

Suggested Solutions to Problem Set 2

1. In the first case we have $\pi_{US} - \pi_{JAP} = 0.05$. This implies that, to keep the exchange rate at the PPP level, we should expect a 5% depreciation of the dollar. But we actually see that $(E_t - E_{t-1}) / E_{t-1} = -1/13 = -0.076$, so there is an appreciation of the dollar and the yen is undervalued.

In the second case, $\pi_{US} - \pi_{JAP} = -0.05$, so we expect a 5% appreciation of the dollar to keep it at the PPP level. But, it appreciates by more, so the yen is still undervalued.

We can also solve this by using absolute PPP rather than relative PPP, which after all is an approximation. On January 1, absolute PPP states that $E = P_{US}/P_J = 1/120$ \$/Y. By the end of year, with 10% inflation in the US and 5% inflation in Japan, then absolute PPP predicts that $E = [(1.1) P_{US}]/[(1.05)P_J] = 1.048(1/120$ \$/Y) $> 1/130$ \$/Y. So if the PPP value exceeds the actual exchange rate, then yen is too cheap in dollars, that is, it is undervalued according to PPP. If the inflation rates were reversed, then $[(1.05) P_{US}]/[(1.1)P_J] = .955*(1/120$ \$/Y) which is still greater than $1/130$ \$/Y. That is, yen is still too cheap, and hence, undervalued with respect to the dollar.

2. The initial effect of a reduction in the money supply in a model with sticky prices is an increase in the nominal interest rate and an appreciation of the nominal exchange rate. The real interest rate, which equals the nominal interest rate minus expected inflation, rises by more than the nominal interest rate since the reduction in the money supply causes not only a rise in nominal interest rate but also generates deflation expectations during the transition to the new equilibrium.

Because prices are sticky (fixed in the short run), the nominal appreciation of the currency translates into a real exchange rate appreciation immediately after the contraction in money supply. During the transition, as prices decrease, the real exchange rate depreciates to the new equilibrium (recall $\% \Delta q = \% \Delta E + \pi^* - \pi$), where its value is the same as in the original state since real exchange is unchanged in the long run by a change in the money supply (money is neutral – it cannot affect real variables in the long run).

This satisfies the real interest parity relationship which states that the difference between the domestic and the foreign real interest rate equals the expected rate of depreciation of the domestic real exchange rate:

$$r_{US}^e - r_E^e = \frac{q_{\$/\epsilon}^e - q_{\$/\epsilon}}{q_{\$/\epsilon}}$$

In our case, the initial effect is an increase in the real interest rate in the domestic economy coupled with an immediate real appreciation of the domestic real exchange rate. These

movements satisfy the equation above, as the real exchange rate, q , falls. As prices decrease and the real money supply slowly comes back to its initial level, expected inflation vanishes and nominal and real interest rates (which are the same when expected inflation is zero) return to their initial level as well. As real interest rates slowly fall in the US, the real exchange rate should depreciate to keep the real interest parity condition holding. This maintains the equality between both sides of the equation.

A last important point is that real exchange rate expectations, which we are assuming to be equal the long run exchange rate, are not affected by the changes in money supply. The reason is that the price level and the nominal exchange rate will have changed proportionately to the change in money supply.

3. Different assumptions about the speed of price level adjustment lead to contrasting predictions about how exchange and interest rates interact. One answer to this question involves the comparison of a sticky price with a flexible price model.

The first case can be thought of as a model with sticky prices (Ch 14). A reduction in the money supply causes the nominal interest rate to rise (since prices can't adjust) and, by the interest parity relationship, the nominal exchange rate to appreciate. The real interest rate, which equals the nominal interest rate minus expected inflation, increases both because of an increase in the nominal interest rate and because there is expected deflation.

The second case can be analyzed in a model with flexible prices, for example, the monetary approach. In the case of a rise in monetary supply *growth rate*, an interest rate increase is associated with higher expected inflation and a currency that will be weaker on all future rates. The result is an immediate currency depreciation. (The increase in interest rate reduces money demand, such that there is potential excess supply. This leads to a jump in the level of prices. An increase in prices implies an increase in the exchange rate by PPP.)

In other words, when a rise in the nominal interest rate is due to a rise in the real interest rate, then investors will bid up the currency, causing an appreciation. Why? Because the increased real interest rate means that productive investment opportunities are yielding higher returns. When a rise in the nominal interest rate is due to a rise in expected inflation, the future purchasing power of the currency is being eroded. Investors then would be more reluctant to hold a currency with declining purchasing power, leading them to sell and short the currency, causing a depreciation.

4. The decrease in relative productivity of the US economy means less output being produced in the US. However, because output and, hence, income in the other country do not change, the demand by foreigners for domestic goods is still the same. This means that there will be an excess relative demand for American output at the previous real exchange rates. To eliminate this excess demand, an increase in the relative price of American products has to occur. This price change is a real appreciation of the dollar against the foreign currency.

To learn what happens to the price level, we also have to think about the impact of a decrease in US productivity on the aggregate real money demand. As output in the US falls due to the decrease in productivity, aggregate real money demand also falls, as people have less goods and services to buy with their money. This pushes the price level up in order to make the supply of real money balances decline and equilibrate the money market.

Because the price level in the US goes up and the real exchange rate appreciates, the net effect on nominal exchange rates is ambiguous.

In the case of a permanent productivity slowdown, there is a continued expected appreciation of the real exchange rate of the dollar against the other currency and a continuous increase in prices in the US. The change of the nominal exchange rate is still ambiguous.

5. Suppose an investor purchases Treasury securities with a maturity of only three months. Then because of the short horizon of the debt instrument, the investor does not need to worry about the erosion of the value of the dollar, i.e., inflation, when receiving interest payments and eventually the principal from the federal government. There is not much opportunity for inflation to affect the investment decision because \$1 will buy about as much today as three months from now.

If however, the investor buys a 10-year Treasury security, then it is highly unlikely that \$1 today will retain as much purchasing power as 10 years from now. Consequently, our investor, like all others, would demand a higher rate of return in the market to compensate for this. This is the main reason why long-term interest rates on government debt are higher than short-term interest rates - all over the world. In terms of the Fisher effect, the inflation that investors *expect* to observe leads directly to their demands for a higher rate of return. You could say that the excess returns that 10-year government bonds deliver over 3-month bonds represent an “inflationary premium” from the horizon spanning three months from now till 10 years from now. All else equal, the larger the excess returns, the greater the level of expected inflation over the horizon by investors.

This pattern of excess returns does not by itself reveal anything about real interest rates. Real interest rates are determined by the pace of economic activity, the money supply, productive investment opportunities, and general economic prospects.

6. The real interest parity condition states that differences in expected real interest rates between the US and Europe are explained by expected movements in the dollar/euro real exchange rate. Algebraically, the condition is (see equation 15-10 in the book):

$$r_{US}^e - r_E^e = \frac{q_{\$/\epsilon}^e - q_{\$/\epsilon}}{q_{\$/\epsilon}} \quad (1)$$

But changes in the real exchange rate are deviations from relative PPP. That is, the expected percentage change in $q_{\$/\epsilon}$ is the expected percentage change in the nominal

dollar/euro exchange rate less the international difference in expected inflation rates between the United States and Europe (see page 422 in the book). Algebraically, we have:

$$\frac{q_{\$/\epsilon}^e - q_{\$/\epsilon}}{q_{\$/\epsilon}} = \frac{E_{\$/\epsilon}^e - E_{\$/\epsilon}}{E_{\$/\epsilon}} - (\pi_{US}^e - \pi_E^e) \quad (2)$$

From equation (2), we see that the real exchange rate is expected to change whenever deviations from relative PPP are large. From equation (1), we see that real interest rate differentials occur when there are expected changes in real exchange rate.

Because relative PPP holds more closely in the long-run than in the short-run, expected changes in the real exchange rate will tend to be smaller in the long-run than in the short-run, and so will real interest rate differentials.

7. It should be increasingly clear to you that over the long run, price levels are flexible and have completed their adjustments to equilibrium levels. Taking the hint from the problem set about how firms engaged in international trade may react to large and persistent cross-border price differentials, we can see why relative PPP holds more closely in the long run. Think of two economic regions, the US and Europe. Recall that relative PPP says that depreciation from time t to $t + 1$ is given by

$$E_{t+1} - E_t / E_t = \pi_{US,t} - \pi_{E,t}$$

Suppose in the short run, European inflation exceeds US inflation and that relative PPP does not hold. In the case of this inflation differential, then trading firms will face an incentive to substitute, where possible, US goods for European goods in their purchases on both sides of the Atlantic. If many firms over time behave in this way, then, all else equal, this should drive down the euro and drive up the dollar. This means that the dollar price of the euro will fall over time, leading the left side to become smaller and more negative. This brings the left side of the expression more into line with $\pi_{US,t} - \pi_{E,t}$. The same reasoning follows symmetrically if $\pi_{US,t} > \pi_{E,t}$. Thus, it is conceivable that purchases by international trading firms can lead to more of an alignment between inflation differentials and currency depreciation in the long run.

8. Recall that the DD curve comes from setting aggregate demand equal to aggregate income, Y . We then solve for Y as a function of the real exchange rate.

$$Y = C + I + G + EX - IM$$

$$Y = 6000 + 0.8(Y - 0.25Y) + 1800 + 1600 + 1000 + 450q - 0.1(Y - 0.25Y)$$

$$Y = 10400 + 450q + 0.525Y$$

$$Y = 21894.7 + 947.4q$$

Substitute $q=2$ to get:

$$Y = 23789.5$$