike may increase the probability of default, hence leading to a rise in risk premium, an interest rate decline (particularly during a crisis) could be interpreted as

[4] Note that as with A-B-B we have assumed concavity of the IPLM. This requires that $L_1(.) > 2[L_1(.)]^2 / L(.)$.

policy laxity, leading to loss of confidence and capital flight. Thus, on balance the impact of interest rates on the risk premium is unclear.

2.3 The Real Sector: Output and Entrepreneurs' Debt

Following A-B-B, assume the existence of credit constraints such that entrepreneurs can at most borrow an amount D_t that is proportional to their cash flow, W_t. In other words, $D_t = \mu_t W_t$ where μ is the "proportionality" or leverage factor. Entrepreneurs' capital stock is $K_t = W_t + D_t$. Assume a linear production technology as follows:

$$Y_t = \sigma K_t + \chi(E_{t-1}/P_{t-1}) \tag{4}$$

where σ is productivity parameter and $\chi(i_{t-1}, E_{t-1}/P_{t-1})$ denotes current exports which is a function of lagged interest rate and exchange rate. In other words, while sustainable output of the economy is given by the production function (capital stock and technology), unlike A-B-B we assume that the economy could be hit by an export shock which could alter output temporarily.[5] We further assume that exports are positively impacted by a lagged real depreciation (to account for J-curve and other inertial effects). In other words, $\chi'(E_{t-1}/P_{t-1}) > 0$. We denote this as the "pro-competitive effects" of exchange rate depreciation.

Current output thus becomes a linear function of current entrepreneurs' wealth:

$$Y_t = \sigma(1 + \mu_t(.))W_t + \chi(i_{t-1}, E_{t-1}/P_{t-1}) \tag{5}$$

[5] Another way of incorporating these effects might be to have export shocks impacting the technology parameter, i.e. there may be positive externalities from exporting.

Assume that the proportionality or leverage factor is as follows: $\mu_t = \mu(i_{t-1}, E_{t-1})$ where $\mu_1 < 0$ and $\mu_2 < 0$. The intuition is straightforward. The first term essentially captures the possibility that an interest rate hike worsens the state of the domestic financial and corporate sector making banks more risk averse (the banking sector is not explicitly modelled here), hence reducing the extent of leverage of entrepreneurs. The second term captures the impact of balance sheet effects on the domestic financial sector, i.e. currency depreciation worsens the state of the financial sector, hence reducing the extent of leverage available to entrepreneurs, resulting in a curtailment of investment and output.[6]

We further assume that domestic consumers are unwilling to lend more than a real amount, D^c in domestic currency to domestic firms in period 1. The remainder of the funding, $D_t - D_c$ is externally financed in foreign currency which is assumed to be unhedged.[7] The entire debt (principal plus interest) must be repaid by the end of period 2. Assume the cost of borrowing in domestic currency is i_t (i.e. floating rate), while that of foreign borrowing is i^* (which is assumed fixed).[8] Assuming debt costs are the only cost incurred, the aggregate nominal profits at the end of any period *t* can be expressed as:

$$\Pi_t = P_t Y_t - (1 + i_t) P_t D^c - (1 + i^*) P_t (D_t - D^c) \frac{E_t}{E_{t-1}} \qquad (6)$$

When profits are positive, entrepreneurs use a proportion (1 - α) of these profits, for production in the following period (a proportion α of profits is distributed or consumed). Total net wealth available for next period production is thus either equal

[6] A-B-B incorporate the first term not the second.

[7] The inability of many emerging economies to borrow externally in domestic currency terms has come to be referred to as the "original sin" hypothesis, see Hausmann, *et al.* (2002).

[8] A-B-B assume that domestic currency borrowing is in fixed rates.

to zero, when net profits are not positive, or otherwise equal to retained earnings (which is some constant proportion of profits):

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

Substituting eq. (6) into eq. (7) derives:

$$W_2 = (1-\alpha)\left[Y_1 - (1+i_1)D^c\frac{P_2}{P_1} - (1+i^*)(D_1 - D^c)\frac{E_1}{E_0}\right] \tag{8}$$

Focusing on the second-period output Y_2 derives:

$$Y_2 = \sigma(1+\mu(.)(1-\alpha)\left[Y_1 - (1+i_1)D^c - (1+i^*)(D_1 - D^c)\frac{E_1}{P_1}\right] + \chi(i_1, E_1/P_1).^{9} \tag{9}$$

Eq. (9^{I}), which depicts the nexus between Y_2 and E_1, is referred to as the W-curve. For now we abstract from the possibility of even weak Laffer curve effects on interest rate -- i.e. $(\partial i_1/\partial E_1) < 0$. In other words we assume that a depreciation accompanies monetary relaxation. Note that $(\partial Y_2/\partial E_1)$ cannot be signed *a priori*.

More to the point, there are four distinct channels:

a) The *competitiveness channel*: $\chi'(E_{t-1}/P_{t-1})$. This is straightforward. A depreciation boosts exports and thus output.

b) The *leverage or credit channel*: $\mu_t = \mu(i_{t-1}, E_{t-1})$ - which has two sub-effects:

[9] Note that $E_0 = P_1 = P_0$.

i) The first sub-effect is $\mu_1(.) < 0$, i.e. a depreciation allows for a monetary relaxation which in turn eases credit availability for entrepreneurs. This stimulates capital investment and growth.

ii) The second sub-effect is $\mu_2 < 0$, i.e. depreciation worsens the net worth of the financial system leading to reduced leverage.

c) The *debt cost channel*: $D^c \frac{\partial i_1}{\partial E_1}$. As interest rates are reduced, the interest burden on debt decreases, thus increasing profits, retained earnings and next period output.

d) The *balance sheet channel*: $(1+i^*)(D_1 - D^c)$. A devaluation raises the domestic value of foreign debt, hence reducing the firm's net worth and future output.

Overall, therefore, we are unable to determine the slope of the W curve. In what follows we undertake some simple comparative statics and discuss appropriate monetary policy responses in the event of a negative real sector shock assuming both positively sloped W curve (Case 1) and a negatively sloped W curve (Case 2).[10]

3. Equilibrium and Comparative Statics

3.1 Real Sector Shocks

Consider Case 1 with a positively sloped W curve and assume that $Y > 0$ in the first instance so as to allow for simple comparative statics (Figure 1). It is apparent that a negative real sector shock (productivity of export) in period 1 leads to a leftward shift of the W curve, causing a fall in output and currency depreciation (point 0 to 1). Consider Case 2 with a negatively sloped W curve and assume that there is a unique equilibrium with $Y > 0$ (Figure 2). Once again a negative real sector shock (productivity of export) leads to a leftward shift of the W curve with an output decline and currency depreciation. However, in this case there is a possibility of

[10] Note that the presence of weak Laffer curve effects makes it more likely that Case 2 holds as the debt cost and first sub-effect of the credit channel become less significant.

multiple equilibra, whereby output contraction and exchange rate depreciation could be "moderate" (point 1) or "sharp" (point 1^1)

3.2 Monetary Policy Response

What would be the appropriate monetary policy response in the event of a negative real sector shock? Abstracting from even the weak Laffer curve effects, an expansionary / contraction monetary policy in period 1 (M_t^s) leads to a decline in i_1 and a rise in the exchange rate and an upward / downward shift of the IPLM curve. An expansionary monetary policy in period 1 shifts the W curve rightwards as the interest rate decline raises output via the leverage channel (i.e. credit availability is eased) and domestic interest debt cost channel. (Vice versa for the case of contractionary monetary policy).

Consider Case 1 with an upward sloping W curve. In response to a negative real sector shock, a policy of *monetary contraction* would lead to a further fall in output, but the impact on the exchange rate is ambiguous (point 2) (Figure 3). The important point here is that a monetary contraction, while exacerbating the domestic output contraction, may not necessarily be successful in stabilizing the currency. In contrast, a policy of *monetary expansion* would unambiguously stabilize output but the impact on the exchange rate is once again ambiguous (Figure 4). There is a possibility that monetary expansion could be especially beneficial in the sense of raising output while also stabilizing the currency. This is more likely the case the less responsive the IPLM curve is to changes in interest rates compared to the W curve, which in turn may happen if one allows for the possibility of weak Laffer curve effects.[11]

[11] This said, as noted, the presence of the Laffer curve effects makes it more likely that the W curve will be downward sloping. We return to this point later on.

Consider Case 2 with a downward sloping W curve. In order to focus on the comparative statics we assume unique equilibrium. *Monetary contraction* in this case leads to ambiguous results with regard to both output and exchange rates (Figures 5a,b). The same is true for *monetary expansion*. For instance, while there is a possibility of a "good equilibrium" of both currency and output stabilization (Figure 6a), there is a possibility of a "bad equilibrium" of both sharp output contraction and currency weakness (Figure 6b). In the presence of weak Laffer curve effects, the more likely scenario is one of output expansion and exchange rate weakness in the case of monetary expansion and output contraction, and exchange rate weakness in the case of monetary contraction.

Table 1 summarizes the preceding discussion. Some interesting conclusions emerge from this.

One, absent the weak Laffer curve effects, regardless of whether the W curve is upward or downward sloping, and regardless of whether there is a monetary expansion or contraction, the impact on the exchange rate is uncertain. This may partly explain the mixed results obtained in the empirical literature to date that have examined the nexus between interest rates and exchange rates noted in Section 2.[12]

Two, absent the weak Laffer curve effects, when the W curve is upward sloping, the impact of monetary contraction / expansion is to unambiguously reduce / increase output, as would be expected a priori. However, in the event of a downward sloping W curve the impact of output is ambiguous regardless of monetary policy stance.

Three, in the presence of weak Laffer curve effects, regardless of the slope of the W curve, the impact of monetary policy stance on output is entirely consistent

[12] However it can be shown that this ambiguity in exchange rate movements disappears if the real sector is relatively interest rate inelastic. To be sure, low interest elasticity effectively leaves just the export competitiveness and balance sheet channels which work in opposite directions to impact the slope of the W curve.

with received orthodoxy, viz. it rises with a monetary loosening and falls with a monetary tightening.

Four, in the presence of weak Laffer curve effects (which is more likely the case during a crisis period), the currency will always weaken with a monetary policy contraction and always appreciate with a monetary expansion. This is inconsistent with received wisdom.

Table 1
Summary of Appropriate Monetary Policy Responses

No Laffer curve effects		
Shape of W Curve	**Monetary Expansion**	**Monetary Contraction**
Case 1: Upward Sloping	*E* uncertain *Y* rises	*E* uncertain *Y* declines
Case 2: Downward Sloping	*E* uncertain *Y* uncertain	*E* uncertain *Y* uncertain
Weak Laffer curve effects		
	Monetary Expansion	**Monetary Contraction**
Case 1: Upward Sloping	*E* declines *Y* rises	*E* rises *Y* declines
Case 2: Downward Sloping	*E* declines *Y* rises	*E* rises *Y* declines

Note: Rise in E implies currency depreciation.

4. Concluding Remarks

As is apparent, the issue of optimal monetary policy is particularly dependent on the presence of weak Laffer curve effects as well as the shape of the W curve. While it is generally acknowledged that weak Laffer curve effects are more likely to occur during a crisis period, there has been much less attention paid to or awareness

of the shape of the W curve. Of course, as noted previously, there is a feedback effect in that the W curve is itself more likely to be downward sloping in the presence of the Laffer curve effects. Beyond this, the analysis above highlights four main factors that impact the shape of the W curve.

First, the greater the size of unhedged foreign currency debt the more likely the W curve is downward sloping. This follows directly from the discussion of the balance sheet effects noted previously.

Second, the greater the size of the exportables sector and the more responsive exports are to devaluation, the more likely the W curve is upward sloping. This too is intuitive.

Third, the weaker or less developed the domestic banking system the more susceptible it is to sharp exchange rate depreciations (due to its exposure to uncovered liabilities directly, i.e. currency mismatch risk, or indirectly, i.e. credit risk). Thus, a given currency depreciation could significantly compromise the ability or willingness of banks to lend to domestic corporates, effectively making them more credit constrained and consequently making the W curve more likely to be downward sloping.

For instance, most East Asian economies in 1997-98 were banks based, their financial institutions were relatively weak, and their corporates were highly leveraged with high unhedged external debt. And while they were highly export-oriented economies, the simultaneous sharp devaluation by regional economies negated the competitive advantage any individual East Asian country might have enjoyed.[13] This suggests that the regional economies may well have had negatively sloped W curves. Assuming a negatively sloped W curve with weak Laffer curve effects, returning to Table 1, we find that an expansionary monetary policy stance may be

[13] Duttagupta and Spilimbergo (2004) find that there is high intraregional price elasticity in East Asia, but limited elasticity of substitution between goods from East Asia as a whole and the rest of the world, such that a regional real devaluation did not significantly increase East Asian global exports.

appropriate in terms of both stabilizing the currency as well as preventing an output contraction. This runs counter to IMF orthodoxy.

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Figure 1
Real Sector Shock with Positively Sloped W Curve

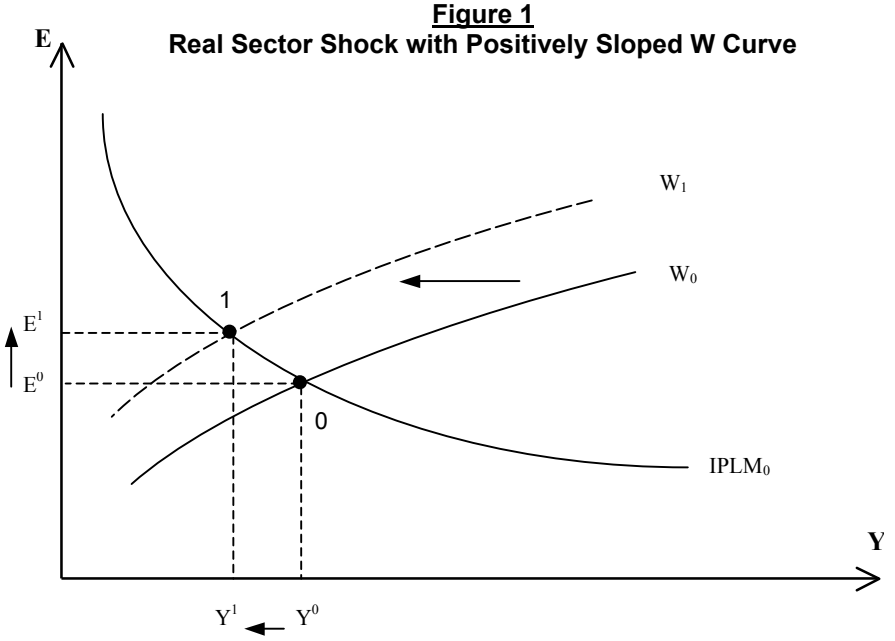

Figure 2
Real Sector Shock with Negatively Sloped W Curve

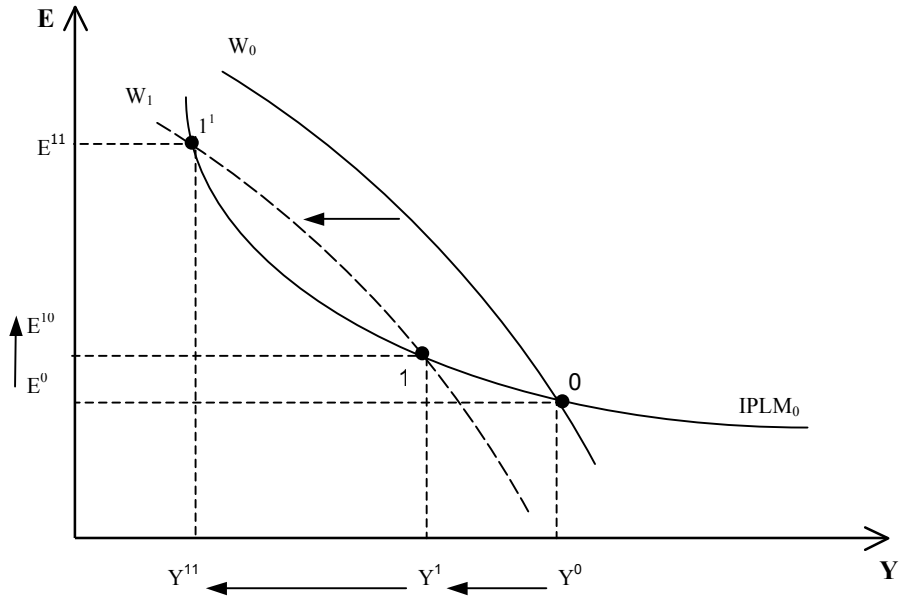

Figure 3
Monetary Policy Contraction with Upward Sloping W Curve

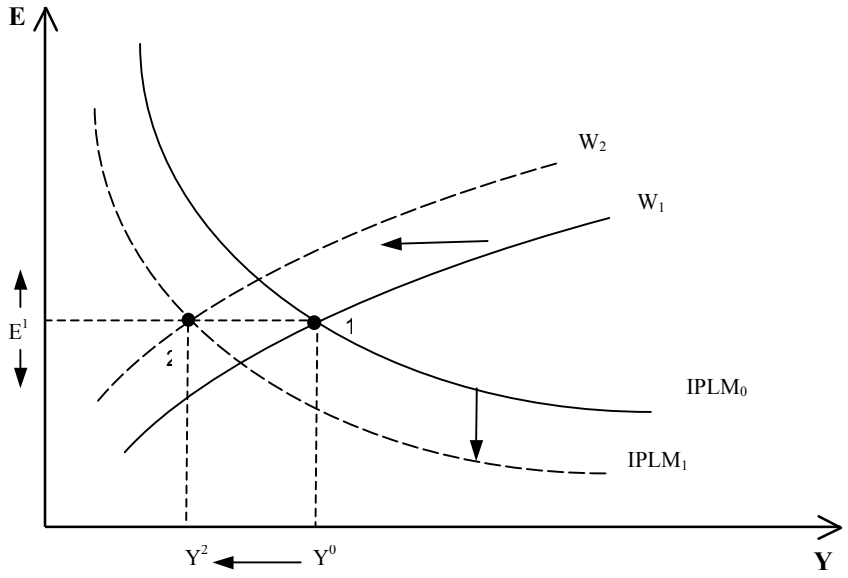

Figure 4
Monetary Policy Expansion with Upward Sloping W Curve

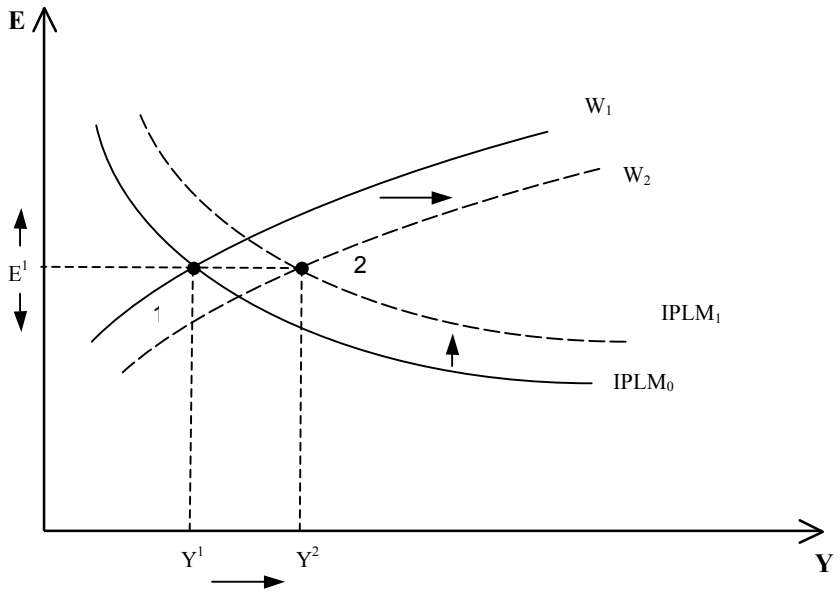

Figure 5a
Monetary Policy Contraction with Downward Sloping W Curve

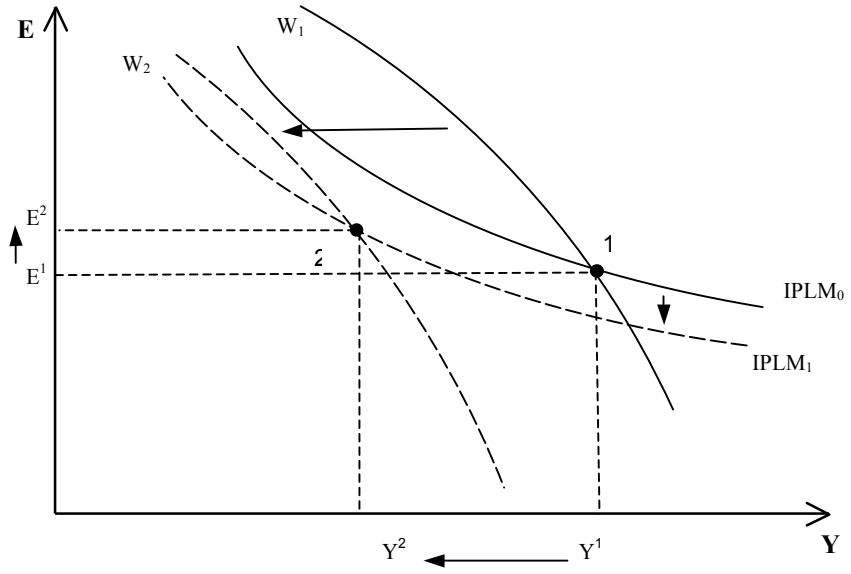

Figure 5b
Monetary Policy Contraction with Downward Sloping WCurve

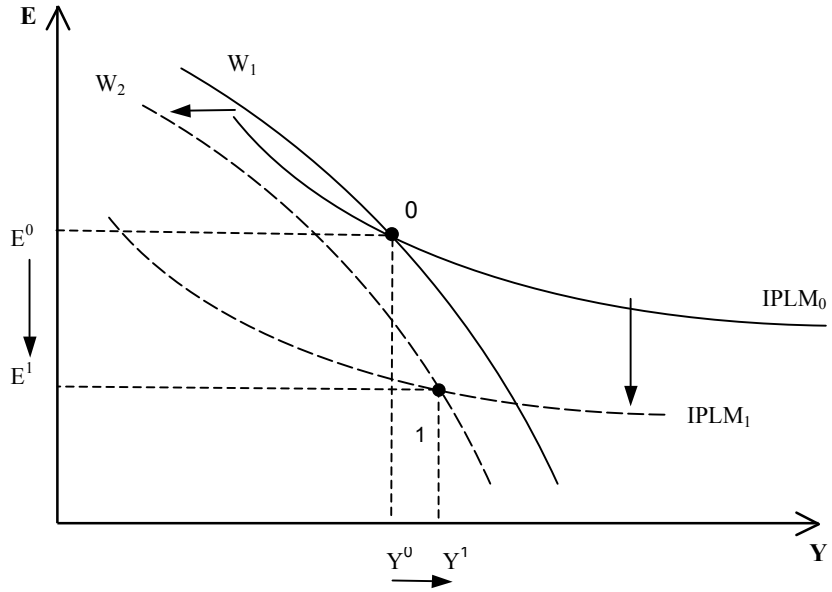

Figure 6a
Monetary Policy Expansion with Downward Sloping W Curve

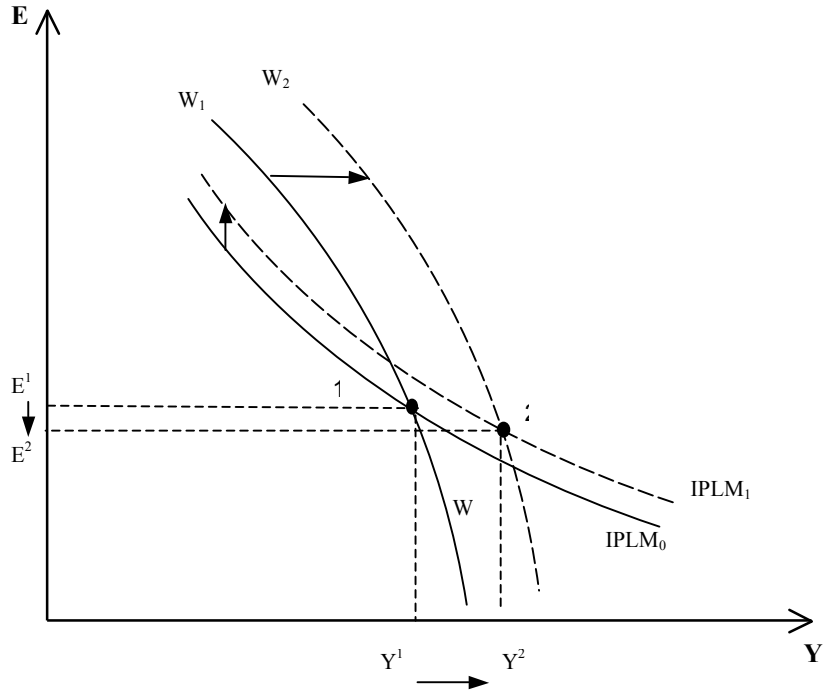

Figure 6b
Monetary Policy Expansion with Downward Sloping W Curve