Chapter 8

Purchasing Power Parity and Real Exchange Rates

PROBLEMS

1. If the consumer price index for the United States rises from 350 at the end of a year to 365 at the end of the next year, how much inflation was there in the United States during that year?

   Answer: Price indexes are ratios of the price level in a given year to the price level in a base year. Because the base year is the same in the two price indexes under consideration, we can take the ratio of the two price indexes and find the rate of inflation over that year. The ratio is 365/350 = 1.0429 or an inflation rate of 4.29%.

2. As a wheat futures trader, you observe the following futures prices for the purchase and sale of wheat in 3 months: $3.00 per bushel in Chicago and ¥320 per bushel in Tokyo. Delivery on the contracts is in Chicago and Tokyo, respectively. If the 3-month forward exchange rate is ¥102/$, what is the magnitude of the transaction cost necessary to make this situation not represent an unexploited profit opportunity?

   Answer: The forward dollar price of wheat in Tokyo is the ratio of the futures price, ¥320 per bushel, to the forward exchange rate, ¥102/$. This ratio is ¥320 per bushel / (¥102/$) = $3.14 per bushel. Since we can buy wheat for delivery in Chicago at $3 per bushel, if transaction costs of shipping wheat from Chicago to Tokyo are smaller than $0.14 per bushel, we could make an arbitrage profit. Thus, the minimum magnitude of the transaction cost necessary to make this situation not represent an unexploited profit opportunity is $0.14 per bushel.

3. Suppose that the price level in Canada is CAD16,600, the price level in France is EUR11,750, and the spot exchange rate is CAD1.35/EUR.

   a. What is the internal purchasing power of the Canadian dollar?

       Answer: It is probably best to calculate the purchasing power of CAD10,000. If we divide this amount by the price level in Canada of CAD16,600, we find

       \[
       \frac{CAD10,000}{CAD16,600} = 0.6024 \text{ consumption bundles}
       \]

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b. What is the internal purchasing power of the euro in France?

*Answer:* Performing a similar calculation to the one in part a., we find
\[
\frac{\text{EUR10,000}}{\text{EUR11,750} / \text{consumption bundle}} = 0.8511 \text{ consumption bundles}
\]

c. What is the implied exchange rate of CAD/EUR that satisfies absolute PPP?

*Answer:* The implied PPP exchange rate equates the internal purchasing power of the CAD to its external purchasing power. This implies that the PPP exchange rate is the ratio of the Canadian price level in Canadian dollars to the French price level in euros:
\[
S_{\text{PPP}}^{\text{(CAD/EUR)}} = \frac{\text{CAD16,600}}{\text{EUR11,750}} = \frac{\text{CAD1.4128}}{\text{EUR}}
\]
d. Is the euro overvalued or undervalued relative to the Canadian dollar?

*Answer:* Because the actual exchange rate of CAD1.35/EUR is less than the PPP exchange rate, the euro is undervalued on the foreign exchange market because it would have to strengthen to move from CAD1.35/EUR to CAD1.4128/EUR.
e. What amount of appreciation or depreciation of the euro would be required to return the actual exchange rate to its PPP value?

*Answer:* The exchange rate moves from the actual value of CAD1.35/EUR to the PPP value of CAD1.4128/EUR for a percentage change of \( \frac{1.4128}{1.35} - 1 = 0.0466 \). This is a 4.66% appreciation of the euro versus the Canadian dollar.

4. Suppose that the rate of inflation in Japan is 2% in 2011. If the rate of inflation in Germany is 5% during 2011, by how much would the yen strengthen relative to the euro if relative PPP is satisfied during 2011?

*Answer:* The approximately correct answer is that the yen should strengthen by the differential in the rates of inflation or 5% - 2% = 3%:. The exact answer is found from equation (8.4) of the text, which incorporates a denominator correction, and we get
\[
s\left(t+1, \frac{\text{DC}}{\text{FC}} \right) = \frac{\pi(t+1,\text{DC}) - \pi(t+1,\text{FC})}{1 + \pi(t+1,\text{FC})}
\]
Since we are concerned about the strengthening of the yen, let the yen be the foreign currency (FC), and let the euro be the domestic currency (DC). Then, the relative PPP formula states that the rate of appreciation of the yen is
\[
\frac{0.05 - 0.02}{1 + 0.02} = 0.0294 \text{ or } 2.94\%.
\]
5. **One of your colleagues at Deutsche Bank thinks that the dollar is severely undervalued relative to the yen. He has calculated that the PPP exchange rate is ¥140/$, whereas the current exchange rate is ¥105/$. Because interest rates are 3% p.a. lower in Japan than in the United States, he thinks that this is a good time to speculate by borrowing yen and lending dollars. What do you think?**

*Answer:* Deviations from PPP are a weak reason to engage in speculation. While the data in the problem indicate that the dollar is 33.33% undervalued, because that is the amount of dollar appreciation that would be required to take the actual exchange rate from ¥105/$ to the PPP prediction of ¥140/$, we know that the return to PPP will not be an overnight event.

The empirical analysis of the issue indicates that the half-life of PPP deviations is around 5 years. Thus, you might expect that the dollar will appreciate by 16.67% over the next 5 years. But, uncovered interest rate parity actually suggests that the yen will appreciate in the short run, because the yen interest rate is 3% less than the dollar interest rate. Notice, though, that the correction back toward PPP can take place with differential rates of inflation in the two countries. If Japanese rate of inflation falls below the U.S. rate of inflation, the PPP prediction will begin falling toward the actual exchange rate. Finally, although the dollar is 33.33% undervalued, there is no guarantee that the undervaluation will begin to be corrected now. It may, in fact, get worse. If the undervaluation of the dollar goes to 50% over the next 2 years, you would lose 16.67% in the foreign exchange market which would not be compensated by the approximate 6% that you would earn by borrowing yen and lending dollars. Finally, do not forget that your boss in proprietary trading at Deutsche Bank would not be happy with such a situation.

6. **Suppose that you are trying to decide between two job offers. One consulting firm offers you $150,000 per year to work out of its New York office. A second consulting firm wants you to work out of its London office and offers you £100,000 per year. The current exchange rate is $1.65/£. Which offer should you take, and why? Assume that the PPP exchange rate is $1.40/£ and that you are indifferent between working in the two cities if the purchasing power of your salary is the same.**

*Answer:* We know from the extensive discussion in Question 8 that we should use the PPP exchange rate to compare the pound salary to the dollar salary. If we do so, we find $1.40/£×£100,000 = $140,000. This is less than the $150,000 that you are being offered in New York. The fact that the dollar is undervalued on the foreign exchange markets makes the perceived salary of $1.65/£×£100,000 = $165,000, calculated with the spot exchange rate, seem more attractive. But, the key point is that to achieve $165,000 of spending in the United States, you would have to work in London and consume in New York.

7. **Suppose that in 2011, the Japanese rate of inflation is 2%, and the German rate of inflation is 5%. If the euro weakens relative to the yen by 10% during 2011, what would be the magnitude of the real depreciation of the euro relative to the yen?**
Answer: The real exchange rate is
\[ RS(t, ¥/€) = \frac{S(t, ¥/€) \times P(t, €)}{P(t, ¥)} \]

We also know that a real depreciation of the euro means that this real exchange rate decreases. The new real exchange rate will be the old real exchange rate with each term multiplied by one plus the respective percentage rate of change. Thus, one plus the percentage rate of change of the real exchange rate is
\[
1 + rs(t, ¥/€) = \frac{[1 + s(t, ¥/€)] \times [1 + \pi(t, ¥)]}{[1 + \pi(t, €)]} = \frac{[1 - 0.10] \times [1 + 0.05]}{[1 + 0.02]} = 0.9265
\]

So, we conclude that the real depreciation of the euro is 7.35%.

8. Pick a particular brand of appliance, like a Bosch dishwasher with certain features, and use the internet to compare its prices across countries. Be sure to have exactly the same style of appliance in each country. How different are the prices when expressed in a common currency?

We found the Bosch Ascenta series Model SHX6AP05UC on sale at Sears-Canada for CAD1,149.99. The exact same model in the United States was available from Amazon through AJ Madison for $728.10. The exchange rate on June 4, 2011 was CAD0.9772/USD. Thus, a Canadian could purchase the U.S. dishwasher for CAD0.9772/USD x $728.10 = CAD711.50. Buying the dishwasher from Sears-Canada would have cost 61.6% more.