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Exchange Rates I: The Monetary Approach in the Long Run

Overview

In the long run, countries experiencing rapid money supply growth also tend to experience high inflation and a depreciating currency. This chapter presents a model that relates the price level and exchange rate in the long run to monetary conditions and so is called the *monetary approach to the exchange rate*. The monetary approach is built on three assumptions: (1) Goods are freely traded, (2) assets are freely traded, and (3) prices are perfectly flexible. This last assumption in particular gives the model a distinctly long-run flavor.

Because goods can be freely traded in international markets, goods' prices must be the same in all countries when measured in the same currency, a situation known as purchasing power parity (PPP). Given price levels in each country, the long-run exchange rate, therefore, must adjust to ensure PPP. Because assets are freely traded, uncovered interest parity holds. When uncovered interest parity and PPP hold simultaneously, a country's interest rate must be equal to the world *real interest rate* plus the expected rate of inflation in that country. Standard monetary theory and the assumption of perfectly flexible prices complete the model. Prices and the rate of inflation depend on the level and rate of change of nominal money supply and of real money demand.

Because the model relies on perfectly flexible prices, it is not an appropriate model of the exchange rate in the short run. However, because short-run models of the exchange rate rely on expectations of the long-run level of the exchange rate, the long-run model is a crucial input into short-run models of the exchange rate.

1 Exchange Rates and Prices in the Long Run: Purchasing Power Parity and Goods Market Equilibrium

ESSENTIAL CONCEPTS

Suppose that we lived in a world in which goods and services cross borders without cost and prices are perfectly flexible. In such a world, the prices of all goods and services would have to be the same in every country when measured in the same currency, for if

they were not, arbitrageurs would buy goods in low cost locations and sell them in high cost locations. The *law of one price (LOOP)* states exactly this. Further, the prices of any given basket of goods when measured in a common currency would have to be the same in every country. This is the idea of *absolute purchasing power parity (APPP)*.

It is useful to define the relative price of a basket of goods and services in two different countries as

$$q_{Japan/US} = (E_{\$/¥} \times P_{Japan}) \; / \; P_{US}$$

where P_{US} is the price in dollars of the basket in the U.S., P_{Japan} is the price in dollars of the basket in Japan, and $E_{\$/¥}$ is the dollar–yen exchange rate. This relative price is called the real exchange rate because it describes the rate at which real (rather than nominal) things are traded. When $q_{Japan/US}$ is less than one, the U.S. dollar is said to be *overvalued* because it takes less than one American basket to buy the exact same basket in Japan. The dollar is said to be *undervalued* when the real exchange rate is above one. APPP holds only when the real exchange rate is equal to one.

A similar concept that can hold even when the real exchange rate is not equal to one is *relative purchasing power parity (RPPP),* which relates rates of change in exchange rates to the difference of rates of change in inflation rates across countries. When the real exchange rate is constant, changes in prices in Japan or in the U.S. must be offset by changes in the nominal exchange rate to keep the relative price of Japanese and U.S. goods constant. Hence, if inflation is higher in Japan than in the U.S., P_{Japan} / P_{US} is increasing, so $E_{\$/¥}$ must be falling at the same rate.

Concepts of PPP are important because they provide a method of predicting the exchange rate. Suppose that APPP were to hold. Then, given price levels P_{Japan} and P_{US}, the exchange rate that makes PPP hold is

$$E_{\$/¥} = P_{US} \; / \; P_{Japan}.$$

In such a world, all we would need to do to forecast exchange rates would be to forecast price levels. In the real world, APPP is a reasonable approximation over a horizon of many years or decades, but it has little to say about short-run movements in exchange rates. This is because the real world involves many frictions in the international exchange of goods, including (1) transaction costs (such as trade barriers such as tariffs and quotas and shipping costs), (2) the existence of non-traded goods, (3) imperfect competition that gives firms pricing power in different markets, and (4) stickiness in domestic price levels. Despite its drawbacks as a predictor of exchange rates in the short run, APPP is useful because it provides a guide to the exchange rate in the long run, where long run is defined as the time necessary for prices to be flexible and for firms to overcome trade barriers.

KEY TERMS

Use the space below to record your notes on the following key terms.

Monetary approach to exchange rates _____

_____

_____

Law of one price (LOOP) _____

_____

_____

Purchasing power parity (PPP) _____

Real exchange rate _____

Real appreciation _____

Real depreciation _____

Overvalued _____

Undervalued _____

Absolute PPP _____

Inflation _____

Relative PPP _____

REVIEW QUESTIONS

Problem 1: The price of an apple in the U.S. is \$1, and the exchange rate is $E_{\$/€} = 1.25$. If international trade in apples is frictionless, then what must the price of an apple be in Germany?

Problem 2: Suppose that in the United States, the price of guns is $200 and the price of doctor's visits is $150. Suppose that in France, the price of guns is €300 and the price of doctor's visits is €50. Guns and doctor's visits receive an equal weight in a basket of goods.

2a. Is there any exchange rate that would make the law of one price hold for both goods?

2b. What is the dollar price of a U.S. basket?

2c. What is the euro price of a French basket?

2d. If $E_{\$/€} = 1$, does APPP hold?

2e. Suppose that $E_{\$/€}$ were to increase. Would this result in a real appreciation or a real depreciation of the dollar?

2f. Provide any value of $E_{\$/€}$ such that the dollar is overvalued. Explain.

2g. If, instead, guns received a weight of 3/5 in an American basket and only 2/5 in a French basket, would APPP hold when $E_{\$/€} = 1$?

TIPS

Problem 2 provides an example in which the law of one price may not hold for any good but APPP holds. Problem 2g gets at a practical problem in comparing price levels across countries: if different countries use different baskets, then different exchange rates are implied for PPP than if all countries used the same baskets.

Problem 3: Home's currency (the dollar) is depreciating relative to Foreign's currency (the blot) at a rate of 5%. Home's inflation rate is 8%. Foreign's inflation rate is 2%. Is Home's real exchange rate appreciating or depreciating and by how much?

Problem 4: (Multiple Choice) Suppose that money growth in Home is 6%, and money growth is 1% in Foreign. Then,

a. Home's real exchange rate is appreciating.
b. RPPP would predict that Home's currency will buy fewer of Foreign's currency next year.
c. Real interest rates are higher in Home than in Foreign.
d. none of the above

Problem 5: (True or False. Please explain your answers.) Assess the following statement, "relative PPP is a better approximation of reality when one of the two countries is suffering hyperinflation and the other is not."

Problem 6: (Multiple Choice) If the law of one price holds for all goods and services, then

a. The real exchange rate must equal one.
b. APPP holds.
c. RPPP holds.
d. all of the above
e. none of the above

Problem 7: (Multiple Choice) Which of the following might explain why PPP doesn't hold in the short run?

a. Prices are sticky.
b. Governments impose tariffs on goods.
c. Firms face imperfect competition.
d. all of the above
e. none of the above

2 Money, Prices, and Exchange Rates in the Long Run: Money Market Equilibrium in a Simple Model

ESSENTIAL CONCEPTS

Given information on future price levels in the long run, PPP can be used to make predictions on future exchange rates. Developing a model of future price levels is therefore the focus of this section. In the long run, price levels are determined by equilibrium in the market for *money*. To keep the analysis simple, we assume that the *central bank* directly determines the *money supply, M. Money demand,* M^d, is generated by its three key uses: as a store of value, as a unit of account, and as a medium of exchange. Specifically, we rely on the *quantity theory of money* to provide a demand equation: the demand for money is equal to the price level (P) multiplied by real output (Y) multiplied by a constant ($\overline{L}$) or

$$M^d = P \times Y \times \overline{L}$$

The idea is that people require a certain amount of money to carry out their transactions, and the volume of transactions is equal to the size of the economy, $P \times Y$. In equilibrium, the price must adjust so that the demand for money is equal to the supply of

money made available by the central bank. Hence, for the United States, the price level should be

$$P_{US} = \frac{M_{US}}{\overline{L}Y_{US}}$$

A similar equation would have to hold for each other country.

By combining the APPP equation with one price equation for each country, we have the *fundamental equation of the monetary approach to exchange rates:*

$$E_{\$/Y} = \left(M_{US} \Big/ M_{Japan}\right)\left(\frac{\overline{L}_{Japan}Y_{Japan}}{\overline{L}_{US}Y_{US}}\right)$$

This equation tells us what matters for the exchange rate in the long run. For instance, holding everything else equal, an increase in real output in the United States will tend to raise money demand and so will lower prices in the United States. Lower prices in the United States will make the dollar appreciate. Other variables that matter are the relative supplies of monies in the two countries and the proportion of real income that people want to hold in real balances. The fundamental equation can also be expressed in terms of changes over time. For instance, holding fixed all other variables, if the U.S. money supply grows faster than real output, then it must be that the dollar depreciates at the rate at which M_{US} / Y_{US} is increasing.

KEY TERMS

Use the space below to record your notes on the following key terms.

Money _____

Central bank _____

Money supply _____

Money demand _____

Quantity theory of money _____

Fundamental equation of the monetary model of the price level _____

Fundamental equation of the monetary model to exchange rates _____

REVIEW QUESTIONS

Problem 8: Home's money supply grows at 3% and Foreign's grows at 5%. Home's currency should

a. appreciate at a rate of 2%
b. appreciate at a rate 3/5%
c. depreciate at a rate of 5/3%
d. depreciate at a rate of 2%
e. none of the above

Problem 9: In the United States, the level of real output is 100 units, and money demand is equal to half of nominal output. In Japan, the level of real output is 80 units, and money demand is equal to three quarters of nominal output. The money supply in the United States is $25. Assume that the monetary approach to the exchange rate holds.

9a. What is the price level in the United States? _____

9b. If $E_{\$/¥}$ is 0.1, then what is the price level in Japan? _____

9c. Given your answer to 9b, what is the supply of money in Japan? _____

Problem 10: Suppose that U.S. money growth is 5% per year and U.S. economic growth is 3% a year. Suppose that money growth in Canada is 7% a year and the economy is shrinking at 2% a year.

10a. What is the inflation rate in the U.S.? _____

10b. What is the inflation rate in Canada? _____

10c. What does the monetary approach to the exchange rate predict about the movement of the Canadian dollar? _____

TIPS

The monetary approach to the exchange rate is really pretty simple. In the long run, PPP (one equation) and the quantity theory of money (two equations) hold. End of story.

3 The Monetary Approach: Implications and Evidence

ESSENTIAL CONCEPTS

This short section presents evidence on the link between money growth rates and exchange rates movements. As predicted by the monetary approach, there is a tight positive relationship between monetary growth rates and inflation rates over the long run. In addition, the evidence presented in this section suggests an improvement that can be made over the approach presented in the previous section. In the previous section, we assumed that money demand was a fixed proportion of nominal output. The evidence suggests that real money demand (M / P) falls dramatically as inflation rates become very high. The empirical evidence motivates a need to generalize our model of money demand, which is done in the next section.

KEY TERMS

Use the space below to record your notes on the following key terms.

Hyperinflation _____

REVIEW QUESTIONS

Problem 11: Provide an intuitive explanation for why demand for real money balances collapses during periods of very rapid money growth (hyperinflations).

Problem 12: There are two countries, Home and Foreign. Assume that the monetary approach to the exchange rate accurately predicts the exchange rate. What is the effect on Home's exchange rate if Home's demand for liquidity constant, $\overline{L}$, were to decrease?

4 Money, Interest, and Prices in the Long Run: A General Model

ESSENTIAL CONCEPTS

In this section the monetary approach to the exchange rate is improved by using a more standard, and realistic, model of money demand. Rather than assume that money demand is a fixed, constant proportion of nominal output, it is assumed that the liquidity ratio is a decreasing function of the interest rate i. In this case the demand for real balances can be written

$$\frac{M^d}{P} = L(i) \times Y,$$

where $L(i)$ is the liquidity ratio (decreasing in i) and Y is real output. The assumption that demand for real balances falls with the interest rate is motivated by the following

logic: Because money does not pay interest, an increase in the interest rate on deposits increases the opportunity cost of holding money and so reduces demand for money. Put another way, individuals are more willing to put up with the inconvenience of having their money tied up in less liquid assets if the return to those assets is higher.

Now that we have the interest rate in the money demand equation, we need to have a model of what determines interest rates when prices are perfectly flexible. The first step is to notice that the uncovered interest parity condition links interest rate differentials to expected changes in the exchange rate which relative PPP links in turn to differences in inflation rates across countries. For two countries, Home and Foreign, this means

$$i_H - i_F = \pi^e_H - \pi^e_F$$

If the interest rate is higher in Home than in Foreign in the long run, then it must be because Home's expected rate of inflation (π^e_H) is higher than the expected rate of inflation in Foreign (π^e_F). This is known as the *Fisher effect*.

Up until now, we have spoken exclusively about nominal interest rates, which tell us the return of a deposit in terms of money. The *real interest rate* is the return of an investment in terms of how much goods and services we can buy, or the nominal interest rate minus the rate at which money is expected to lose value relative to goods and services: $r = i - \pi^e$. By rearranging the Fisher effect equation, we find that as long as uncovered interest parity and RPPP hold, then real interest rates must be the same in both countries and equal to the *world real interest rate.* Arbitrage in financial and goods markets causes *real interest parity.* For a country taking real interest rates as given (determined on world markets), the nominal rate of interest must be equal to the sum of the fixed world interest rate r and the expected local rate of inflation π^e. In the long run the rate of inflation is equal to the rate of money growth less the rate of output growth. This observation completes the model. Monetary policy simultaneously determines (1) price levels and inflation rate, (2) interest rates, and (3) exchange rates and depreciation rates.

Relative to the monetary approach described earlier in the chapter, the more general approach differs in two important respects: (1) Changes in monetary policy alter the nominal interest rate, and (2) changes in this interest rate have direct effects on price levels and exchange rates. Hence, a sudden change in money growth rates leads to a leap in prices and exchange rates that work through changes in money demand that in turn are induced by changes in interest rates.

KEY TERMS

Use the space below to record your notes on the following key terms.

Real money demand function _____

Fisher effect _____

Real interest rate _____

Real interest parity _____

World real interest rate _____

REVIEW QUESTIONS

Problem 13: In a long-run equilibrium, Country A has an interest rate of 10%, whereas Country B has an interest rate of 7%. Real output in each country is growing at 2% per year. The money growth rate in Country B is 6%.

13a. Which country has a higher inflation rate? _____

13b. Which country has a higher real interest rate? _____

13c. What is the inflation rate in Country B? _____

13d. What is the money growth rate in Country A? _____

Suppose that the central bank of Country B announces at time T that the country will henceforth have a money growth rate that will be 2% per year.

13e. What is the effect of the decrease in money growth on nominal interest rates in Country B at time T? _____

13f. What is the effect of the decrease in money growth rate on the liquidity ratio $L(i)$?

13g. What is the effect of the decrease in the money growth rate on the price level in Country B?

13h. What is the effect of the decrease in the money growth rate on Country B's exchange rate at time T? _____

13i. How does Country B's exchange rate change after time T? _____

Problem 14: (Multiple Choice) Which of the following could explain a sudden depreciation in a country's exchange rate?

a. a decrease in the expected rate of inflation
b. an increase in the real level of output
c. a decrease in the money supply
d. all of the above
e. none of the above

Problem 15: (Multiple Choice) Suppose that prices are perfectly flexible. Home is growing at a faster rate than Foreign. Money supplies in each country are fixed. Which of the following is predicted by the monetary approach?

a. Home's currency is depreciating relative to Foreign's currency.
b. The exchange rate is constant between the two countries.
c. Interest rates are lower in Home than in Foreign.
d. none of the above

Problem 16: Imagine a world with two countries, Home and Foreign. Home's currency is the dollar and Foreign's currency is known as the blot. Trade in goods and in assets is completely free. In a long-run equilibrium Home's money supply grows at 10%, and Foreign's money supply grows at 5%. Assume that *prices are perfectly flexible.*

16a. At what rate does Home's currency appreciate or depreciate? _____

16b. Is Home's interest rate higher or lower than Foreign's interest rate and by how much?

Suppose that at time *t,* Home's central bank announces that henceforth the money growth rate will be 5% instead of 10%.

16c. What happens to Home's interest rate at time *t?* _____

16d. What happens to Home's exchange rate at time *t?* _____

16e. After time *t,* what happens to the value of the dollar relative to the blot?

TIPS

In the long-run model presented in this section, a country with higher inflation also has a higher interest rate. This positive relationship between interest rates and inflation rates may seem backwards to students raised in low inflation countries. The important thing to remember is that this is a *long-run model.*

The more complicated money demand equation affects only some of the model's predictions. An increase in money growth rate will alter the rates of changes of prices and exchange rates in the same way, but the "jump" at time *T* happens only because of the adjustment in the interest rate.

5 Monetary Regimes and Exchange Rate Regimes

ESSENTIAL CONCEPTS

High and/or volatile inflation rates tend to destabilize an economy and retard its long-run growth. For this reason, countries frequently set an *inflation target* and structure their monetary policies to achieve this target. To meet long-run targets, governments often choose a *monetary regime* featuring a *nominal anchor.* The government chooses a nominal variable to target the rate of inflation in prices, another nominal variable.

Three potential nominal anchors are considered. The first nominal anchor is motivated by RPPP. Rearranging the basic RPPP equation yields

$$\pi_H = \frac{\Delta E_{H/F}}{E_{H/F}} + \pi_F$$

While Home's government has no control over Foreign's inflation rate, it can target the rate at which its currency appreciates or depreciates relative to Foreign's currency. In this case, the government imposes an *exchange rate target*. For instance, a government could fix its exchange rate vis-à-vis a low-inflation country so that Home's inflation becomes equal to Foreign's inflation rate. The second nominal anchor is the growth rate of the nominal money supply. The fundamental equation for the price level implies that the rate of inflation is

$$\pi_H = \mu_H - g_H,$$

where g_H is the rate of growth of real output and μ_H is the nominal anchor, the growth rate of the money supply. In this case the government announces a *money supply target.* Finally, the Fisher effect implies another nominal anchor, the nominal interest rate. Because the nominal interest rate is equal to the real interest rate plus inflation, and because the real interest rate is fixed from the perspective of the government, a government that controls nominal interest rates *(inflation plus interest rate target)* also controls inflation rates.

The key problem facing a government pursuing a monetary regime with a nominal anchor is that the government must be committed to its target. This means that a country with a nominal anchor sacrifices monetary policy autonomy in the long run. To be able to pursue such a policy (which often has negative, short-run political consequences), it is often necessary for *central bank independence* so that government officials cannot order the bank to change its policies.

KEY TERMS

Use the space below to record your notes on the following key terms.

Inflation target _____

Nominal anchors _____

Monetary regime _____

Exchange rate target

Money supply target

Inflation target plus interest rate policy

Central bank independence

REVIEW QUESTIONS

Problem 17: Suppose the economy of Home grows at a rate of 3% and inflation in Foreign runs at a rate of 5%. Home's inflation target is 2%.

17a. What exchange rate target would allow Home to meet its inflation target?

17b. What money supply target would allow Home to meet is inflation target?

17c. If foreign interest rates are 8%, what interest rate should the government target to meet its inflation target?

17d. If the growth rate of real output were to fall to 1%, how would the government have to adjust its nominal anchor policies? Consider all three nominal anchors.