Models of Exchange Rate Determination: Asset Approach

The Trade Flow approach was a reasonable way of looking at the world when trade is the dominant factor in exchange rate variability, e.g. before the world's capital markets were fully integrated with highly specialized derivative markets, or when there are capital controls. In today's foreign exchange market, where capital movements are more than 95% of total foreign exchange transactions, the asset approach to the exchange rate determination has become the accepted model of analysis. The asset approach emphasizes the financial asset market. The asset approach can be divided into two parts: Monetary models and Portfolio-Balance model.

1. Monetary Model

Basic Monetary Model

This basic monetary model views the exchange rate as any other financial asset, which is regarded as the value of one country's money against another. Hence the exchange rate is strongly influenced by the demand and supply for money in each country and by the flow of capital between countries.

The basic monetary model provides the groundwork for understanding the role of money in determining the exchange rate: the changes in the exchange value of its currency are a monetary phenomenon so that the exchange rate variations result from the monetary disequilibrium (difference between the quantity of money supplied and the quantity of money demanded).

The principal assumptions behind the basic monetary model are given by the following behavioral relationships and equations:

Purchasing Power Parity

(1) $S = P/P^*$,

where S is the spot exchange rate, P is the level of domestic prices and P^* is the level of foreign prices. S is measured as the value of domestic currency in terms of foreign currency, so that as domestic prices increases, the domestic currency will depreciate and there will be more domestic currency for one foreign currency. Conversely, as the foreign prices P^* increase, S will decrease in value, so there will be less domestic currency for one foreign currency and hence the domestic currency will appreciate.

Interest Rate Parity

(2) $F = S[1 + i]/[1 + i^*]$,

where F is the forward exchange rate, i is the domestic rate of interest and i^* is the foreign rate of interest. As discussed and demonstrated earlier, this relationship is valid more or less continuously at any point of time. Note we should really express the interest rate parity condition as,

$$F = S[1 + i(T/360)]/[1 + i^*(T/360)],$$

but equation (2) is a convenient shorthand.

Forward Rate Unbiasedness Theory

(3) $F = E(S_{+1})$,

i.e. the forward exchange rate is a good predictor of the future spot exchange rate. In fact the forward rate is assumed to be an "unbiased" predictor, so that there are no consistent forecast errors, i.e. the forward rate does not consistently over predict or underpredict the future spot rate.

Stable Domestic Money Demand Function

(4) $(M^d /P) = \phi Y - \lambda i$,

where M^d is the domestic demand for money, P is the domestic price level, Y is the domestic real income (real output) and i is the domestic nominal interest rate. And, ϕ is the elasticity of money demand with respect to real output, and λ is the semi-elasticity of money demand with respect to nominal interest rates. Note that in the Keynesian money demand theory, the transaction motive implies money demand increases as real income rises, and the opportunity cost theory implies money demand decreases as the nominal interest rate increases.

The central bank sets the supply of money, M^s; and in equilibrium the supply and demands of money are the same, so that $M = M^d = M^s$ Assuming there is an equilibrium in the money market so that $M = M^s = M^d$, the Domestic Demand for Real Balances, is

(4') $(M /P) = \phi Y - \lambda i$,

Stable Foreign Money Demand Function

(5) $M^{*d} = \phi Y^* - \lambda i^*$,

where M^{*d} is foreign money demand, Y^* is foreign income and i^* is the foreign rate of interest. The same motivations are assumed to explain foreign money demand as with domestic money demand.

The central bank sets the supply of money, M^{*s}; and in equilibrium the supply and demands of money are the same, so that $M^* = M^{*d} = M^{*s}$, the Foreign Demand for Real Balances, is

(5') $M^*/P^* = \phi Y^* - \lambda i^*$,

Fisher Equation in the domestic country

The nominal rate of interest, i is assumed to be large enough to compensate investors for the expected rate of inflation. The difference between the nominal rate of interest and the expected rate of inflation is defined to be the real rate of interest, r. Then,

(6) $r = i - \Pi$,

where ð is the expected inflation rate, i.e. the percentage change in prices,

$\Pi = (P_{t+1} - P_t)/P_t$,

When the expected rate of inflation is used in (6), the Fisher equation is said to be based upon the **ex ante** real rate of interest.

When the actual, observed rate of inflation is used in (6), the Fisher equation is said to be based upon the **ex post** real rate of interest.

Fisher Equation in the Foreign Country

Correspondingly to the domestic country, the foreign real rate of interest, r^* is defined as,

(6') $r^* = i^* - \Pi^*$,

where Π^* is the foreign inflation rate, i.e.

$\Pi^* = P^*_{t+1}/P^*_t$.

International Fisher Equation

When the real rates of interest are approximately the same in the two countries, then

(7) $F - S = i - i^* = \Pi - \Pi^*$,

i.e. the interest rate differential equals the inflation differential. Or, more precisely, the interest rate differential equals the expected inflation differential.

The Basic Monetary Model of Exchange rate determination

When the above equations are solved out we get the following model of exchange rate determination in logarithm form,

(8) $$\mathbf{s = (m - m^*) - \phi (y - y^*) + \lambda(i - i^*),}$$

where s is the logarithm spot exchange rate of domestic currency in terms of foreign currency, m is the logarithm money supply for home and foreign country(*), y is the logarithm real income for home and foreign country(*), and i is the interest rate of home and foreign country(*)

This equation is known as <u>the monetary model of exchange rate determination</u>.

The variable $(M - M^*)$ is known as the money supply differential,

the variable $(Y - Y^*)$ is known as the income differential and

the variable $(i - i^*)$ is known as the interest rate differential.

The model has several important features:

(i) <u>There is an exactly proportional relationship between domestic money supply and the price level; and also between domestic money supply and the nominal exchange rate.</u> A 1% increase in the domestic money supply leads to a 1% depreciation of the exchange rate. The idea here is that all monetary increases eventually lead through to a corresponding increase in prices. Also money supply increases inevitably increase the world supply of the currency and hence lead to a exchange rate depreciation.

(ii) An increase in domestic income Y, leads to an increased demand for the domestic currency and hence to an appreciating currency.

(iii) An increase in the domestic nominal rate of interest, i, is a signal of inflationary expectations and hence leads to a depreciation of the currency. Also, as the rate of interest increases, so the demand for money is reduced. If real balances, M/P in equation (4) remains constant, then in order to keep the equation (4) balanced, it is necessary for income, Y to increase. That is given the same amount of money, less money is invested, more is spent on consumption and there will be a multiplier effect which increases income.

The Flexible Price Monetary Model

The flexible price monetary model was developed by Frenkel (1976) and Frenkel and Johnson (1976). Assuming that PPP holds in the short run as well as in the long run due to the price flexibility, the interest rate differential is equated with the expected inflation differential in the long run since the international investment equates the real rate of interest.

Under this model, the spot exchange rate can be determined,

$$s = (m - m^*) - \beta_1 (y - y^*) + \beta_2 (\pi - \pi^*),$$

where s is the logarithm spot exchange rate of domestic currency in terms of foreign currency, m is the logarithm money supply for home and foreign country(*), y is the logarithm real income for home and foreign country(*),and π is the logarithm rate of inflation for home and foreign country(*).

This model represents,

1) A monetary expansion leads to a proportional rise in the exchange rate (the depreciation of the domestic currency)
2) An increase in income leads to a decrease in the exchange rate (the appreciation of the domestic currency)
3) A rise in the domestic price level leads to a rise in the exchange rate (the depreciation of the domestic currency)
4) Since an increase in domestic interest rate indicates the increase of the inflationary expectation, it leads to an increase in the exchange rate (the depreciation of the domestic currency) indirectly through the Fisher equation.

Real Interest Rate Differential (RID) Model

Frankel (1979) derived the Real Interest Rate Differential (RID) version of the monetary model. This model is identical to the flexible price model except that the real interest rate is included as an additional explanatory variable.

The exchange rate can be determined by the following equation,

$$s = (m - m^*) - \beta_1 (y - y^*) + \beta_2 (i - i^*) + \beta_3 (\pi - \pi^*),$$

where s is the logarithm spot exchange rate of domestic currency in terms of foreign currency, m is the logarithm money supply for home and foreign country(*), y is the logarithm real income for home and foreign country(*),π is the logarithm rate of inflation for home and foreign country(*), and i is the interest rate of home and foreign country(*)

Under this model,

1) A monetary expansion leads to a proportional rise in the exchange rate (the depreciation of the domestic currency)
2) An increase in income leads to a decrease in the exchange rate (the appreciation of the domestic currency)
3) A rise in the domestic price level leads to a rise in the exchange rate (the depreciation of the domestic currency)
4) An increase in domestic interest rate leads to an increase in the exchange rate (the depreciation of the domestic currency).

In this RID model, the changes in both interest rate and inflation rate affect the exchange rate directly.

Sticky Price Model with overshooting

One major criticism of the flexible price model is the assumption that PPP holds always, in the short run and in the long run. Especially, empirical evidences do not support short-run PPP.

In order to overcome the problematic feature of the flexible price model, Dornbush (1978) developed the model of overshooting and price adjustment by relaxing the assumption of short run PPP, but still maintaining the assumption that the long run PPP holds.

This model assumes that prices are sticky in the short run because the goods markets adjust more slowly than financial markets to monetary shocks. Thus, the main feature of the overshooting model is that the actual nominal exchange rate can overshoot or undershoot the relative price level.

In this model, the spot exchange rate is given,

$$\mathbf{s = (m - m^*) - ß_1 (y - y^*) - ß_2 (i - i^*)},$$

where s is the logarithm spot exchange rate of domestic currency in terms of foreign currency, m is the logarithm money supply for home and foreign country(*), y is the logarithm real income for home and foreign country(*), and i is the interest rate of home and foreign country(*)

Under this model,

1) A monetary expansion leads to a proportional rise in the exchange rate (the depreciation of the domestic currency)
2) An increase in income leads to a decrease in the exchange rate (the appreciation of the domestic currency)
3) An increase in domestic interest rate leads to a decrease in the exchange rate (the appreciation of the domestic currency). In this model, the increase in the domestic interest rate indicate a relative shortage of money supply in the domestic money market, which give rise to capital inflows and hence leads to a fall in the exchange rate.

2. Portfolio Balance Model

The portfolio balance model allows <u>relative bond supplies and demands</u> as well as relative money market conditions to determine the exchange rate. This model assumes that domestic bonds and foreign bonds are imperfectly substitute. Thus, people have preferences for distributing their portfolio over different countries' assets.

Currency Substitution Model

Branson and Kouri (1978) developed the currency substitution model when they found a significant decline of US$ in 1978 coincided with large US current account deficits. Since they assume that the domestic and foreign bonds are imperfect substitutes, the domestic wealth of people is represented in terms of bonds holdings. Thus, a current account deficit decreases the domestic wealth and leads to the decrease in demand for bonds and hence to a depreciation of domestic currency.

3.Foreign Exchange Market Microstructure

The Role of News or public information

In addition to the fundamentals such as money supply, real income, interest rate, inflation rates, and trade balance, the exchange rate is also affected by the news, the unexpected events, or the public information because the fundamental factors are changed by the news or the public information received by the market. Thus, the news will result in the variability or volatility of the exchange rate.

Recently, the real world can be characterized by unexpected shocks or surprises. Hence, the effects of news on the exchange rate become more significant, and recent financial studies become focus more on the volatility of the exchange rate rather than the level changes.

The effects of news or public information can be macro level since they affect the entire economy and other prices change along with exchange rates.

Market Microstructure

Except the new or public information which affect exchange rates at the macro level, there exist factors which affect exchange rate at micro level which determine exchange rate by interactions among traders. Thus, the private information from some traders know more than others about the market also affects exchange rate at micro level.

The "market microstructure" allow people to explain the evolution of the foreign exchange market in an intarday sense in which traders adjust their bid and ask prices throughout the day without any macro news. There are mainly two reasons why exchange rate changes over the day even without any macro news or public information regarding the fundamental determinants of exchange rate.

Inventory Control Effect

One reason that traders adjust their quotes (prices) is in response to inventory changes. At the end of the day, most traders balance their position: the orders to buy a currency should be equal to the orders to sell. This inventory control effect explains why trader should change their prices.

Asymmetric Information Effect

The asymmetric information among traders causes exchange rate to change due to the trader's fear that some other traders may have more information about the market conditions.