

### III. Theories of Exchange Rate Determination

#### The Different Theories

A theory of exchange rate determination explains how the exchange rate is determined. We have several such theories today. The different theories were advanced throughout the years, reflecting the changing reality in the foreign exchange market. When a new theory was promoted, it was sometimes with criticism of the earlier theory. Today, almost three decades since a new theory of exchange rate determination was introduced, the consensus is that none of the theories are wrong. Rather, each of the theories is correct for a particular time horizon. Specifically, Purchasing Power Parity explains the long term trend in the exchange rate, over a hundred years. In the medium term between several years to decades, the flow approach to exchange rate determination has some merit. And in the short term, the stock equilibrium approach to exchange rate determination explains the day-to-day determination of exchange rates. We will go over each of these theories.

#### Purchasing Power Parity

Back when currencies were exchanged mainly to conduct trade, it was natural to try to explain the exchange rate in terms of their use in purchasing goods. In one of the earliest theories, the exchange rate was considered to settle at a level where a basket of goods cost the same, whether it was imported or bought domestically. If the price of the same basket of goods was different from one country to another, arbitrage would continue until the exchange rate came to a level where the prices were the same. In other words, the equilibrium level of the exchange rate was such that the purchasing power of the different currencies was equal. This was the Purchasing Power Parity theory or PPP, launched by the Swedish economist Gustav Cassel (1866-1945) in 1921. In a simple model with only one good produced both at home and abroad, PPP is expressed as  $P = eP^*$ . The real exchange rate is equal to one when PPP holds.

Later on, Cassel's original theory came to be recognised as the "Absolute PPP", in contrast to the newly introduced "Relative PPP". The latter focuses on the rate of change instead of the level of the nominal exchange rate. We choose a period in time when the exchange rate was at a level that most closely reflected the international competitiveness of the two countries involved, and use it as the reference period. Between this reference period and today, inflation rates would have been different in the two countries. The exchange rate today is at the relative PPP level if it has changed in just such a way that cancelled out these inflation differentials.

Needless to say, for this theory to stand, the reasons behind the choice of reference period

must be robust. There should also not have been any new trade barriers introduced between the reference period and today. Furthermore, if the price index used to calculate inflation differentials included both prices of traded and non-traded goods, we may have the “Balassa-Samuelson effect”. This is when the “international competitiveness” of traded-good industries in a country with high growth is underestimated (or the real exchange rate  $\frac{eP^*}{P}$  is overestimated). It happens because the non-traded goods sector is less efficient than the traded-goods sector, and non-traded goods prices tend to rise more rapidly than traded good prices, in countries with high growth.

### **The Flow Approach to Exchange Rate Determination**

Eventually, economists began to see the exchange rate as an instrument to bring about balances in the current account. This went on until the mid-1970s. Capital controls were still in place, demand for and supply of foreign exchange were trade-related, and the major exchange rates were fixed under the Bretton Woods System. In such a world, current account imbalances were serious problems that interfered with stabilisation of the domestic economy. Participants of the Bretton Woods System were obliged to maintain fixed exchange rates and stable current accounts. This obligation took precedence over domestic policy concerns. When macroeconomic policy stances desirable for domestic stabilisation were inconsistent with the requirements of being part of the Bretton Woods System, the latter prevailed over the former. (Recall the loss of monetary policy autonomy when the exchange rate must remain stable, as shown by the Inconsistent Triangle.)

Seeing this, economists such as Milton Freedman began to advocate freeing the exchange rate, to use the exchange rate as an instrument to bring about current account balances. Exports give rise to supply of foreign exchange; imports give rise to demand for foreign exchange. Hence exports were equal to imports and the current account was in balance, when supply was equal to demand in the foreign exchange market. If exchange rates were allowed to float, therefore, they will settle at levels that made demand equal to supply, freeing us of the problems caused by current account imbalances.

It was natural to see the demand and supply as flow variables, because exports and imports were flow variables. And this came to be called the flow approach to exchange rate determination. The flow approach was at first shown in a partial equilibrium model of the current account as a function of real exchange rates. An example of such an “elasticity approach” is shown below when deriving the Marshall-Lerner condition.

Later on, the flow approach took on a general equilibrium framework, placing the current

account in the IS equation. This was called the “absorption approach” because it emphasised the importance of the discrepancy between aggregate supply and domestic absorption (domestic absorption) as the cause of current account imbalances. In any event, the flow approach to the theory of exchange rate determination was inseparable with the question of how to bring about current account balances.

### **The Stock Equilibrium Approach to Exchange Rate Determination**

As it turns out, after floating, the exchange rates did not bring about current account balances. This was because floating coincided with the gradual removal of capital controls. In Japan, for instance, controls began to be gradually relaxed and international capital flows began to increase in the late 1970s. Before the changes in the foreign exchange law (Gaitame-ho) in December 1980, foreign exchange transactions were “prohibited in principle, free as an exception”. After the changes, they became “free in principle, prohibited as an exception”.

After removal of capital controls, foreign exchange markets became increasingly dominated by demand and supply unrelated to trade. Households, financial institutions and firms began to invest in financial and real assets all over the world. Exchange rate movements became more and more volatile and quick.

Pentti Kouri was one of the first to argue that it was more appropriate to define demand and supply in the foreign exchange market in terms of stocks, as opposed to flows (P.J.K. Kouri (1976), “The Exchange Rate and the Balance of Payments in the Short run and in the Long run: A Monetary Approach”, *Scandinavian Journal of Economics*). This would allow us to explain why the equilibrium level of the exchange rate changed from moment to moment. Flow variables can only be defined over a period of time, while stock variables can be defined at each moment. Stock demand and stock supply can be defined and change from moment to moment, leading to equilibrium price changes from moment to moment. The exchange rate should be seen as one of the asset prices that were determined in stock equilibrium, as the result of portfolio decisions of asset holders.

This idea turned out to be extremely insightful, and led to the stock equilibrium approach. It correctly incorporated the increasing importance of the capital account and the currencies’ role as a store of value (in contrast to the current account and the currencies’ role as a medium of exchange) into the theory of exchange rate determination. We were no longer paying attention solely on the left-hand side of the  $CA = S - I$  equation. Furthermore, the theory succeeded in explaining the rapid changes in the exchange rate, and introduced the notion of “difference in adjustment speed” among the endogenous variables in macroeconomic models.

**An example of a Model using the Stock Equilibrium Approach**

Here is an example of a simple model using the stock equilibrium approach. We emphasise the role of the stock equilibrium in the financial market, and treat  $Y$  as given at the level corresponding to full employment. We also assume  $P^* = 1$  for simplicity.

The notation is as follows:

$Y$  : income/production

$i$  : domestic interest rate                       $i^*$  : foreign interest rate

$e$  : nominal exchange rate                       $e^f$  : expected nominal exchange rate

$W$  : nominal financial assets in terms of the domestic currency

$\pi$  :  $(e^f - e)/e$  : expected rate of exchange rate depreciation

$M$  : nominal stock of domestic money                       $B$  : nominal stock of domestic bonds

$F$  : nominal stock of foreign bonds

$P, P^*$  : domestic and foreign goods price

The circled variables are stock variables. Foreigners do not hold assets denominated in the domestic currency. Domestic residents hold three types of financial asset, domestic money, domestic bonds and foreign bonds. There is effectively only one good in the world as a result of arbitrage, so  $P = eP^*$ . Because we have assumed  $P^* = 1$ ,  $e = P$ .

It is important to note that this does not mean that the exchange rate is determined by PPP in this model. Even when  $P = eP^*$  is assumed in a model, that does not necessarily mean that PPP is assumed. Whether PPP is assumed depends on which equation determines the exchange rate in that model. As we will see shortly, it is not PPP but the stock equilibrium in the financial markets that determines the exchange rate in this model.

The exogenous variables are  $Y, i, P^*, e^f, M, B, F$  and the endogenous variables are  $i, e = P$ .

The model contains only the financial side of the macro economy.

$$(1) \quad W = M + B + eF$$

$$(2) \quad P = eP^*$$

$$(3) \quad i = i^* + \pi, \quad \pi \equiv (e^f - e)/e$$

$$(4) \quad \frac{M}{P} = L\left(i, Y : \frac{W}{P}\right)$$

$$(5) \quad \frac{B}{P} = H\left(i, Y : \frac{W}{P}\right)$$

$$(6) \quad \frac{eF}{P} = H^*(i, Y : \frac{W}{P})$$

The partial derivatives have the following signs:

$$\begin{array}{lll} L_1 < 0 & L_2 > 0 & L_3 > 0 \\ H_1 > 0 & H_2 < 0 & H_3 > 0 \\ H_1^* > 0 & H_2^* < 0 & H_3^* > 0 \end{array}$$

where for instance  $L_1$  indicates the partial derivative of  $L(\dots)$  with respect to the first variable of which  $L$  is a function. The reason why  $H_2$  is negative is because a change in  $Y$  increases the demand for money as the medium of exchange, decreasing the demand for bonds. Only when the real stock of assets increases will demand for all three assets increase.

At any given time, the amount of real stock of financial assets  $W/P$  is given. This given amount is allocated among the three types of financial asset, the demand for which are  $L$ ,  $H$  and  $H^*$ . Hence, the asset constraint (or the Walras' law of financial markets) is:

$$(7) \quad \frac{W}{P} \equiv L(\dots) + H(\dots) + H^*(\dots)$$

This constraint ensures that

$$\begin{array}{l} L_j + H_j + H_j^* = 0 \\ L_3 + H_3 + H_3^* = 1 \end{array} \quad j = 1, 2$$

and that only two of the three financial asset equilibrium conditions are independent. Furthermore, because the interest rate parity holds, domestic and foreign bonds are effectively indistinguishable from one another, and there is only one equilibrium condition for both bonds.

Therefore, there are only two independent equations; the interest rate parity condition and one of the three asset market equilibrium conditions. These two determine  $i$  and  $e$ . Clearly, the exchange rate is determined, along with another asset price (interest rate) in the stock equilibrium of the financial asset market. Using this type of model, we can also emphasise the importance of expectations of exchange rate changes in the determination of exchange rates.

This model is almost too simple, but it conveys the essence of the stock equilibrium approach to exchange rate determination. A more general model would incorporate the IS side of the economy. If we depict the process through which the current account changes the stock of foreign assets (as in dynamic models briefly mentioned at the end of this section), the current account will affect the exchange rate over time through that route.

In any event, because the exchange rate is an asset price determined in a stock equilibrium, this type of model can depict a situation in which the exchange rate takes a new value every moment.

### The Marshall-Lerner Condition

The “elasticity approach” to exchange rate determination gave us the Marshall-Lerner condition. The Marshall-Lerner condition is the sufficient (not necessary) condition for stability in the foreign exchange market, under the flow approach. If this condition held, an exchange rate depreciation reduced a deficit in the current account and brought it to balance, via increase in exports and decrease in imports. We now derive this condition using a partial equilibrium model of the current account as a function of exchange rates.

The foreign exchange market is in equilibrium when  $CA = 0$ , and the equilibrium level of  $e$  is determined at this level.  $e$  is the variable that changes to bring about equality between demand and supply in the foreign exchange market.

$X$  is exports,  $IM$  is imports and both are functions of the real exchange rate. Prices at home and abroad are both fixed, so effectively, exports and imports are functions of nominal exchange rates:

$$CA = P \cdot X \left( \frac{eP^*}{P} \right) - eP^* \cdot IM \left( \frac{eP^*}{P} \right).$$

The condition that an exchange rate depreciation causes an improvement in the current account can be expressed as:

$$\frac{dCA}{de} > 0.$$

The Marshall-Lerner condition expresses this condition in terms of the elasticity of domestic and foreign imports with respect to the real exchange rate ( $\eta$  and  $\eta^*$ ). The elasticity of domestic imports is

$$\eta \equiv - \frac{dIM}{d \left( \frac{eP^*}{P} \right)} \frac{\left( \frac{eP^*}{P} \right)}{IM} > 0$$

Since there are only two countries, the elasticity of foreign imports is the same as the elasticity of domestic exports:

$$\eta^* \equiv \frac{dX}{d\left(\frac{eP^*}{P}\right)} \frac{\left(\frac{eP^*}{P}\right)}{X} > 0.$$

$\eta$  is defined with a negative sign in front, because we are taking the absolute value. Both elasticities must be positive by definition.

By differentiating the expression above for CA with the nominal exchange rate and using the elasticities we have:

$$\begin{aligned} \frac{dCA}{de} &= P \cdot \frac{dX(\cdot)}{d\left(\frac{eP^*}{P}\right)} \frac{d\left(\frac{eP^*}{P}\right)}{de} - P^* \cdot IM(\cdot) - eP^* \frac{dIM(\cdot)}{d\left(\frac{eP^*}{P}\right)} \frac{d\left(\frac{eP^*}{P}\right)}{de} \\ &= P \cdot \frac{P^*}{P} \frac{dX(\cdot)}{d\left(\frac{eP^*}{P}\right)} \frac{\left(\frac{eP^*}{P}\right)}{X(\cdot)} \frac{X(\cdot)}{\left(\frac{eP^*}{P}\right)} - P^* IM(\cdot) - eP^* \frac{P^*}{P} \frac{dIM(\cdot)}{d\left(\frac{eP^*}{P}\right)} \frac{\left(\frac{eP^*}{P}\right)}{IM(\cdot)} \frac{IM(\cdot)}{\left(\frac{eP^*}{P}\right)} \\ &= \frac{PX(\cdot)}{e} \eta^* - P^* \cdot IM(\cdot) + P^* \cdot IM(\cdot) \cdot \eta \\ &= P^* \cdot IM(\cdot) (\eta^* + \eta - 1) \end{aligned}$$

where we have used the condition that the CA is in equilibrium initially ( $eP^* IM(\cdot) = PX(\cdot)$ ).

$\eta^* + \eta - 1 > 0$  is the Marshall-Lerner condition, a sufficient condition for  $\frac{dCA}{de} > 0$ . If a

current account deficit can cause the exchange rate to depreciate, and this condition holds, exports and imports will adjust until the deficit disappears. Needless to say, this condition does not explain why, or guarantee that, the exchange rate will indeed move in the right direction in response to a given current account imbalance. The condition only states that IF the exchange rate moved in the right direction, then the condition will be sufficient to balance the current account.

This does not diminish the significance of the condition, however. First of all, this is a very intuitive condition. It states that if demand responds vigorously enough to price changes as expected by the most basic economic logic (higher prices leads to lower demand), then the market is stable. Second, it points us to the importance of elasticities,

which enables us to explain the “J-curve effect”.

### **The J-curve Effect**

The name “J-curve effect” comes from the shape of the path that the current account takes, after an exchange rate depreciation. If the Marshall-Lerner condition holds, a current account deficit should immediately start improving after an exchange rate depreciation. However, economists observed that the current account deteriorated initially, before beginning its path towards balance. This path looked like a J. The term “J-curve effect” includes a case when the J is upside down, the path of the current account after an exchange rate appreciation.

The J-curve exists because exports and imports do not respond to price changes immediately. Even if the Marshall-Lerner condition held eventually, it failed to hold in the short-term. Economists have estimated the length of the J-curve. It could last from six months to two years. Here again, the question is the speed of adjustment. We are observing quantity variables adjusting more slowly than price variables, especially a price variable as changeable as the exchange rate. In the short-run, before exports and imports begin to adjust to price changes, the only effect of the price change is the change in the product of price and quantity. For instance, when the exchange rate depreciates to cause  $eP^*$  to rise (because goods prices are also slow to change) and  $IM$  is still fixed,  $eP^*IM$  goes up, leading the deficit to expand (temporarily).

### **How does the CA affect the exchange rate?**

The Marshall-Lerner condition is a condition regarding the response of the CA to the exchange rate. But the two endogenous variables (CA and  $e$ ) are in general simultaneously determined, and the effect runs in the other direction also. In other words, the exchange rate is affected by the current account.

We touched upon this in discussing the usefulness of the Marshall-Lerner condition; even if the condition held, the exchange rate had to move in the right direction initially, if it were to correct the CA imbalance. One way in which a CA deficit could cause the exchange rate to depreciate is through a mechanism relying on “home-bias”. “Home-bias” in the current context means that the marginal propensity to spend on domestic goods is larger than the marginal propensity to import. When the CA is in deficit, the country is borrowing more from abroad than it lends abroad during that period, which leads to a decrease in the stock of foreign assets. If expenditure was a function of assets, including foreign assets, this decreases expenditure. Because of home bias, this decreases purchase of domestic goods more than it decreases imports. Purchase at home is done using the

domestic currency while imports are done using the foreign currency. This means that the decline in demand for the domestic currency is larger than the decline in the demand for the foreign currency, leading to a depreciation of the domestic currency. If this mechanism always worked, then a CA imbalance will bring about the desired change in the exchange rate, and with the Marshall-Lerner condition at work, correct itself.

But as we discussed in the previous section, the exchange rate is affected by many things other than a CA imbalance. This is especially true when capital controls are removed, and is one reason why the CA was not automatically balanced by the introduction of floating exchange rates.

### **The short-run, medium-run and the long-run in macroeconomic analyses**

It may be useful to point out that the expressions short-term, medium-term and long-term (or the short-run, medium-run and long-run) used in theories of exchange rate determination do not indicate the same thing in macroeconomic analyses.

In the context of exchange rate determination, the long-run is the period long enough so that the trend of the exchange rate more or less coincided with the path predicted by PPP. In the short-run, exchange rates are asset prices influenced by expectations, determined along with other asset prices such as interest rates by the stock equilibrium in the financial markets. Yet the current account does manage to have some influence on the exchange rate. First of all, in the short-run, it influences the exchange rate via expectations. In the medium-run dynamic adjustment process, it changes the stock of foreign assets and affects the exchange rate determined by the stock equilibrium in the financial market. And the exchange rate does show some tendency to move in the direction that would cause CA imbalances to disappear. In other words, the current account explains some of the medium-run divergences from the long-run trend.

In macroeconomic analyses, the long-run, medium-run and short-run mean something different.

The long-run has a distinct definition in macroeconomic analyses; it is the “steady state” or “stationary state” where all nominal variables move at the same rate and all real variables are constant. We never actually reach such a state. The dynamic variables (variables that are functions of time and change with time) are constant in the short-run, only the directions of their change (differential of dynamic variables with respect to time) are endogenous. All real dynamic variables come to a halt in the long-run stationary state.

Each short-run equilibrium corresponds to a given level of the dynamic variable. Short-run equilibrium usually signifies equilibrium in both the real and financial sides of the economy (in contrast to signifying only the asset market equilibrium in the theory of

exchange rate determination).

One could see the dynamic variable as taking the economy to the new long-run equilibrium by carrying a corresponding short-run equilibrium on its shoulders. The economy is initially in a long-run equilibrium, and then some exogenous change pushes it out of this equilibrium. Dynamic variables begin to change, until the new long-run equilibrium is reached. This adjustment process from the initial steady state to the new steady state is sometimes called the medium-run. Often the real stock of foreign exchange is a dynamic variable. It changes through time in response to CA imbalances. In such a model, the current account is in balance in the long-run steady state (instead of the medium-term as in the theory of exchange rate determination). Another example of a dynamic variable is the stock of capital used in production.

A model without such a dynamic adjustment process to the long-run is called a “static model”, and a model with such an adjustment process is called a “dynamic model”.

The *IS LM* equilibrium is often laid out as a static model. If the model incorporates dynamics, *IS LM* equilibrium is the short-run equilibrium corresponding to each level of the dynamic variable changing through time. The Dornbusch overshooting analysis which we discuss in Section V uses a dynamic model with the price level as the dynamic variable.