Financial liberalization and economy crisis: macromodelling the Thai economy

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NOTE

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CHAPTER 4
FINANCIAL LIBERALIZATION AND ITS MACROECONOMIC EFFECTS IN A SMALL OPEN ECONOMY

4.1 Introduction

This chapter provides an overview of theoretical models concerned with identifying the macroeconomic adjustment process arising from the effects of financial liberalization. A comparative analysis of theoretical frameworks and assumptions of these will be examined with the aim of developing a long run macroeconomic model for Thailand, which can be used to compare the effects of regulation and deregulation on Thai financial markets and consequences for the economy as a whole. In this thesis, financial liberalization measures will be considered in terms of three aspects, interest rate, exchange rate, and capital account liberalization respectively.

The basic theoretical frameworks, which will be investigated in this chapter, for analyzing the effects of financial liberalization are the seminal contributions of Mundell-Fleming (MF) (1961), Dornbusch (DB) (1976) and the Portfolio balance models (PBM) (Branson (1977, 1984)) respectively. For the MF model, the central feature is international capital mobility in response to interest rate differentials. Although the speed of capital mobility between nations can vary, the removal of controls on capital account transactions in most developed and some developing countries created a substantial increase in capital flows across these nations. The MF model allows one to analyze why large scale capital inflows resulting from a radical dismantling of exchange controls during the early 1990s in East Asia and Thailand in particular, might lead to a real appreciation of the exchange rate and consequently deteriorate the current account balance. In the MF model the relative efficacy of monetary compared to fiscal policy depends crucially on the structure of the economy, the exchange rate regime and the degree of international capital mobility (this will be discussed in section 4.3). Under a fixed exchange rate regime, if capital is highly...
mobile, any attempt to sterilize the effects of the inflows may not be viable because it prevents domestic interest rates from falling in response to the inflows and hence results in the attraction of even greater capital inflows (see section 4.4).

The DB model extends the earlier MF model. The DB model is dynamic while the MF model is a static framework. One of the limitations of the static framework in the MF model is that there is no role for expectations in the explanation of exchange rate behavior. The DB model focuses on exchange rate expectations, which has implications for economic policy and, in particular, the propensity of the exchange rate to overshoot its long-run equilibrium value. However this may not occur when capital mobility is imperfectly mobile. Defects in the MF and DB models arise from their assumptions of perfect substitutability of domestic and foreign assets and failure to analyze explicitly the stock flow interactions arising from current account imbalances as well as neglect of the supply side of the economy.

In the PBM model, the exchange rate is determined jointly by financial markets and goods markets (the latter only over the medium to long-term), through the interaction of stock and flow variables. The central feature of this approach is the variety of assets that wealth holders hold in their portfolios. These assets are considered to be gross or imperfect substitutes for each other. Exogenous shocks will impact on relative asset prices, altering desired holdings of asset stocks. These in turn have consequences for flow variables such as income, investment and the current account balance. A current account surplus or deficit leads to a rise or fall in net domestic holdings of foreign assets which in turn affect the level of domestic wealth, which in turn affects the level of asset and goods demand, which again affects the exchange rate and so on. Hence, the chain of reasoning in the PBM model runs from stocks to flows, and again back to stocks.

These three models, in particular the PBM framework, provide the basic building blocks of a dynamic macroeconomic model for Thailand and this will be discussed in the following chapter. The rest of this chapter is organized as follows. Section 4.2 contains a comparative analysis of the key assumptions underlying each of
these three models. Section 4.3 investigates the implications of these models for analyzing the impact effects of changes in monetary policy upon the macroeconomy. Thereafter, Section 4.4 investigates the link between financial liberalization and its macroeconomic effects. Finally, the major conclusions derived from this analysis is presented in Section 4.5.

4.2 A Comparative Analysis of the Mundell-Fleming, Dornbusch and Portfolio Balance Models

This section is concerned with the key assumptions underlying each of these three models. The similarities and differences of assumptions for each have implications for the transmission mechanism of monetary and fiscal policies upon the real economy. Hence the consequences of such policy changes varies depending on the key assumptions underlying these models. Before proceeding to a detailed analysis, the crucial features and assumptions underlying these models will be examined and these are summarized in Table 4.1.

(1). Comparative Static and Dynamic Analysis

The MF model is a comparative static model that concentrates only on a comparison of equilibrium states before and after an exogenous disturbance, and hence it does not establish the path of the endogenous variables during the adjustment process between two such equilibrium states. From a policy perspective this is a major deficiency. The DB and PBM models are dynamic models that allow variables to react to each other through time and hence it explains the adjustment process for the time path of the endogenous variables. However the DB model is still regarded as a short run model. It says nothing about the current account and its role in generating long run equilibrium. This is remedied in the PBM model by incorporating wealth effects and foreign asset stock accumulation arising from developments in the current account, which is only captured by taking a long run perspective. Nevertheless the PBM model is a partial equilibrium model, and hence it says nothing about output, employment and so on.
(2). Fixed Price and Sticky Price Model

The MF model can be regarded as a short run model because of the assumption of fixed prices. It does not allow any price response to a monetary shock and it does not have any feedback from a depreciation or appreciation of the exchange rate via import prices to domestic prices. Hence the attainment of purchasing power parity (PPP) is also absent in the MF model. In the DB model, domestic prices do not change on impact. The rise in the price level during the adjustment process arises from excess demand in the goods market. Goods prices are assumed to respond sluggishly to an excess demand for output, that is, \( p = \pi (d - y) \), where \( p \) is the rate of inflation, \( d \) and \( y \) are aggregate demand and aggregate supply of domestic goods respectively. Goods prices are sticky, they respond to market disequilibria with a factor \( \pi \), but not fast enough to eliminate those disequilibria instantly. The goods market adjusts slowly and remains in disequilibrium throughout the adjustment process, while the exchange rate and interest rate are assumed to instantaneously adjust following a disturbance ensuring that the asset markets remains in equilibrium throughout the adjustment process. This differential speed of adjustment leads to the possibility that the exchange rate will overshoot its long run equilibrium. For the PBM model, because the model is a partial and not general equilibrium model, it does not have much to say about price adjustment.

In both the DB and PBM models a monetary disturbance can lead to exchange rate overshooting, meaning that PPP does not hold in the short run. In the long run there are some important differences between these two models. In the DB model, PPP holds in the long run which means that after all nominal variables have adjusted equi-proportionally. The long run (nominal) exchange rate and domestic price level rise in proportion to the increase in the money supply. In the PBM model PPP does not hold in the short and the long run. A monetary expansion with a flexible domestic price response in the long run will tend to be associated with an appreciation in the real exchange rate, and hence the PBM model represents a more radical departure from the PPP-based DB model. As a result, in contrast to the DB model (and other monetary
models), a monetary disturbance in the PBM can produce a long run departure from PPP (See details in section 4.3.3 (A)).

(3). Capital Mobility and Substitutability between Assets

In this context capital can be regarded as perfectly mobile due to a combination of two factors: firstly domestic and foreign assets are perfect substitutes, secondly capital is freely mobile. In the MF model there are assumed to be four financial assets: domestic and foreign money which are non-substitutable and thus only held in the country of issue, a domestic and foreign bond which have identical maturities and are perfectly substitutable. However in the MF model, the case of imperfect substitutability can also be analyzed. The assumption of perfect substitutability implies that capital is perfectly mobile, and if expectations are static (that is the expected change in the exchange rate is equal to zero) and arbitrage is assumed to ensure that bond yields are continuously equalized, then the domestic interest rate must continually equal the world interest rate ($r = r^*$). In this case the capital account and the balance of payments can only be in equilibrium if $r = r^*$, and hence the BP curve is horizontal in

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1 Perfect capital mobility requires two conditions. Firstly, free mobility of funds into and out of a country, capital is considered perfectly mobile if it can be moved into the preferred form of investment anytime without delay and in the desired amount (i.e., the absence of capital controls and transaction costs and political barriers). Secondly foreign and domestic assets, identical in all respects apart from their currency denomination, are perfect substitutes. Domestic and foreign assets are evaluated solely on the basis of their expected returns. Minimal differences between expected yields at home and abroad would draw the entire investment capital into the asset which offers the higher expected yield. For example, if an investor regards domestic and foreign bonds as equally risky (the investors under consideration are risk-neutral, in the sense that they have neither an aversion nor preference toward risk taking and therefore base their investment decisions on the expected return of their investment other than risk), and can switch between the two assets instantaneously, the only difference between the bonds is their currency of denomination and possibly the interest rate attached to them. Given this, asset markets can only be in equilibrium if $r = r^* + E(e)$ where $r$ is the home country interest rate, $r^*$ is the foreign interest rate, $E(e)$ is the expected rate of depreciation. This equilibrium condition is known as uncovered interest parity which will be taken as a representation of perfect capital mobility.

In the case of imperfect capital mobility, this may occur when domestic and foreign assets are not perfect substitutes, international investors cannot arbitrage differences in interest rates (adjusted for exchange rate expectations) without having to be concerned about the risk of exchange rate changes over the life of the investments. That is $r = r^* + E(e) + r_p$ where $r_p$ is the risk premium. This condition can hold continuously if short-term portfolio investment is freely mobile and hence arbitrage continually ensures that the domestic interest rate equals the foreign rate adjusted for the expected change in the exchange rate and the risk premium. Imperfect capital mobility may also occur when portfolios take time to adjust.
this case. With the horizontal BP curve and flexible exchange rates the MF model suggests that monetary policy is the most powerful and fiscal policy is completely impotent in terms of affecting output. However if capital is less than perfectly mobile, which implies that assets are not perfect substitutes, the slope of the BP curve is less than perfectly elastic and consequently both monetary and fiscal policy will influence domestic output. In this case the BP curve may be steeper or flatter than the LM curve. However, the consequences of a money supply increase are the same in the case of perfect and imperfect capital mobility, that is a money supply increase leads to a depreciation of the exchange rate and an increase in real income. The tendency for a lower interest rate resulting from a monetary expansion implies a higher capital outflow which worsens the capital account, while an increase in income deteriorates the current account and produces an overall deficit on the balance of payments resulting in the exchange rate depreciating. This depreciation improves the current account to exactly offset the preceding effects.

The consequences of increasing government expenditure depend on whether capital is perfectly mobile or not. With differing degrees of capital mobility increased government spending could depreciate or appreciate the domestic currency.

Like the MF model the DB model assumes that assets are perfectly substitutable and this implies that UIP holds continuously. However there are some differences from the MF model in that the capital movements are not solely dependent

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2 See details in the next section and also in Appendix 4.1.

3 An increase in government expenditure raises income and deteriorates the current account but increases interest rates and attracts capital inflows which improve the capital account. The net effect on the balance of payments and the exchange rate depends upon the slope of the BP curve relative to the LM curve or in other words it depends on the degree of capital mobility. If capital mobility is relatively high then the BP curve is flatter than the LM curve. This is more likely to be the case when domestic bonds and foreign bonds are closer substitutes than are (domestic) money and domestic bonds. This also means that capital flows are relatively sensitive to interest rate changes, while money demand is fairly inelastic with respect to the interest rate. In this case the increased capital inflow resulting from the rise in interest rate more than offsets the deterioration in the current account due to the increase in income, and hence the balance of payments moves into surplus and the exchange rate will appreciate to sustain external balance. On the other hand if the BP curve is steeper than the LM curve capital flows are less responsive to changes in the interest rate and an improvement in the capital account caused by increased capital inflows does not outweigh the deterioration in the current account. In this case the balance of payments moves into deficit which induces a depreciation of the exchange rate.
on the interest rate differential but exchange rate expectations also play an important role in determining capital flows. The interest rate differential between domestic and world markets will reflect the expected rate of depreciation or appreciation of the domestic currency \((r - r^* = E(e))\). If the domestic currency is expected to depreciate \((E(e)\) is positive) then financial markets demand a higher rate of return on domestic currency denominated asset holdings, in other words \(r > r^*\), and vice versa.

Expectations about the exchange rate in the original Dornbusch model are assumed to be regressive and hence the expected change in the exchange rate depends upon the difference between the current exchange rate \((e)\) and the long-run equilibrium exchange rate \((\hat{e})\) multiplied by the speed of adjustment coefficient, \(\theta\), that is, \(E(e) = \theta (e - \hat{e})\). If \(e\) exceeds the equilibrium value then there is an expectation that \(e\) will appreciate (fall) back to the equilibrium level. Similarly, if the current value is below the equilibrium value then it is expected that the rate will depreciate (rise) back towards the equilibrium. The relaxation of the static expectations assumption in the DB model has implications for policy shocks and allows the policymaker to analyze the impact of policy shocks in different time periods, short-term, medium term and long term. For example, in the short run (on impact) an increase in the money supply requires a fall in the domestic interest rate, \(r\), to clear the money market. The decline in \(r\) causes a potential capital outflow and hence the domestic exchange rate depreciates to the point where it creates the expectation of an exchange rate appreciation so as to preserve uncovered interest parity. According to regressive expectations an expected appreciation of the domestic currency requires the actual spot rate immediately to depreciate above its long equilibrium value, resulting in exchange rate overshooting. Moreover the other feature worth elaborating upon is the perfect foresight variant of rational expectations in making predictions about movements of the exchange rate. In the DB model with perfect foresight expectations means the expected change in the

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4 Rational expectations implies that agents utilize all information available at the time at which they make their forecasts. Since their forecasts are formed using the true model of the process generating the data, the expected value of a variable differs from actual outcome only by a random error. If there were no random element in behavior the prediction would equal the actual outcome and rational expectations would reduce to perfect foresight.
exchange rate next period based on information available in this period is exactly the change which occurs. That is \( E(e) = \dot{e} \) so that the uncovered interest parity condition is \( r = r^* + \dot{e} \). The assumption of rational expectations allows the model to make an important distinction between policies which are anticipated and those which are unanticipated and this in turn will have important implications for the effectiveness of monetary and fiscal policies.

In contrast with the previous models the PBM model assumes that domestic and foreign non-money assets are imperfect substitutes. This assumption implies that the UIP does not hold in the PBM model since investors will hold a diversified portfolio including non-money assets, and the proportion of each asset in the portfolio depends on its risk-return characteristics. In the PBM model the domestic interest rate can diverge from the world interest rate not only because of exchange rate expectations as in the DB model but also because of the risk premium \( r - r^* = E(\dot{e}) + rp \).

In the PBM model imperfect substitutability of assets implies that in addition to considering equilibrium only in the money and domestic bond markets it is also necessary to pay attention to changes in relative demands and supplies in the foreign bond market which will disturb portfolio equilibrium and influence exchange rate behavior (See details in next section).

(4). Current Account Equilibrium

In the MF and the DB model there is no requirement that the current account must be balanced in long run equilibrium. This is one of the deficiencies of these models. If the current account is not in equilibrium it will affect the stock of foreign assets and therefore financial wealth, which in turn will have implications for expenditure on goods and the asset demand function and thus the equilibrium in the MF and the DB model can only be temporary. The PBM model requires for overall equilibrium that the current account has to be in balance, and to ensure that the current account is restored to balance in the long run it is necessary for the real exchange rate to have appreciated (in the case of monetary expansion) in the long run equilibrium.
This is because the current account surplus which is generated by an initial monetary expansion results in an accumulation of foreign assets and accompanying increasing in net investment income from the holding of foreign assets on the service component of the current account, thereby tending to push the current account further into surplus. For the current account balance to achieve long run equilibrium requires an appreciation in the real exchange rate so that there is a worsening of net exports in the trade account to offset an increase in net investment income in the service account. The eventual real exchange rate appreciation is determined by the cumulative size of the current account generated between equilibrium positions and hence accumulation of foreign asset stocks.

(5). Supply Side Determination

The MF and the DB models emphasize solely the demand side of the economy and neglect the supply side. The MF model assumes that aggregate supply is perfectly elastic at a given price level implying that increased aggregate demand does not lead to changes in the domestic price level but rather is reflected solely in increased real output. The DB model also emphasizes the demand side of the economy in which output supply is fixed at the full employment level, and hence fluctuations in goods demand only results in price movements and not in output movement. The original PBM model also does not incorporate the supply side effects directly, but can be extended to allow for changing capital stock accumulation in both the public and private sector which in turn will affect the production function and therefore aggregate supply.

(6). Wealth Effects

One of the deficiencies of the MF model is that it is based upon a flow theory of the capital account while the PBM emphasizes the dynamic stock-flows interaction of changes in the exchange rate, the current account, the level of wealth, and expenditure. The PBM model gives explicit recognition of the current account by incorporating wealth effects which influence the demand for output and assets that is not considered in the MF and the DB model. The current account surplus generates accumulation of foreign asset stocks and hence increases domestic wealth leading to
increased demand for money and other domestic assets. In addition it may directly affect domestic expenditure through wealth effects on consumption and also upon investment in an elaborate version of the model. Through these mechanisms the current account will influence the exchange rate and domestic real income, which in turn feed back to the current account until full equilibrium is achieved.

In summary, the MF analysis is an important contribution to the international economic literature by exploring the policy implications of international capital mobility. However a number of features and assumptions underlying this model seem questionable: the absence of any price response, either to the monetary disturbance or to the consequent depreciation or appreciation of the exchange rate; the absence of dynamic interaction and adjustment of variables through time and the peripheral role of exchange rate expectations which are a crucial determinant of capital flows. In addition the model does not contain stock/flow interaction of changes in the exchange rate, the current account and the level of wealth. There is no requirement that the current account must be balanced in the long run equilibrium and also no supply side consideration. The DB model extends and amends the MF model by introducing dynamic adjustment into it. However as with the MF model, the DB model is also open to the criticism in that there is no explicit role for the current account to influence the exchange rate over the medium to longer term. Moreover, domestic and foreign bonds are regarded as perfect substitutes and hence the models concentrate on the money market to the exclusion of all other asset markets. Domestic and foreign bonds are regarded as equally risky thus there is no role for risk perceptions to play a part in determining exchange rates. The PBM explores the consequences of explicitly relaxing these assumptions by incorporating asset preferences and the requirements for portfolio balance, including the wealth effects of imbalances on current account. The implications of these three models for the analysis of macroeconomic policy will be represented in the following section.
### Table 4.1 Summarized assumptions underlying the MF, DB and PBM models

<table>
<thead>
<tr>
<th>Assumption</th>
<th>The MF model</th>
<th>The DB (original) model</th>
<th>The PBM model (the Branson models 1977, 1984)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prices</td>
<td>Fixed price model</td>
<td>Sticky price model (price is fixed in the short run and adjusts gradually in the long run)</td>
<td>Price dynamics are suppressed, but still discuss exogenous price movements as delayed response to monetary shocks (1984)</td>
</tr>
<tr>
<td>Aggregate supply (AS) Curve</td>
<td>Perfectly elastic AS curve (unemployed resources and hence the horizontal AS curve)</td>
<td>Perfectly inelastic AS curve (economy is at full employment and hence vertical AS curve)</td>
<td>No mention</td>
</tr>
<tr>
<td>Purchasing power parity (PPP)</td>
<td>Absence of PPP</td>
<td>PPP does not hold in the short run but holds in the long run (from monetary shocks)</td>
<td>Does not hold even in the long run (from monetary shocks)</td>
</tr>
<tr>
<td>Exchange rate expectations</td>
<td>Static expectations</td>
<td>Dynamic exchange rate expectations (rational expectations (regressive))</td>
<td>Dynamic exchange rate expectations (rational expectations 1977, 1984)</td>
</tr>
<tr>
<td>Substitutability between assets and the uncovered interest parity condition (UIP)</td>
<td>Domestic and foreign assets are perfect substitutes $\Rightarrow$ risk premium = 0 $\Rightarrow$ the UIP holds $\Rightarrow (r = r^* + E(e))$ where $E(e) = 0$ and hence $r = r^*$</td>
<td>Domestic and foreign assets are perfect Substitutes $\Rightarrow$ risk premium = 0 $\Rightarrow$ the UIP holds $\Rightarrow (r = r^* + E(e))$ where $E(e) = 0$ and hence $r = r^*$</td>
<td>Domestic and foreign assets are imperfect substitutes $\Rightarrow$ risk premium exists $\Rightarrow$ the UIP does not hold $\Rightarrow (r = r^* + E(e) + rp)$</td>
</tr>
<tr>
<td>Wealth effect</td>
<td>No mention</td>
<td>no mention</td>
<td>explicit wealth effects</td>
</tr>
<tr>
<td>Current account</td>
<td>No required equilibrium condition in the current account in the long run</td>
<td>no required equilibrium condition in the current account in the long run</td>
<td>the current account balance must be zero in the long run</td>
</tr>
</tbody>
</table>

**Notes:** $r$ = domestic interest rate; $r^*$ = foreign interest rate; $e$ = exchange rate; $\bar{e}$ = equilibrium exchange rate; $E(e)$ = exchange rate expectation; $rp$ = risk premium.

### 4.3 The Impact Effects of Policy Changes

The great increase in the international movement of capital together with the movement for many currencies, since 1973 from fixed to flexible exchange rates, raises important questions concerning the frequency and amplitude of disturbances to macroeconomic stability in national economies and the effectiveness of monetary and...
fiscal policy. In particular, financial liberalization in some East Asian countries over the late 1980s to the mid 1990s period ended with capital outflows, financial and currency turmoil, and a deterioration of real economic growth. The purpose of this section is to investigate the impact effects of changes in policy, in particular monetary policy, upon a small open macroeconomy. The MF model, regarded as a short run model due to presumed price fixity will be examined first, and is then followed by the dynamic DB and PBM models respectively.

4.3.1 The Mundell-Fleming Model

The MF model is a fixed price model which assumes a small open economy, unemployed resources, a perfectly elastic aggregate supply curve, static exchange rate expectations and perfect or imperfect capital mobility. The model shows that the relative effectiveness of monetary and fiscal policies depends on both the nature of exchange rate arrangements and the degree of international capital mobility.

The MF model can be set out in the context of the IS-LM-BP schedules (See Appendix 4.1) as represented in Figure 4.1. The LM curve has a positive slope (A4.1.2) because as income rises the demand for money increases; therefore for a given real money supply the interest rate has to increase to reduce the money demand so as to maintain equilibrium in the money market. The IS curve has a negative slope (A4.1.4) since a fall in the domestic interest rate stimulates domestic absorption, via the implicit investment function, hence increasing aggregate demand which is matched by an equal rise in aggregate supply. Under the assumption of perfect capital mobility, the slope of the BP curve is zero or a horizontal straight line at a domestic interest rate which is the same as the exogenous world interest rate (A4.1.6).

Consider monetary and fiscal policy with perfect capital mobility. From Figure 4.1, in the case of a floating exchange rate regime, suppose that the initial equilibrium level of income is at \( y_1 \) and the authorities attempt to expand output by a monetary expansion through an open market purchase of government bonds by the central bank. This pushes up the price of bonds and leads to a fall in the domestic interest rate
towards \( r_1 \) below the world interest rate \( r^* \). An increase in the money supply by this open market operation can be illustrated by the shift of the LM curve from LM1 to LM2. As a result of the downward pressure on domestic interest rates, domestic and foreign financial investors will switch toward the relatively more attractive foreign assets resulting in a capital outflow. This in turn causes an excess demand for foreign currency resulting in a depreciation of the domestic currency. However it should be noted that with perfect capital mobility the interest rate in reality never declines. The monetary expansion effects on the economy does not actually result from a decline in the interest rate as in a closed economy, but rather from an expansion of the domestic export sector via a domestic currency depreciation.

**Figure 4.1**

*Mundell-Fleming Model:*

*Floating and Fixed Exchange Rates under Perfect Capital Mobility*

![Diagram of IS-LM model with IS1, IS2, LM1, LM2, IS2, and OY axes.](image)

Assuming that the Marshall-Lerner (ML) condition holds, the depreciation improves the trade balance and shifts the IS curve to the right as a net export increase.

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5 The condition states that a depreciation will improve the trade balance only if the sum of the exchange rate elasticities of export and import demand is larger than 1. In deriving this condition, make the simplifying assumptions (1) domestic prices \( P \) are unaffected by the exchange rate \( e \) where \( e \) is measured in units of the domestic currency per unit of foreign currency; (2) domestic output is held constant (say, by altering fiscal or monetary policy); (3) export \( X \) and import volumes \( IM \) are determined by the real exchange rate \( P^e/P \) where \( P^* \) is the foreign price level and \( P \) with imports also influenced by domestic output \( Y \). Then the trade balance (BOT) in domestic currency may be written as:

\[
BOT = PX - (P^e)IM \quad \text{where} \quad X = X(P^e/P) \quad \text{and} \quad IM = IM[(P^e/P), Y]
\]

(1)

Assumption (1) and (2) imply \( \partial P/\partial e = \partial Y/\partial e = 0 \). Differentiating (1), then obtains
generates an increase in aggregate demand. The outcome is an increase in domestic real income. The IS curve will continue to shift rightward until it intersects the LM 2 curve at the world interest rate level \( r^* \), point C. Hence, with perfect capital mobility and a floating exchange rate, monetary policy is at its most effective.

By contrast from Figure 4.1 an increase in government spending shifts the IS curve from IS1 to IS2, but the bond sales that finance the expansion leads to a potential rise in the rate of interest above the world rate (the interest rate does not in fact change), and hence a larger foreign inflow of capital which will appreciate the exchange rate. The appreciation reduces the country's net exports and ultimately shifts the IS curve back towards its original position. As a result, with a floating exchange rate and perfect capital mobility fiscal policy is ineffective in influencing real output.

Consider next monetary policy with imperfect capital mobility and a flexible exchange rate. This is illustrated in a mathematical framework in Appendix 4.1. Expansionary monetary policy works by lowering the domestic interest rate (See A4.1.10), which increases income as absorption rises (See A4.1.8). But because the domestic interest rate has fallen below the world rate this causes capital outflows which in turn deteriorate the balance of payments. Capital outflows lead to an exchange rate depreciation (See A4.1.12) to bring the balance of payments back to equilibrium. However under imperfect capital mobility, monetary policy is less potent in altering the level of output than in the perfect capital mobility case. The reason for the dampened effect of monetary policy is that the depreciation of the domestic currency.

\[
\frac{\partial \text{BOT}}{\partial e} = (P \frac{\partial X}{\partial e}) - (P^*e \frac{\partial \text{IM}}{\partial e}) - P^* \text{IM} \tag{2}
\]

If assuming initial payments equilibrium \( PX = (P^*E)IM \), then

\[
\frac{\partial \text{BOT}}{\partial e} = \frac{PX}{e} (|\eta_X| + |\eta_{IM}| - 1) \tag{3}
\]

For a depreciation to lead to an improvement in the trade balance we require \( \frac{\partial \text{BOT}}{\partial e} > 0 \) and hence \( |\eta_X| + |\eta_{IM}| - 1 > 0 \) \( \eta_X \) and \( \eta_{IM} \) are the exchange rate elasticities of exports and imports respectively.
currency required to eliminate the balance of payments disequilibria under imperfect capital mobility is smaller than in the case of perfect capital mobility, and hence increasing output by a smaller proportion.

In the case of fiscal policy, expansionary fiscal policy raises domestic income (See A4.1.14) but the rise in government spending raises domestic interest rates (See A.4.1.16) because of increased money demand when income rises which in turn causes net capital inflows since the domestic interest rate rises above the world rate. The net effect on the exchange rate is ambiguous (A4.1.18). It depends on the degree of international capital mobility. If capital mobility is comparatively low, the BP curve is steeper than the LM curve ($|\frac{\bar{Y}}{K_r}| > |\frac{L_y}{L_r}|$), then capital flows are less responsive to changes in the interest rate. An improvement in the capital account caused by an increased capital inflow does not outweigh the deterioration in the current account. In this case the balance of payments moves into deficit which induces a depreciation of the exchange rate.

In sum, both fiscal and monetary policies are successful in increasing income when capital is imperfectly mobile.

By contrast, under a fixed exchange rate regime and perfect capital mobility a monetary expansion is completely ineffective in influencing the level of real domestic income. From Figure 4.1, a monetary expansion shifts the LM curve to the right from LM1 to LM2, and a new equilibrium arises at point B with an increased level of real income and a lower domestic interest rate. However point B is not an equilibrium point. If the domestic interest rate is decreased below $r^*$ a massive capital outflow will occur, deteriorating the capital account. Furthermore, as domestic income increases imports increase and the trade balance deteriorates and hence the balance of payments is now in deficit as both the current account and capital account deteriorate. The balance of payments deficit means that there is an excess supply of the domestic currency on the foreign exchange market, and to maintain the fixed exchange rate the authorities have to purchase the domestic currency by selling some of its holdings of foreign exchange reserves. The money supply will then decrease in response to the loss
in international reserves which is a component of the monetary base, shifting the LM curve back toward the initial LM. The impact effect of monetary and fiscal policy on real output under a fixed exchange rate regime is also represented mathematically in appendix 4.1. In this case where capital is perfectly mobile \((k, \rightarrow \infty)\) a monetary expansion does not alter real income (See A4.1.27) or the interest rate (See A4.1.29). The only change is in the composition of the money stock. An increased quantity of domestic currency reserves leads to a lower quantity of foreign currency reserves by the same amount (A4.1.31).

In addition, if the authorities pursue a policy to sterilize the effect that its intervention in foreign exchange markets has on the monetary base, such sterilization operations are not viable under a fixed exchange rate and perfect capital mobility. As mentioned earlier, the balance of payments deficit implies a loss in the Central Bank's holdings of international reserves. If the authorities do not sterilize the reduction in reserves this tends to reduce the domestic money supply shifting the LM curve to its initial equilibrium. If the authorities want to maintain the LM curve at point B, they must pursue a policy of sterilization of reserve changes by purchasing an amount of domestic bonds in the open market equal to the loss of international reserves. The problem is that by maintaining the LM curve at point B, the country will suffer continuous balance of payments deficits and a continuous fall in international reserves.

Summarizing the MF model, the relative effectiveness of fiscal and monetary policy is very much dependent upon the choice of exchange rate regime and the degree of capital mobility. With perfect capital mobility monetary policy has the most powerful effect under a flexible exchange rate regime, but has no effect on output with a fixed exchange rate. In contrast fiscal policy has no effect on output under a flexible exchange rate but has the most powerful effect on output under a fixed exchange rate. These results are reversed when there is zero capital mobility. However relaxing various restrictive underlying assumptions of the MF model such as allowing a variable price level to deflate money balances and non-static exchange rate expectations may
yield different results from those discussed above and this will be considered next in
the DB model.

4.3.2 The Dornbusch Model

The Dornbusch model (1976) extends and amends the MF model by
introducing dynamics of adjustment into it. The model establishes the time path
followed by particular variables during adjustment between two equilibria. Moreover
the model assumes that prices are sticky in the short run but variable over the long run
resulting in disequilibrium in the goods market, while the interest rate and exchange
rate are perfectly flexible responding to any shock instantaneously and hence financial
markets are in continual equilibrium. This is the key point of the DB model, leading to
the overshooting phenomenon. In the short run, an expansionary monetary policy leads
to an immediate depreciation of the domestic currency, and hence accounts for the
fluctuations of the exchange rate and the terms of trade. During the adjustment process
rising prices may be accompanied by an appreciation of the nominal exchange rate in
violation of the PPP condition. In the DB model, the exchange rate is a critical channel
for the transmission of monetary policy to aggregate demand for domestic output. The
model is explained in Figure 4.2.

Goods market equilibrium as shown in (A4.2.10) is also represented in Figure
4.2. In Figure 4.2 the locus \( p = 0 \) shows the equilibrium values of the exchange rate \( e \)
and price level \( p \) which clear the goods market. The schedule has a positive slope
because a depreciation of the exchange rate is associated with a higher level of
aggregate demand and hence higher prices to maintain goods market equilibrium. The
slope is steeper than the \( 45^\circ \) ray because an exogenous increase in the price level
decreases aggregate demand (A4.2.5), both via a relative price effect and a higher
interest rate, which is necessary to maintain money market equilibrium (A4.2.3), and

\[ \text{The details of the mathematics and the rational expectations solution of the model are}
\]
hence a more than proportionate increase in the exchange rate is required to restore the goods market equilibrium.

**Figure 4.2**

**Dornbusch Model: Monetary Shocks under Perfect Capital Mobility**

Asset market equilibrium (A4.2.8) is depicted by the AM schedule in Figure 4.2. The slope of this line is negative ($\frac{\partial e}{\partial p} = -\frac{1}{\lambda \theta}$). For asset market equilibrium a fall in $p$ below $\bar{p}$ implies relatively higher real money balances which requires a fall in the interest rate to maintain money market equilibrium. This in turn requires an expected appreciation of the exchange rate to compensate the holders of the domestic currency. Given that exchange rate expectations are regressive, such an expected appreciation can only occur if the exchange rate depreciates. Equilibrium in the model is initially at point A when both the goods and asset markets are in equilibrium, and the exchange rate is at its PPP (purchasing power parity) value which implies that the trade account is also in a balanced position.

Prior to the monetary shock, the economy is in a position of steady state equilibrium at $(e_o, p_o)$. Suppose that there is an unexpected expansion in the money supply by x percent, in the long run domestic prices will rise by the same percentage as the rise in the money stock. This gives a long run price of $p_1$ which is x percent above
A key assumption of the model is that PPP holds in the long run. An increase of x percent of the domestic price level requires a depreciation of the exchange rate by x percent, giving a long run exchange rate of \( e_1 \).

In the short run, the x percent increase in the money supply shifts the AM curve from AM to AM1. New long run equilibrium will be at point C, but with sluggishness of price adjustment the new long run equilibrium cannot be obtained instantly. If prices can not adjust instantly, and with output \( (y) \) exogenously given at the full employment level, the only way the money market can clear is by a fall in the interest rate \( (dr = -(1/\lambda)dm) \) (A4.2.3). With perfect capital mobility the interest rate can only fall if there is an expectation of an appreciation of the exchange rate (A4.2.1) and this requires an initial exchange rate depreciation (A4.2.2). The exchange rate depreciation on impact must be more than the long run depreciation so that the UIP condition is maintained. This is shown by the movement from A to B and \( e_0 \) to \( e_1 \). The extent of exchange rate overshooting is given by totally differentiating the price level equation, noting that \( de=dm=dp \) and \( y \) and \( r^* \) are constant, gives \( de/dm = (1 + (1/\lambda\theta)) \). The extent of overshooting depends upon the interest elasticity of the demand for money, \( \lambda \), and the regressive expectations coefficient, \( \theta \). Notice also that since domestic prices are inflexible in the short run, the change in the nominal interest rate and exchange rate will also be a real change.

Consider next the adjustment process from the short run market equilibrium at point B to long run equilibrium at point C. At point B there is an excess demand for goods, which arises both from the decline in domestic interest rates and from the depreciation in the exchange rate that lowers the relative price of domestic goods. The decline in the domestic interest rate causes an increase in investment demand, while the depreciation in the exchange rate raises competitiveness and net export demand also increases. Thereafter, from B, the exchange rate and the price level adjust gradually to equilibrium. Unlike the MF model the excess demand for goods does not lead to an output expansion rather it gives rise to an increase in the price level, because of the vertical Phillips curve output is fixed at the full employment level (A4.2.4). As prices
rise the excess demand is gradually eliminated in two ways. Firstly, the higher relative price of domestic goods worsens competitiveness and net export demand falls and hence reduces the excess demand. Secondly, the higher price reduces the real money supply pushing up the interest rate which produces an incipient capital inflow causing an appreciation of the exchange rate simultaneously as the interest rate is rising, permitting the UIP to be maintained continuously. The appreciation of the exchange rate further erodes competitiveness and excess demand. The transition from B to C therefore is characterized by a rising price level; falling real money balances; a rising nominal and real interest rate; and an appreciation of the nominal and real exchange rate. In terms of Figure 4.2, this is described by the move along AM1 from B to C.

However by relaxing the assumption that capital is perfectly mobile, implying that foreign and domestic assets are imperfect substitutes, the exchange rate may or may not overshoot its long run equilibrium. With imperfect capital mobility the exchange rate is not determined solely in the asset market, since the current account and the capital account both have a role to play. The balance of payments account (BP) comprises the current account (CA) and capital account (CP). Suppose that the current account depends linearly on the real exchange rate, \((e - p)\) and capital account depends on the expected excess yield of domestic assets, \(r - r^* - \theta(\bar{e} - e)\), yields

\[
BP = \bar{\xi}(e - p) + k[ r - r^* - \theta(\bar{e} - e) ]
\]

The model with less than perfectly mobile capital combines the equations (A4.2.2-A4.2.5) in appendix 4.2, with the balance of payments equilibrium equation (4.1) replacing equation (A4.2.1). The equilibrium condition for the asset market or the AM curve (including the balance of payments) results from equation (A4.2.2, A4.2.3 and 4.1) are:

\[
p = \frac{m - \phi y + \lambda r^*}{1 - \lambda \bar{\xi}/k} - \frac{\lambda \theta e}{1 - \lambda \bar{\xi}/k} - \frac{\lambda \theta + \lambda \xi/k}{1 - \lambda \bar{\xi}/k} e
\]

In the case of perfect capital mobility \((k \to \infty)\) equation (4.2) is similar to (A4.2.6). In equation (4.2) the slope of the new MS curve depends on the sign of the expression \((1 - \lambda \bar{\xi}/k)\). It can be negative or positive. If \(\xi/k\) is very large, that is the
current account responds strongly to movements of the real exchange rate, or if capital mobility is sufficiently low, \( k \) is very small, then the relationship between \( e \) and \( p \) for asset market equilibrium will be positive, giving the upward sloping AM curve as in Figure 4.3.

Figure 4.3 shows that an expansionary monetary policy in the long run shifts the economy from \( G \) to \( G' \), no matter whether the AM curve is negatively or positively sloped. In the case of \( (k \to \infty) \) this is identical with the original Dornbusch model, thus in the short run the exchange rate will overshoot from \( e \) to \( e_1 \). However when the AM curve is positive the exchange rate no longer overshoots, it only jumps to \( e_2 \).

**Figure 4.3**

**Dornbusch Model: Monetary Shocks under Imperfect Capital Mobility**

For simplicity, assume that the current account is in balance at initial equilibrium point \( G \). An increased nominal money supply places downward pressure on domestic interest rates and leads to the anticipation of a depreciation in the long run and, therefore, at the current exchange rate, to the expectation of a depreciating exchange rate. Both factors reduce the attractiveness of domestic assets, leading to capital outflows. Hence at point \( G \) if the exchange rate remains at \( e \), the current account is in equilibrium but the capital account moves into deficit. In contrast if the exchange rate rises to \( e_1 \) the capital account is in balance but the current account
moves into surplus. Hence any exchange rate between $\tilde{e}$ and $e_1$ generates a current account surplus and a capital account deficit. At some exchange rate larger than $\tilde{e}$ and smaller than $e_1$, the current account surplus will equal the capital account deficit and hence the balance of payments account will be in balance.

In summary, one of the features of the conduct of monetary policy in the DB model is that the combination of sticky prices or sluggish output response and perfect capital mobility causes the exchange rate to temporarily overshoot its long run equilibrium. This, however, may not hold in the case of imperfect capital mobility. A defect in the DB model is its assumption of the perfect substitutability of domestic and foreign assets and a failure to analyze explicitly the stock flow interactions arising from current account imbalances. This is remedied in the PBM model that will be discussed next.

### 4.3.3 The Portfolio Balance Model

The PBM model was pioneered by Branson (1976, 1977, 1984) and Kouri (1976), and has been subsequently extended in various directions. The portfolio balance model presented in this section is based upon the Branson model. Emphasis in the PBM model is particularly placed upon the long run nature of the adjustment process. The link between the short and long runs is from capital stock accumulation and from foreign asset stock accumulation arising from developments in the current account. The workings of the model are divided into two cases; the dynamics of the model under static exchange rate expectations and under perfect foresight expectations respectively.

(A). **Dynamic Model under Static Exchange Rate Expectations**

The model assumes that there are three assets which are all imperfect substitutes: domestic money ($M$), domestic bonds ($B$), and foreign bonds ($F^*$) which are denominated and earn interest in foreign currency. Total domestic nominal wealth

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7 The PBM model emphasized here refers to that in Stevenson A, Muscatelli V and Gregory M (1988), "Macroeconomic Theory and Stabilisation Policy" chapter 8. The model the authors employed is the model developed by Branson in a number of papers (Branson 1977, 1984).
at any moment consists of: \( W = M + B + eF^* \) where \( e \) is the exchange rate defined in terms of the domestic price of foreign currency. The asset market equilibrium conditions for each of these three assets are given as

\[
M = m(r, r^* + E(e))W \quad m1 < 0, m2 < 0 \tag{4.3}
\]

\[
B = b(r, r^* + E(e))W \quad b1 > 0, b2 < 0 \tag{4.4}
\]

\[
EF = f(r, r^* + E(e))W \quad f1 < 0, f2 > 0 \tag{4.5}
\]

The asset demands depend upon the two rates of return: the interest rate on domestic bonds, \( r \), and the domestic value of the return on foreign securities, which is equal to the sum of the (exogenous and given) foreign interest rate, \( r^* \), and the rate of expected depreciation of the domestic currency, \( E(e) \). The asset demands are assumed to be exogeneous of degree 1 in nominal wealth; this allows them to be written in nominal terms (assuming homogeneity in prices and real wealth, prices cancel out) as in Tobin (1969). The asset supplies are assumed to be exogenous and fixed. The demand for money, as shown by equation (4.3), increases when either rate of return falls, while the demand for domestic and foreign bonds in equation (4.4) and (4.5) are affected positively by increases in their own rate of return and negatively by increases in the return on the other asset. The assets are also assumed to be gross substitutes, so that \( b1 > f1 \) and \( f2 > b2 \). However in the case that investors view the domestic and foreign bonds as perfect substitutes, a zero risk premium, all four of the partial derivatives of the functions \( b \) and \( f \) would be infinite. The slightest deviation from the world rate of return would result in massive money flows to or from the asset in question. In this case equations 4.4 and 4.5 collapse to the UIP condition which implies that the BB and FF schedule must coincide and be fixed at the world interest rate level. As a result the financial sector of the model collapses to the money market equilibrium given by equation 4.3 and the UIP condition holds as in the MF model. Figure 4.4 shows the short-run determination of the exchange rate diagrammatically in \((e, r)\) space, for given levels of \( r^* + E(e) \), where \( r^* \) is given exogenously and \( E(e) = 0 \) because of static exchange rate expectations, and given level of asset stocks.
The MM line gives the locus over which the money market is in equilibrium. The slope of the MM curve is positive and is given by:

$$\left[ \frac{de}{dr} \right]_{MM} = -\left( \frac{W_m}{mF} \right) > 0$$

A depreciation (rise) of the exchange rate increases the domestic value of domestic residents' wealth, resulting from increases in the domestic currency value of their holdings of foreign bonds. This creates an increased demand for money to restore portfolio equilibrium. Given the existing money stock, a rise in domestic interest rates is required to maintain money market equilibrium.

**Figure 4.4**

**The Short-run Determination of the Exchange Rate**

Equilibrium in the domestic bond market is represented by the BB schedule, and has a negative slope given by:

$$\left[ \frac{de}{dr} \right]_{BB} = -\left( \frac{W_b}{bF} \right) < 0$$

A depreciation of the domestic currency increases domestic wealth through a revaluation of domestic residents' holdings of foreign assets, which also leads to an increase in demand for domestic bonds. However, given the existing number of domestic bonds, the increased demand for these must be offset by a decline in the domestic interest rate.

The FF schedule shows equilibrium in the foreign asset market, and is negatively sloped as given by:
\[ \left( \frac{de}{dr} \right)_{SF} = Wf_i (1 - f_i) F < 0 \]

An increase in the interest rate in the domestic bond market makes domestic bonds relatively attractive when compared with foreign bonds, reducing the demand for foreign assets. This must be offset by a fall in the domestic currency price of foreign assets, that is an appreciation of the domestic currency. However the FF schedule is flatter than the BB schedule on the assumption that domestic demand for domestic bonds is more responsive than domestic demand for foreign assets to changes in the domestic rate of interest.

Note that, in the case where assets are perfect substitutes \( b_1 = b_2 = f_1 = f_2 \to \infty \), the slope of the BB and FF curves coincide, and have a vertical line as shown in Figure 4.4. Under this circumstance, analyzing the short run effects of monetary policy in the PBM model is consistent with the MF model.

In Figure 4.5 (A), the intersection of the MM, BB, FF schedules gives short run equilibrium in the asset markets. In fact the asset markets can be in full equilibrium where any two of the curves intersect the third market necessarily clearing by residual, and thus the full equilibrium is at point A with an interest rate and exchange rate of \( r_i \) and \( e_i \) respectively.

The short run impact of monetary policy can be illustrated by Figure 4.5(A). The result of the impact depends upon how the central bank has increased the money supply. In Figure 4.5 (A), suppose that the central bank expands the money supply by an open market purchase of domestic bonds in exchange for domestic money. At point A, the initial equilibrium, there is now an excess supply of money and excess demand for domestic bonds. A large proportion of new money goes to increase demand for bonds, raising the price of bonds and hence the interest rate falls. The net effect is that the MM and BB schedules shift leftward. The MM schedule moves further than the BB schedule since demand for foreign assets also increases. Foreign assets become more attractive as the interest rate decreases, this in turn increases the demand for foreign assets and requires a depreciation of the exchange rate.
Now consider the long run impact of an expansionary monetary policy by an open market purchase of domestic bonds. As mentioned from Figure 4.5A, in the short run the impact of an increased money supply is that the interest rate will fall and the exchange rate depreciates until all asset markets clear at the new short run equilibrium at point B. However asset market equilibrium is not equivalent to long run equilibrium. To reach long run equilibrium it is necessary to incorporate the current account explicitly into the analysis, as shown in Figure 4.5B. The CA line shows the combinations of the exchange rate and interest rate which will clear the current account. It is a ray from the origin whose slope reflects the real exchange rate which is determined by the foreign interest rate \( r^* \), price level \( p^* \), and supply of foreign bonds \( F^* \). A rise in \( p^* \), \( F^* \), or \( r^* \) will rotate the CA line clockwise as a lower exchange rate is required for every level of \( p \) to maintain equilibrium in the current account. The initial equilibrium is at point R where the current account is in balance. An increase in the money supply, as mentioned above, will lead to a real depreciation...
of the domestic currency (before prices have time to respond) which will produce a current account surplus at point X.

The adjustment to final equilibrium comprises three elements. First, the current account surplus means that domestic residents are accumulating foreign assets and this will lead to a fall in the exchange rate by shifting the FF curve, the BB curve and the MM curve downward. If these were the only adjustments, then the long run equilibrium point should be at point A, \( e_1 \), the initial equilibrium. However the adjustment to the long run equilibrium is complicated and comprises two other elements. First, in the long run, the price level will also respond to an increase in the supply of money, as it is related proportionately to the money stock. Suppose the new long run equilibrium price in response to the monetary disturbance is at point \( p_2 \). In the absence of other adjustments this would bid down the nominal exchange rate to \( e_3 \) and now the adjustment would be to CA1 at point y, and the real exchange rate would come back to its original value \( e_1/p_1 = e_3/p_2 \).

However, the third adjustment is that while the current account is in surplus, domestic residents have accumulated additional stocks of foreign assets. The increased interest income obtained from the additional stock of foreign assets creates a surplus in the current account at the original real exchange rate \( e_3/p_2 \). Therefore long run equilibrium requires an appreciation in the real exchange rate, and is represented by a clockwise rotation of the CA line to CA2. The long run equilibrium is attained at point z in Figure 4.5A and asset markets will also be in equilibrium at point C, the nominal exchange rate is bid down to \( e_4 \) and the real exchange rate appreciates from its initial equilibrium to \( e_4/p_2 \) (\( e_4/e_2 > e_1/p_1 \)) and the current account balance is equal to zero.

(B) Dynamic Exchange Rate Expectations

The analysis of the previous subsection is based on the assumption of static exchange rate expectations. This subsection will represent the dynamics of the exchange rate. The formal structure of the model is represented in Appendix 4.3. The impact of a monetary shock is shown in Figures 4.6(A) and 4.6(B).

---

8 The model emphasized here refers to Pentecost (1993), "Exchange Rate Dynamics", Chapter 7.
In the PBM model exchange rate dynamics are generated by specific equations for wealth accumulation and a hypothesis of exchange rate expectations. Wealth is assumed to accumulate endogenously only through the purchase of foreign currency assets since domestic asset stocks are held constant and the government budget is in balance. However wealth can change with changes in the exchange rate as well. The current account balance is crucial to the dynamics of the system because the current account surplus implies an accumulation of foreign assets. Holding domestic output constant, the current account balance (in foreign currency), CA, can be written as:

\[ F^* = \frac{dF}{dt} = CA = T(e/p, W, i) + r^* F^* \]

where \( T \) represents the trade balance which is assumed to be a positive function of the (real) exchange rate (the sign of \( T_1 \) assumes the Marshall-Lerner condition always holds), inversely related to domestic non-bank private sector wealth, \( W \) (the sign of \( T_2 \) reflects wealth effects on import demand), and inversely related to an exogenous
import shock parameter, \( i \). The \( r^*F \) is net interest income from domestic holdings of foreign currency assets.

In the long run steady-state equilibrium the current account must be in balance \((\dot{F}^* = 0)\). The dynamic model is depicted diagrammatically in Figure 4.6(A) and 4.6(B) in \( e \) and \( F^* \) space. The \( \dot{F}^* = 0 \) schedule may have either a positive or negative slope. From Appendix 4.3, the slope of the \( \dot{F}^* = 0 \) schedule is given by the expression:

\[
d e/ d F^* = -(eT_2+r^*)/(T_1+T_2F^*) \geq 0
\]

The denominator will be positive if the Marshall-Lerner condition holds, although the numerator can be either positive or negative depending on the relative size of \( eT_2 \) and \( r^* \). If \( eT_2 \) is larger than \( r^* \) then the \( \dot{F}^* = 0 \) curve has a positive slope. If the significant amounts of changes in wealth are spent on foreign goods, then \( |T_2| \) is high, and the \( \dot{F}^* = 0 \) schedule has a positive slope. On the other hand if a large amount of the change in wealth is spent on domestic goods, then \( |T_2| \) is low, and the \( \dot{F}^* = 0 \) schedule has a negative slope. The stability of the system can occur even in the case of the \( \dot{F}^* = 0 \) schedule having a positive or negative slope. However in the case of the \( \dot{F}^* = 0 \) curve having a negative slope, stability only occurs when \( \dot{F}^* = 0 \) curve is fatter than the \( e = 0 \) curve in the neighbourhood of the intersection. This is represented in the form of a phase-diagram in Appendix 4.3.

The slope of the \( \dot{e} = 0 \) schedule is a rectangular hyperbola, that is the elasticity of the schedule is given by the expression \( F^* (de/d e) dF^* = -1 \), reflecting that given \( M \) and \( B \) asset market equilibrium requires a given value of \( eF^* \). From Appendix 4.3 (A4.3.8), \( e \) is given by:

\[
e = \phi [(eF^*/W), (M/W)] = 0 \quad \text{where} \quad \phi_1 > 0, \phi_2 < 0 \tag{A4.3.8}
\]

In Figure 4.6 the \( \dot{e} = 0 \) schedule must be a rectangular hyperbola which can be seen by observing that \( \phi, e \) and \( F^* \) enter multiplicatively (in both \( W \) and \( eF^* \)), so changes in \( e \) and \( F^* \) which keeps the product \( eF^* \) constant and will also keep \( \dot{e} = 0 \) constant. Combinations of \( e \) and \( F^* \) off the locus will move \( e \) away from it. For example, since \( \phi_1 > 0 \) a rise in \( e \) or \( F^* \) from a point on the locus causes \( \dot{e} > 0 \).
Figure 4.6(A) and 4.6(B) represent a dynamic adjustment resulting from a monetary shock. The model is in equilibrium where the $F^* = 0$ and the $e = 0$ schedules intersect at A, with nominal exchange rate of $e_o$ and domestic residents' holdings of foreign currency assets of $F^*_o$.

Consider now the case of an increase of the money supply by way of an open market purchase of domestic bonds. Figures 4.6 A and B show that in the long run the implications for the exchange rate is different according to the slope of the $F^* = 0$ schedule. From Figure 4.6A, the case where the $F^* = 0$ schedule has a negative slope, an increase of the domestic money supply will shift the $e = 0$ curve up to the right and the exchange rate will immediately depreciate to $e_1$ on the stable arm of the saddle path (labelled SP). At this point the current account balance is in surplus which means that domestic residents are accumulating foreign assets and hence the exchange rate starts to appreciate down the saddle path towards the new long run equilibrium at $e_2$ where the current account surplus has been completely eliminated and full equilibrium is attained. In this case the net effect on the exchange rate is an appreciation. There are two points to be noted about this result. Firstly, unlike the MF model, in the long run the real exchange rate may appreciate in response to an expansionary monetary policy. Secondly, under perfect foresight expectations an unanticipated increase in the domestic money stock will cause an immediate depreciation of the home currency, but this depreciation will not be as great as under static expectations. In this case speculators with long run perfect foresight assist the adjustment of the foreign exchange market, because in the face of the initial depreciation rational agents will foresee that this will improve the trade balance and generate a future appreciation of the currency. In this case the agents cushion the exchange rate against a discrete and once and for all change in the money stock.

In Figure 4.6B the $F^* = 0$ schedule has a negative slope indicating that higher domestic wealth requires a higher value of $e$ to maintain current account balance, because domestic residents use their higher wealth to buy foreign goods. An increase in the money supply leads to an immediate depreciation of the exchange rate from $e_o$ to
At B the exchange rate partly reverses its initial depreciation and appreciates down the saddle path towards \( e_2 \). In this case the long run equilibrium exchange rate is higher, at \( e_2 \), than in the initial equilibrium. Thus an expansion of the money supply causes a depreciation of the nominal exchange rate and this is consistent with the MF model.

Table 4.2 summarizes the impact effects of monetary policy on the financial and real sectors between the MF, DB and PBM models.

4.4. Financial Liberalization and Its Macroeconomic Effects

The major factors underlying the buildup to the recent crisis in East Asia during 1997/98 arose from changes in the world economic environment and the rapid liberalization of capital accounts in the Asian countries. The changes in the external environment such as the decline of asset yields which have been in part influenced by the very low level of interest rates in the major industrial economies since the early 1990s made the Asian markets an increasingly attractive investment opportunity. This, together with the liberalization of capital accounts in the Asian countries, has contributed to massive capital inflows to them. These capital inflows caused serious macroeconomic imbalances. For example the real appreciation observed in Asia in the 1990s was in part the consequence of the rigidity of exchange rate policy (fixed exchange rate) in the region, and the ensuing large capital inflows contributed to the erosion of competitiveness and the worsening of current account balances. When the growing current account imbalances in some East Asia countries were not sustainable, speculative attacks on these currencies led to sharp depreciation.

In addition the attempt to sterilize capital flows by the monetary authorities in some East Asian countries were difficult to execute when the exchange rate was fixed and capital mobility was high. In the Thai case its sterilization policies for preventing the capital outflows in 1996/1997 has proved futile because they stimulated even greater capital outflows. The MF model can be used to explain this inconsistency of
### Table 4.2 Summarized Effects from a Monetary Expansion in the MF, DB and PBM models

<table>
<thead>
<tr>
<th>Effects from a Monetary Expansion</th>
<th>The MF model</th>
<th>The DB model</th>
<th>The PBM model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed exchange rate</td>
<td>Flexible exchange rate</td>
<td>Flexible exchange rate</td>
</tr>
<tr>
<td>Perfect Capital Mobility</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Imperfect Capital Mobility</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Real income</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Price level</td>
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<td>Fixed</td>
<td>Fixed</td>
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<tr>
<td>Nominal interest rate</td>
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<td>Real interest rate</td>
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<td>Nominal exchange rate + (depreciation)</td>
<td>0</td>
<td>0</td>
<td>+</td>
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<td>Nominal exchange rate - (appreciation)</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Real exchange rate + (depreciation)</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Real exchange rate - (appreciation)</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Balance of payments</td>
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</tr>
<tr>
<td>Current account</td>
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<tr>
<td>Capital account</td>
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</tr>
</tbody>
</table>

**Note:**
- + increase of the variables
- - decrease of the variables
- 0 No change
- ? change in the variable not known, since not explicitly included in the model
trying to sterilize capital flows by using open market operations in the face of pursuing a fixed exchange rate and liberalizing the capital account. This perspective is illustrated in Figure 4.7 (A) under the assumption of perfect capital mobility and a fixed exchange rate regime. Suppose that an economy was initially in an equilibrium position at point E. Consider the effects of an increase in the foreign interest rate which shifts the BP curve upward to BP1, since a rise in the foreign rate of interest requires a higher domestic level of interest to keep the balance of payments in equilibrium. Following the shock the economy at point E moves into balance of payments deficit because when the foreign interest rate rises and the domestic interest rate is initially unchanged, massive capital outflows would occur moving the capital account and the balance of payments into deficit. This implies an excess of private demand for foreign exchange over its supply, as agents now try to acquire foreign exchange with which to buy the more profitable foreign financial assets. To prevent the domestic currency from depreciating from the outflows of capital, the authorities sell some of its holdings of foreign exchange reserves. The domestic money supply then decreases in response to the loss in the international reserves and this shifts the LM curve leftward to LM1 causing the rise of the domestic interest rate to the new higher world interest rate $r^*$. 

However the authorities may want to eliminate the effects of their intervention because an increase of domestic interest rates might lead the economy into recession. The central banks can sterilize such intervention with the aim of increasing the domestic money supply and lowering domestic interest rates by using open market operations and purchasing domestic bonds. This in turn puts upward pressure on the price of domestic bonds and hence lowers the domestic interest rate. Such sterilization prevents domestic interest rates from rising in response to the outflows of capital and thus stimulates even greater capital outflows. To maintain its sterilization operations, and as long as it remains committed to maintaining a fixed exchange rate, the countries would suffer continuous balance of payments deficits and a continuous fall in foreign exchange reserves.
No matter how large holdings of these reserves are, however, the central banks would not be able to support its sterilization operations to any significant extent in the face of massive capital outflows that would occur under perfect capital mobility. The foreign exchange reserves would be quickly depleted and the eventual loss of all of them. At that point a fixed exchange rate collapses, then a big devaluation becomes necessary to restore the equilibrium in the foreign exchange market.\footnote{This can be used to explain the Thai case during the period of heavy capital outflows from late 1996 to the middle of May 1997. Foreign exchange market interventions by the BOT to defend the currency peg were partially sterilized to shelter the weak financial sector from interest rate increases and the increasing severity of asset-price deflation. However such sterilized intervention would lead to a continuous fall in foreign exchange reserves as the devaluation pressure on the domestic currency was not eliminated through higher domestic interest rates. The other alternative option is to perform non-sterilized capital outflows. Under a fixed exchange rate regime non-sterilized intervention would reduce the money supply and increase domestic interest rates. Therefore the domestic interest rate tends to rise much more than if outflows are sterilized. Although the higher increase in domestic interest rates had negative effects on the fragile financial sector the increase in domestic interest rate can alleviate the pressure on the devaluation of the domestic currency that resulted from the outflow of capital. In addition, this policy can avoid the persistent and continuous losses of foreign exchange reserves. Alternatively, if the Thai authorities allowed some flexibility of the exchange rate such as widening the exchange rate band, the nominal exchange rate would have depreciated in response to the outflows of capital. This will reduce the need to sterilize all capital outflows. However the possible downside effect of this policy is to keep domestic interest rates higher than in the case of sterilization. In addition the depreciation of the domestic currency would lead to an increase in import prices which contributed to the upward pressure on inflation.}
On the contrary suppose the foreign interest rate falls below the domestic interest rate. Under perfect capital mobility massive capital inflows would occur, moving the capital account and the balance of payment into surplus and lead to an appreciation of the domestic currency. To maintain a fixed exchange rate regime the government has to buy foreign exchange with newly created monetary base, thus building up foreign exchange reserves and expanding domestic money stocks and generating excess demand in the goods market. This may lead to an increase in domestic prices resulting in a real appreciation through higher domestic inflation. In the case of Thailand, if the Thai monetary authorities had not been obliged to keep the baht/dollar within a narrow band so long (from 25.2 to 25.6 to the $US from 1990 until 1997) the baht would have appreciated against the US dollar for much of the time between 1990 and 1996. Allowing the Thai baht to appreciate (greater exchange rate flexibility) gradually to accommodate upward pressures when capital flowed in would reduce competitiveness but the Thai monetary base and the money supply would not have been inflated by the capital inflows.

Consider the effects of a decline in the foreign interest rate under perfect capital mobility and a flexible exchange rate. This is illustrated in Figure 4.7 (B). A decline in the foreign interest rate from r*0 to r*1 shifts the BP curve downward to BP1. At the initial equilibrium at E, there is now a potential balance of payments surplus as capital flows in causing an appreciation of the exchange rate. Under a flexible exchange rate the appreciation will shift the IS curve leftward to IS1, as the trade balance deteriorates. The final equilibrium is at F where the exchange rate appreciates in response to the decline of the world interest rate without any changes in money stock.

However the above discussion does not mean that a floating exchange rate is more favourable than a fixed exchange rate. Actually, a flexible rate has disadvantages as well. The choice between fixed and flexible exchange rate arrangements depends on the nature and source of the shocks to the economy, policymakers' preferences and the structural characteristics of the economy. With regard to the DB flexible exchange rate
model, the model emphasizes the significant role of exchange rate expectations that may cause volatility of the exchange rate in the short run. With perfect capital mobility and a flexible exchange rate, financial markets respond instantaneously to exogenous shocks. Combined with the fact that goods markets are slower to react to such shocks, this asymmetric adjustment speed of the goods and asset markets coupled with exchange rate expectations may contribute to the overshooting of the exchange rate in the short run as discussed in a previous section.

One significant factor in explaining the rapid depreciation of the East Asian currencies during the crisis period 1997/98 arises from the presence of a portfolio diversification effect toward their domestic currencies induced by an increasing risk in holding the domestic assets relative to the foreign assets. In a situation where domestic and international investors have lost their confidence in holding domestic currency, they would seek to minimize desired risk by decreasing the share of domestic assets in their portfolios. The consequent capital outflows would lead to a decline in the demand for domestic currencies and a depreciation of the domestic currency. The PBM model provides a role for risk factors to influence exchange rates that may account for some of the exchange rate changes experienced under a floating exchange rate. Consider the case where investors perceive that domestic bonds have become more risky as compared with foreign bonds. The effects of such a change in perceptions is illustrated in Figure 4.8.

An increase in risk attached to holding domestic bonds resulted in a decreased demand for domestic bonds and increased demand for foreign bonds. Both the domestic bond schedule BB and foreign bond schedule FF shift to the right and the new schedules BB1 and FF1 intersect at point F. As a result in the short run the effects of the perceived increase in risk attached to holding domestic bonds will lead to a depreciation of the exchange rate from e1 to e2 and a rise in the domestic interest rate from r1 to r2.
However in the long run a depreciation of the exchange rate results in an improvement in international competitiveness, which contributes to an improvement in the trade balance. The improvement in the trade balance implies an accumulation of foreign asset stocks, an increase in wealth, and a larger proportion of foreign bonds in investors' portfolios than they desire. Consequently agents try to purchase domestic bonds and money leading to an appreciation of the exchange rate. Over time, the appreciation reduces the country's international competitiveness so reducing the current account surplus.

4.5. Conclusion

The liberalization of the capital account in the East Asian countries since the late 1980s created a substantial increase in short-term capital flows into these nations. From a policy perspective, massive capital flows affect the efficacy of monetary and fiscal policy under different exchange rate regimes and different degrees of capital mobility.
In the MF model, under a flexible exchange rate and perfect capital mobility, monetary policy is the most effective in altering output. An increase in the money supply, for example, puts downward pressure on domestic interest rates, inducing incipient capital outflows and depreciating the domestic currency. This depreciation improves the trade balance as net exports increase generating an increase in aggregate demand and ultimately increasing domestic real income. In contrast fiscal policy is not effective in influencing output under a flexible exchange rate and perfect capital mobility. An increase in government expenditures, for example, would increase aggregate demand for domestic goods and put upward pressure on domestic interest rates. This induces capital inflows to the economy, leading to an appreciation of the exchange rate and switching demand away from domestic goods. The reduction of aggregate demand in turn will offset the direct expansionary effects of increased government spending.

Under a fixed exchange rate and perfect capital mobility, monetary policy has no effect on the equilibrium levels of income, interest rate, the balance of payments, or the trade balance. The only effect of an open-market operation is to change the composition of the central bank's portfolio because a purchase (sale) of bonds implies an equal loss (gain) of international reserves. On the contrary, fiscal policy is highly effective in influencing equilibrium income because it does not crowd out investment. Therefore with a fixed exchange rate and perfect capital mobility a small country tends to lose monetary policy independence.

The MF model provides some explanations about the currency crisis in the East Asian countries during 1997/98. The model implies that under a fixed exchange rate regime, with perfect capital mobility, sustained interest rate differentials leads to massive financial capital inflows and generate a real appreciation of the domestic currency via an increased inflationary pressure. The reason is that the authorities have to intervene in the foreign exchange market by purchasing the foreign exchange that flows in and this increases the international reserves and hence the domestic money supply increases. An increase in the money supply generates excess demand in the
goods market and may lead to an increase in domestic prices resulting in a real appreciation through higher domestic inflation. Allowing the exchange rate to float may cause an appreciation of the nominal exchange rate, but the monetary base and money supply will not be affected directly. Especially in the case where capital outflows resulting from the rapid deterioration in confidence of domestic and foreign investors in the soundness of the economy, would contribute to a sharp depreciation of the domestic currency. In this case the intervention of the monetary authorities in supporting the fixed exchange rate regime will cause a continuous loss of foreign exchange reserves that either results in eventual devaluation of the domestic currency or in a foreign exchange crisis.

However financial liberalization with a floating exchange rate has also generated negative effects by creating substantial volatility of the exchange rate, as occurred, for example, in Thailand and Korea where their domestic currencies depreciated substantially after allowing their exchange rate to float. The DB model explained that under perfect capital mobility and a free floating exchange rate the volatility of the exchange rate in the short run resulted from a difference of adjustment speeds between goods and financial markets as well as exchange rate expectations.

Under the circumstance where the domestic and international investors' confidence were substantially deteriorated in holding Asian currencies, the domestic and foreign assets can not be regarded as perfectly substitutable because investors perceive that domestic assets have become more risky as compared with foreign assets. The PBM model allows changes in perceived risk to play a significant role in determining the exchange rate. An increase in the perceived riskiness of domestic bonds compared with foreign bonds can lead to an increase in the domestic interest rate and a depreciation of the domestic currency in the short run.

Another important contribution of the PBM model is that it focuses upon the long-run nature of the adjustment process. The link between the short and long runs is from foreign asset stock accumulation via developments in the current account. A current account surplus implies an accumulation of foreign asset stock, this in turn
affects the level of wealth which, in the adjustment to long run equilibrium, feeds back into the financial market and exchange rate behavior.

These three models, in particular the PBM model, provide the building blocks in developing a macroeconomic model for Thailand. However a number of amendments will be required to make it more applicable to Thailand. Developing a dynamic long run macroeconomic for Thailand will be represented in the following chapter with appropriate amendments.