EXCHANGE RATE DETERMINATION

Unlike commodities, exchange rates do not give utility to their owners, but rather a derived utility, since owning foreign currency is necessary to purchase foreign goods, services and capital. Previously we discussed the institutional detail behind the structure and organization of the foreign exchange market. We now consider the causes of exchange rate movements due to changes in supply and demand conditions.

The $/DM bilateral exchange rate represents the price of the US currency in terms of German currency and in order to understand the determinants of the exchange rate we have to consider the relative demand and supply of US dollars ($). On figure 1 the price of the dollar is given on the vertical axis as DM/$, which represents the number of DM obtained from one US $. The quantity of dollars traded in the foreign exchange market is given on the horizontal axis.

Since the demand and supply for an exchange rate is unlike the demand and supply conditions for a regular good, it is not immediately obvious that they will have the usual slopes. However, an appreciation of the $ relative to the DM will lead to US goods becoming more expensive for Germans and will probably lead to a reduction in the volume of goods exported from the US to Germany. Hence the appreciation of the $ will lead to reduction in $ outpayments, so there is a downward sloping demand curve for $.

Similarly, as the $ appreciates, the price in $ of German goods declines. Consequently, the US will purchase more German goods and will probably spend more $ to buy them. This will raise German inpayments in $ and produce a positively sloping supply curve for $.

Suppose German residents increase their demand for US goods. In order to purchase US goods they need to exchange their DM for dollars; hence this creates an increased supply of DM and an increased demand for dollars. In figure 2 the increased demand for $ leads to an outward shift in the demand for $ curve; and leads to an intersection with the supply of $ at a higher point. This new equilibrium point is at a greater level of DM/$ than before indicating that the $ has <u>appreciated</u> against the DM.

Exactly the same situation can also be visualized from the perspective of the demand and supply for DM. In the right hand side panel of figure 2 the $/DM exchange rate is given on the vertical axis and the quantity of DM traded in the foreign exchange market on the horizontal axis. The increase in German demand for US goods is now seen in terms of an increased supply of German DM. The outward shifting DM supply curve will intersect the existing demand curve at a lower point which indicates that the new equilibrium will be at a lower point, i.e. less $ for one DM. That is the DM has <u>depreciated</u> against the $.

Both panels give the same information; one from the US perspective and the other from the German perspective.

Trade Flow Model of Exchange Rate Movements

One primary reason to trade currencies is to facilitate the international trade of goods and services. In the Trade Flow paradigm or model, the supply and demand of currencies is determined by trade considerations alone.

If there is excess demand for the dollar, then in a floating system the spot dollar exchange rate will appreciate to a new level.

If there is an excess supply of dollars, then in a floating system the spot dollar exchange rate will depreciate to a new level.

An alternative policy to floating rates, is to keep the exchange rate fixed at some level. If at the end of a year there is substantial imbalance in the Balance of Payments, the central banks will have to move official reserves between themselves to maintain the exchange rate at the fixed, non market rate.

The Trade Flow model analyzes the supply and demand of currencies through looking at the effect of how various macroeconomic and financial variables affect the exchange rate. In this framework, the following relationships can be expected:

(1) An increase in US prices will lead to a $ depreciation.

(2) An increase in US income will lead to a $ depreciation.

(3) An increase in US interest rates will lead to a $ appreciation.

According to the trade flow model, **changes in trade determine the change to the exchange rate**.

If the trade flow model was the only explanation of the present determinants of the exchange rate then the flow of trade between countries would cause (determine) the exchange rate. Historically, before capital movements became so substantial, the trade flow model was a reasonable approximation to reality. We will soon discuss the alternative theory of the monetary model of exchange rate determination. Subsequently the alternative monetary view, or **asset market approach**, has become the dominant view of exchange rate determination.

Income Effects on Exchange Rates

An increase in US real income will lead to an increased demand for imported goods and therefore will create an increased supply of $. Hence the $ will depreciate vis a vis the DM.

Diagram 3

Price Effects on Exchange Rates

If the US price level is growing faster than that of Germany, then US goods will become less competitive in Germany and will lead to a reduced demand for $. Also, German goods will appear cheaper in the US leading to increased imports to the US from Germany and hence an increasing supply of $. These changed supply and demand conditions will both have the effect of depreciating the $ vis a vis the DM.

Diagram 4

Interest Rate Effects on Exchange Rates

An increase in the US nominal rate of interest will make US bonds more attractive to investors from abroad. Hence their will be an inflow of speculative capital and an increased demand for $ from Germany. Hence the $ will appreciate.

Diagram 5

Relationship Between the Exchange Rate and the Trade Balance

Suppose a country is operating under a fixed exchange rate system. Clearly, an appreciation of the $ relative to the DM will lead to US goods becoming more expensive for Germans and will probably lead to a reduction in the volume of goods exported.

If a country has a trade deficit, should it devalue its currency? A cheaper dollar will lead to exports increasing, while imports should be reduced. However, the cost of imported goods has increased because the terms of trade have changed, i.e. each individual imported good is more expensive to the US citizens. The volume of goods imported depends on the substitutability with respect to domestic goods. If US citizens are unable to substitute domestically produced goods for foreign goods, they will then have to import the same quantity as before, but at higher prices. Hence, in the short run the trade balance will worsen as the cost of imported goods has increased. However,

in the long run, more substitution should occur; the volume of imports will be reduced and hence the dollar amount of imports will also fall, leading to an improvement of the trade deficit. This phenomenon is known as the J Curve and seems to have often occurred in practice.

Diagram 6

A curious statistical fact has emerged regarding financing the Trade Deficit. It appears that the world is running a large trade deficit! With whom? Capital flows are far larger then needed to finance trade. We know that capital movements have become almost independent of trade.

The Mundell-Fleming Model

Concerns the effects on trade, investment, the exchange rate when a country has a fiscal expansion or an open market operation?

Fixed Exchange Rates

With a fixed exchange rate, a central bank buys and sells foreign currency at an agreed price. In this case, **Monetary policy is ineffective**; a monetary expansion forces the LM curve outwards, output, Y increases and the rate of interest, R, decreases. There is therefore pressure on the $ to depreciate. However, because the $ is fixed, the Federal Reserve has to buy dollars at the fixed rate, and sells reserves of foreign currency, this reduces the money supply, so the LM curve shifts back to its previous position. Alternatively, the Fed does an open market operation of buying bonds, this decreases i below i^* and motivates an outflow of capital. Domestic residents go the Federal Reserve Bank, buy foreign currency and sell dollars until everything is back to normal; i.e. same money supply, more T bills, and less foreign reserves.

However, with fixed exchange rates, **Fiscal policy will be effective**. An expansionary fiscal policy moves the IS curve out to the right, and will increase output (GNP), Y and also the rate of interest, R. The total effect on the trade balance is ambiguous. Increased income will increase the amount of imports, while increased interest rates will lead to a crowding out effect on investment and GNP. So that most of the effect is to reduce Net Exports. However, the main effect will be to increase the demand for $ due to higher I and M^* increasing. To prevent the exchange rate changing, the fed sells $, buys reserves, to increase its own money supply. The LM curve shifts to the right, but equilibrium will be a higher level of GNP (Y). Hence fiscal policy is effective.

Flexible Exchange Rates

With expansionary monetary policy the LM curve moves to the right, and the exchange rate is allowed to depreciate, which will make the domestically produced goods more competitive. This relative price effect makes exports cheaper, imports more expensive, X is increased, hence the IS curve shifts to the right, Y increases. Hence monetary policy is effective.

However, fiscal policy is ineffective, since as the $ appreciates following increased income and interest rates, relative prices change, exports are reduced, imports are increased, so Net Exports, X, is reduced. Also, the IS curve shifts back to its previous level following the reduction in X.

Does the Budget Deficit Effect the Trade Deficit?

A government funds a budget deficit by partly borrowing from abroad, i.e. selling capital to finance current consumption. In this paradigm budget deficits are very much related to trade deficits.

Recently it is more generally accepted that trade deficits occur due to capital inflows

following increased investment opportunities. Hence the trade deficit is independent of the budget deficit.

The Monetary Model of Exchange Rate Determination

The monetary model takes a radical departure from the Trade Flow model and 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 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 98% to 99% of total foreign exchange transactions, the Monetary Model has become the accepted mode of analysis.

The monetary model takes a radical departure from the Trade Flow model and views the exchange rate as being like any other financial asset. Hence agents hold foreign currency as a store of value and because of the expected return to be derived from foreign exchange.

In this model the exchange rate is regarded as the value of one country's money against another. Then, 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 principal assumptions behind the 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 \$/DM, so that as domestic, US prices; so that as US prices increase, the \$ will depreciate and there will be more \$ for one DM. Conversely, as the German prices P^* increase, S will decrease in value, so there will be less \$ for one DM and hence the \$ 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

(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) $M^{d}/P = öY - ëi$,

where M^{d} is US money demand, P is the US price level, Y is US income and i is the US rate of interest. In this equation, ö is the money demand elasticity with respect to the level of income and ë is the elasticity of money demand with respect to the rate of interest. In this Keynesian money demand function, US residents hold money for,

Transactions motives, i.e. as income rises, people hold more money for the purchasing of goods and services,

Opportunity Cost Motives, i.e. as interest rates increase the return from holding bonds increases and people will switch liquid holdings to bonds with a rate of return. Hence as interest rates rise, the demand for money will be reduced.

The Federal Reserve Board sets the supply of money, M^{*}; and in equilibrium the supply and demands of money are the same, so that

$$M = M^{d} = M^{s},$$

and the **Demand for Real Balances**, is

(4') $M/P = öY - ëi$,

Stable Foreign Money Demand Function

(5) $M^{*d} = \ddot{o}Y^{*} - \ddot{e}i^{*}$,

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

The German Bundesbank sets the supply of money, M^{*}; and in equilibrium the supply and demands of money are the same, so that

$M^{*} = M^{*d} = M^{*s}$,

and the **Demand for Real Balances**, is

(5') $M^{*}/P^{*} = \ddot{o}Y^{*} - \ddot{e}i^{*}$,

Fisher Equation in the US

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) $r = i - E(\eth_{+1})$,

where $\eth$ is the inflation rate, i.e. the percentage change in prices,

$\eth_{+1} = (P_{+1} - P)/P$,

i.e.

$\eth_{+1} = P_{+1}/P - 1$.

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 US, the German real rate of interest, r^* is defined as,

(6') $r^* = i^* - E(\eth^*_{+1})$,

where $\eth^*$ is the German inflation rate, i.e.

$\eth^*_{+1} = P^*_{+1}/P^* - 1.$

International Fisher Equation

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

(7) $i - i^* = \eth - \eth^*$,

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

The Monetary Model

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

(8) $S = (M - M^*) - ö(Y - Y^*) + ë(i - i^*)$,

which is known as the monetary model of exchange rate determination.

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) 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. 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 dollars and hence lead to an exchange rate depreciation.

(ii) An increase in domestic income Y, leads to an increased demand for the domestic currency, i.e. dollars 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.

Notice how different the implications of the monetary model are to the Trade Flow model.