3

Exchange Rates I: The Monetary Approach in the Long Run

1. Suppose that two countries, Vietnam and Côte d'Ivoire, produce coffee. The currency unit used in Vietnam is the dong (VND). Côte d'Ivoire is a member of Communaute Financiere Africaine (CFA), a currency union of West African countries that use the CFA franc (XOF). In Vietnam, coffee sells for 5,000 dong (VND) per pound of coffee. The exchange rate is 30 VND per 1 CFA franc, $E_{VND/XOF} = 30$.

a. If LOOP holds, what is the price of coffee in Côte d'Ivoire, measured in CFA francs?

Answer: According to LOOP, the price of coffee should be the same in both markets:

$P_C^{coffee} = P_V^{coffee}/E_{VND/XOF} = 5{,}000/30 = 166.7$

b. Assume the price of coffee in Côte d'Ivoire is actually 160 CFA francs per pound of coffee. Calculate the relative price of coffee in Côte d'Ivoire versus Vietnam. Where will coffee traders buy coffee? Where will they sell coffee? How will these transactions affect the price of coffee in Vietnam? In Côte d'Ivoire?

Answer: The relative price of coffee in these two markets is:

$q_{C/V}^{coffee} = (E_{\frac{VND}{XOF}} P_C^{coffee})/P_{VND}^{coffee} = (30 \times 160)/5000 = 0.96 < 1$

Traders will buy coffee in Côte d'Ivoire because it is cheaper there. Traders will sell coffee in Vietnam. This will lead to an increase in the price of coffee in Côte d'Ivoire and a decrease in the price in Vietnam.

2. Consider each of the following goods and services. For each, identify whether LOOP will hold, and state whether the relative price, $q_{F/US}^g$, is greater than, less than, or equal to 1. Explain your answer in terms of the assumptions we make when using LOOP.

a. Rice traded freely in the United States and Canada

Answer: $q_{F/US}^g = 1$

LOOP should hold in this case because its assumptions are met.

b. Sugar traded in the United States and Mexico; the U.S. government imposes a quota on sugar imports into the United States

Answer: $q_{F/US}^g < 1$

If the U.S. government imposes a quota on sugar, this will lead to an increase in the relative price of sugar in the United States through restricting competition.

c. The McDonald's Big Mac sold in the United States and Japan

Answer: $q^g_{F/US} \neq 1$

The McDonald's Big Mac sold in the United States may sell for a different price compared with Japan because there are nontradable elements in the production of the Big Mac, such as labor and rent.

d. Haircuts in the United States and the United Kingdom

Answer: $q^g_{F/US} \neq 1$

Because haircuts cannot be traded across the United States and the United Kingdom, consumers will not arbitrage away differences in the prices of haircuts in these two regions.

3. Use the table that follows to answer this question. Suppose the cost of the market basket in the United States is P_{US} = \$190. Check to see whether PPP holds for each of the countries listed, and determine whether we should expect a real appreciation or real depreciation for each country (relative to the United States) in the long run. For the answer, create a table similar to the one shown and fill in the blank cells. (Hint: Use a spreadsheet application such as Excel.)

Country (currency measured in FX units)	Per \$, $E_{FX/\$}$	Price of Market Basket (in FX)	Price of U.S. Basket in FX (P_{US} times $E_{FX/\$}$)	Real Exchange Rate, q	Does PPP Hold? (yes/no)	Is FX Currency Overvalued or Undervalued?	Is FX Currency Expected to Have Real Appreciation or Depreciation?
Brazil (real)	2.1893	520					
Cyprus (Cy£)	0.45	75					
India (rupee)	46.6672	12,000					
Mexico (peso)	11.0131	1,800					
South Africa (rand)	6.9294	800					
Zimbabwe (ZW\$)	101,347	4,000,000					

Answer: See the following table. Note that the United States is treated as the foreign country relative to each "home" country listed in the table.

Country (currency measured in FX units)	Per \$, $E_{FX/\$}$	Price of U.S. Basket in FX (P_{US} times $E_{FX/\$}$)	Price of Market Basket (in FX)	Real Exchange Rate, $q_{US/F}$	Does PPP Hold? (yes/no)	Is FX Currency Overvalued or Undervalued?	Is FX Currency Expected to Have Real Appreciation or Depreciation?
Brazil (real)	2.1893	520	416	0.80	No	Real overvalued	Real depreciation
Cyprus (Cy£)	0.45	75	86	1.14	No	Cy£ undervalued	Real appreciation
India (rupee)	46.6672	12,000	8,867	0.74	No	Rupee overvalued	Real depreciation
Mexico (peso)	11.0131	1,800	2,092	1.16	No	Peso undervalued	Real appreciation
South Africa (rand)	6.9294	800	1,317	1.65	No	Rand undervalued	Real appreciation
Zimbabwe (ZW\$)	101,347	4,000,000	19,255,930	4.81	No	ZW\$ undervalued	Real appreciation

In the previous table:

- PPP holds only when the real exchange rate $q_{US/F} = 1$. This implies that the baskets in the home country and the United States have the same price in a common currency.
- If $q_{US/F} > 1$, then the basket in the United States is more expensive than the basket in the home country. This implies the U.S. dollar is overvalued and the home currency is undervalued. According to PPP, the home country will experience a real appreciation (Cyprus, Mexico, South Africa, and Zimbabwe).
- If $q_{US/F} < 1$, then the basket in the home country is more expensive than the basket in the United States. This implies the U.S. dollar is undervalued and the home currency is overvalued. According to PPP, the home country will experience a real depreciation (Brazil and India).

4. Table 3-1 in the text shows the percentage undervaluation or overvaluation in the Big Mac, based on exchange rates in February 2007. Suppose PPP holds in the long run so that these deviations would be expected to disappear. Suppose the local currency prices of the Big Mac remained unchanged. Exchange rates in June 2007 were as follows:

Country	Per U.S. $
Australia (A$)	1.20
Brazil (real)	2.02
Canada (C$)	1.12
Denmark (krone)	5.49
Eurozone (euro)	0.736
Japan (yen)	118.47
Mexico (peso)	10.97
Sweden (krona)	6.77

Based on these data and Table 3-1, for which countries were the PPP-based exchange rate predictions derived from the Big Mac Index correct? For which were they incorrect? How might you explain the failure of the Big Mac Index to correctly predict the change in the nominal exchange rate between February and June 2007?

Answer: First, we need to identify which countries experienced a real appreciation and which experienced a real depreciation between January and June 2007. Then we can compare the actual change in the exchange rate to the one predicted by PPP:

Country (currency measured in FX units)	Jan. 2007 Per $, $E_{FX/\$}$	Was FX Currency Overvalued or Undervalued?	June 2007 Per $, $E_{FX/\$}$	Actual appreciation (−)/ depreciation (+)	Did FX Change as Predicted by PPP?
Australia (A$)	1.28	Undervalued (−17%)	1.20	−6.25	Yes
Brazil (real)	2.13	Undervalued (−6%)	2.02	−5.16	Yes
Canada (C$)	1.18	Undervalued (−4%)	1.12	−5.08	Yes
Denmark (krone)	5.75	Overvalued (+50%)	5.49	4.52	No
Euro area (euro)	0.77	Overvalued (+19%)	0.736	−4.42	No
Japan (yen)	121	Undervalued (−12%)	118.47	−2.09	Yes
Mexico (peso)	10.9	Undervalued (−17%)	10.97	+0.64	No
Sweden (krona)	6.97	Overvalued (+43%)	6.77	−2.87	No

We can see from the table that during this time, PPP correctly predicted exchange rate movements for only half of these countries. The Big Max index may fail to predict exchange rate movements because there are nontradable inputs used in the production of Big Macs, such as labor and rent.

5. You are given the following information. The current dollar-pound exchange rate is \$2 per pound. A U.S. basket that costs \$100 would cost \$120 in the United Kingdom. For the next year, the Fed is predicted to keep U.S. inflation at 2% and the Bank of England is predicted to keep U.K. inflation at 3%. The speed of convergence to absolute PPP is 15% per year.

a. What is the expected U.S. minus U.K. inflation differential for the coming year?

Answer: The inflation differential is equal to −1% (= 2% − 3%)

b. What is the current U.S. real exchange rate, $q_{UK/US}$, with the United Kingdom?

Answer: The current real exchange rate is:

$q_{UK/US} = (E_{\$/£}P_{UK})/P_{US} = \$120/\$100 = 1.2$

c. How much is the dollar overvalued/undervalued?

Answer: The British pound is undervalued by 20% and the U.S. dollar is overvalued by 20% (= 1.2 − 1 / 1)

d. What do you predict the U.S. real exchange rate with the United Kingdom will be in one year's time?

Answer: We can use the information on convergence to compute the implied change in the U.S. real exchange rate. We know the speed of convergence to absolute PPP is 15%; that is, each year the exchange rate will adjust by 15% of what is needed to achieve the real exchange rate equal to 1 (assuming prices in each country remain unchanged). Today, the real exchange rate is equal to 1.2, implying a 0.2 decrease is needed to satisfy absolute PPP. Over the next year, 15% of this adjustment will occur, so the real exchange rate will decrease by 0.03. Therefore, after one year, the U.S. real exchange rate, $q_{UK/US}$, will equal 1.17.

e. What is the expected rate of real depreciation for the United States (versus the United Kingdom)?

Answer: From (d), the real exchange rate will decrease by 0.03. Therefore, the rate of real depreciation is equal to −2.5% (=−0.03 / 1.20). This implies a real appreciation in the United States relative to the United Kingdom.

f. What is the expected rate of nominal depreciation for the United States (versus the United Kingdom)?

Answer: The expected rate of nominal depreciation can be calculated based on the inflation differential plus the expected real depreciation from (e). In this case, the inflation differential is −1% and the expected real appreciation is −2.5%, so the expected nominal depreciation is −3.5%. That is, we expect a 3.5% appreciation in the U.S. dollar relative to the British pound.

g. What do you predict will be the dollar price of one pound a year from now?

Answer: The current nominal exchange rate is \$2 per pound and we expect a 3.5% appreciation in the dollar (from [f]). Therefore, the expected exchange rate in one year is equal to \$1.93 (= \$2 × (1−0.035).

6. Describe how each of the following factors might explain why PPP is a better guide for exchange rate movements in the long run versus the short run: (1) transactions costs, (2) nontraded goods, (3) imperfect competition, and (4) price stickiness. As markets become increasingly integrated, do you suspect PPP will become a more useful guide in the future? Why or why not?

Answer: Each of these factors hinders trade more in the short run than in the long run. Specifically, each is a reason to expect that the condition of frictionless trade is not satisfied. For this reason, PPP is more likely to hold in the long run than in the short run.

(1) Transactions costs. Over longer periods of time, producers generally face decreasing average costs (as fixed costs become variable costs in the long run). Therefore, the average cost associated with a given transaction should decrease.

(2) Nontraded goods. Over short periods of time, it may be difficult to trade some goods where there isn't an existing international market. For example, commodities are heavily traded across countries in designated locations. However, differentiated goods are traded less frequently. Over longer periods of time, businesses may find it profitable to trade these types of goods through engaging in infrequent, high-volume sales.

(3) Imperfect competition. Imperfect competition implies that producers of differentiated products have the ability to influence prices. In the short run, these firms may either collude to prevent price adjustment, or they may engage in dramatic changes in price (e.g., price wars) designed to capture market share. These collusion agreements and price wars generally are not long-lasting.

(4) Price stickiness. In the short run, prices may be inflexible for several reasons. Firms may face menu costs, or fear that price adjustments will adversely affect market share. Firms also may have wage contracts that are set in nominal terms. However, in the long run, these costs associated with changing prices dissipate, either because menu costs decrease over time or because firms and workers renegotiate wage contracts in the long run.

As markets become more integrated, PPP should become a better predictor of exchange rate movements. For PPP to hold, we have to assume frictionless trade. The more integrated markets are, the closer they are to achieving frictionless trade.

7. Consider two countries, Japan and Korea. In 1996, Japan experienced relatively slow output growth (1%), whereas Korea had relatively robust output growth (6%). Suppose the Bank of Japan allowed the money supply to grow by 2% each year, whereas the Bank of Korea chose to maintain relatively high money growth of 12% per year. For the following questions, use the simple monetary model (where L is constant). You will find it easiest to treat Korea as the home country and Japan as the foreign country.

a. What is the inflation rate in Korea? In Japan?

Answer:

$\pi_K = \mu_K - g_K \rightarrow \pi_K = 12\% - 6\% = 6\%$

$\pi_J = \mu_J - g_J \rightarrow \pi_J = 2\% - 1\% = 1\%$

b. What is the expected rate of depreciation in the Korean won relative to the Japanese yen?

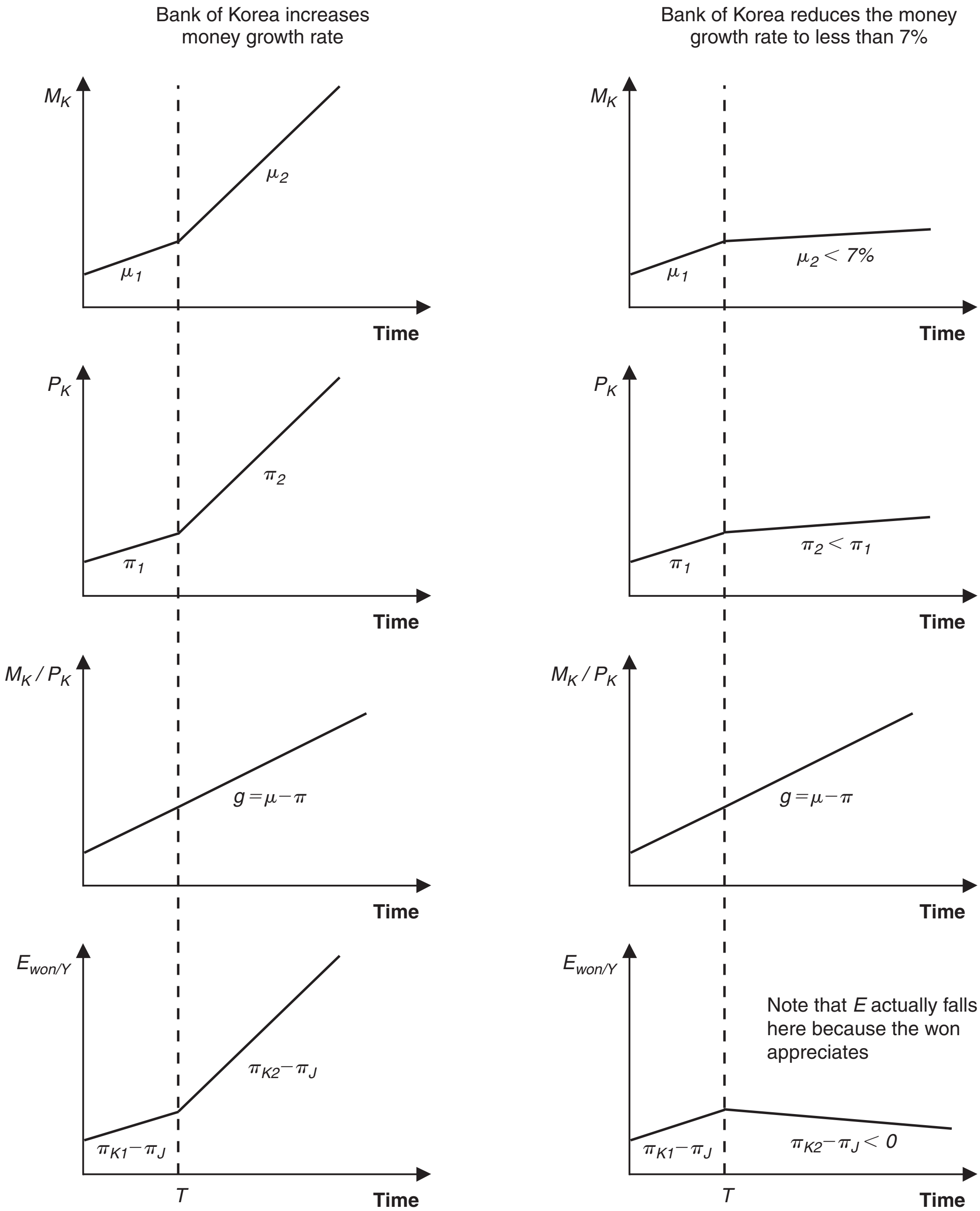
Answer: $\%\Delta E^e_{won/¥} = (\pi_K - \pi_J) = 6\% - 1\% = 5\%$. You can check this by using the following expression from the monetary model: $\%\Delta E^e_{won/¥} = (\mu_K - g_K) - (\mu_J - g_J)$

c. Suppose the Bank of Korea increases the money growth rate from 12% to 15%. If nothing in Japan changes, what is the new inflation rate in Korea?

Answer: $\pi^{new}_K = \mu_K - g_K = 15\% - 6\% = 9\%$.

d. Using time series diagrams, illustrate how this increase in the money growth rate affects the money supply, M_K; Korea's interest rate; prices, P_K; real money supply; and $E_{won/¥}$ over time. (Plot each variable on the vertical axis and time on the horizontal axis.)

Answer: See the following diagrams.



e. Suppose the Bank of Korea wants to maintain an exchange rate peg with the Japanese yen. What money growth rate would the Bank of Korea have to choose to keep the value of the won fixed relative to the yen?

Answer: To keep the exchange rate constant, the Bank of Korea must lower its money growth rate. We can figure out exactly which money growth rate will keep the exchange rate fixed by using the fundamental equation for the simple monetary model (used above in [b]):

$\%\Delta E^e_{won/¥} = (\mu_K - g_K) - (\mu_J - g_J)$

The objective is to set $\%\Delta E^e_{won/¥} = 0$:

$(\mu_K^* - g_K) = (\mu_J - g_J)$

Plug in the values given in the question and solve for μ_K^*:

$(\mu_K^* - 6\%) = (2\% - 1\%)$

$\mu_K^* = 7\%$

Therefore, if the Bank of Korea sets its money growth rate to 7%, its exchange rate with Japan will remain unchanged.

f. Suppose the Bank of Korea sought to implement policy that would cause the Korean won to appreciate relative to the Japanese yen. What ranges of the money growth rate (assuming positive values) would allow the Bank of Korea to achieve this objective?

Answer: Using the same reasoning as previously, the objective is for the won to appreciate: $\%\Delta E^e_{won/¥} < 0$

This can be achieved if the Bank of Korea allows the money supply to grow by less than 7% each year. The diagrams on the following page show how this would affect the variables in the model over time.

8. This question uses the general monetary model, in which L is no longer assumed constant and money demand is inversely related to the nominal interest rate. Consider the same scenario described in the beginning of the previous question. In addition, the bank deposits in Japan pay 3% interest; $i_{¥} = 3\%$.

a. Calculate the interest rate paid on Korean deposits.

Answer:

Fisher effect: $(i_{won} - i_{¥}) = (\pi_K - \pi_J)$

Solve for $i_{won} = (6\% - 1\%) + 3\% = 8\%$

b. Using the definition of the real interest rate (nominal interest rate adjusted for inflation), show that the real interest rate in Korea is equal to the real interest rate in Japan. (Note that the inflation rates you calculated in the previous question will apply here.)

Answer:

$r_{¥} = i_{¥} - \pi_J = 2\% - 1\% = 1\%$

$r_{won} = i_{won} - \pi_K = 8\% - 6\% = 2\%$

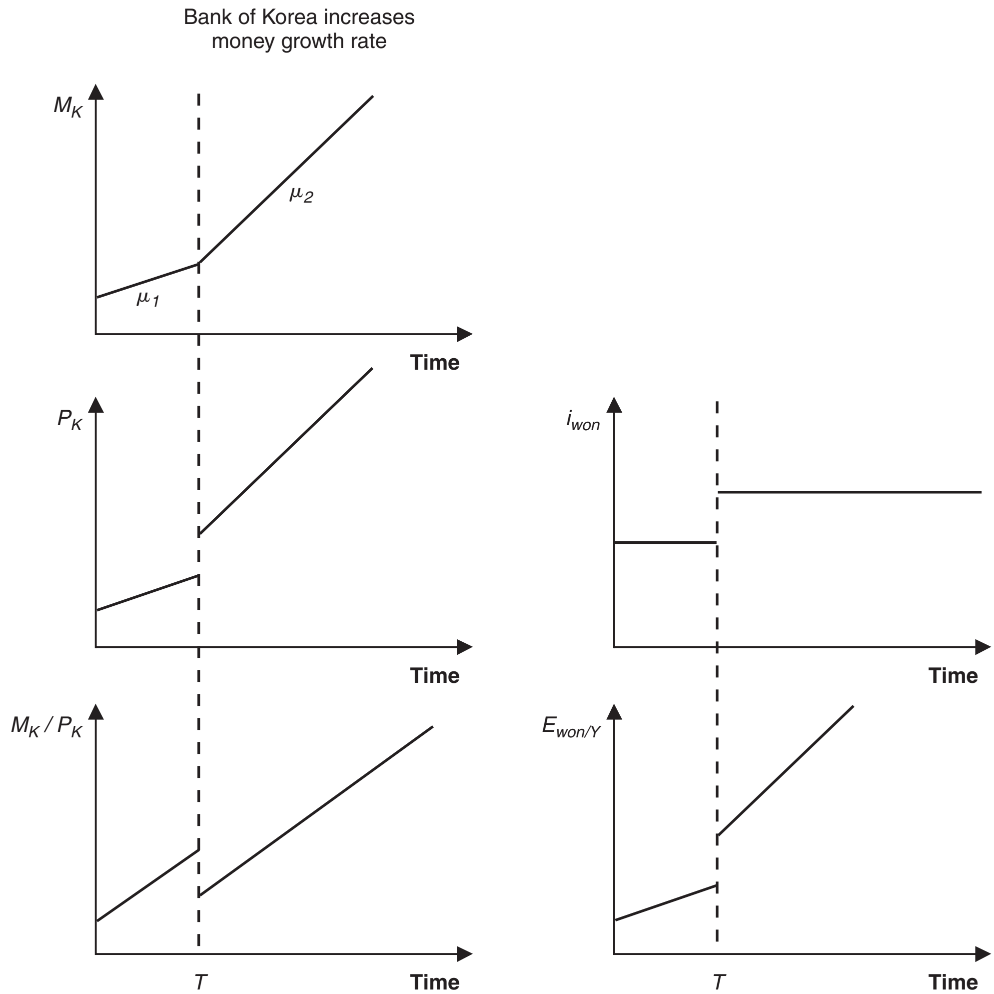
c. Suppose the Bank of Korea increases the money growth rate from 12% to 15% and the inflation rate rises proportionately (one for one) with this increase. If the nominal interest rate in Japan remains unchanged, what happens to the interest rate paid on Korean deposits?

Answer: We know that the inflation rate in Korea will increase to 9%. We also know that the real interest rate will remain unchanged. Therefore:

$i_{won} = r_{won} + \pi_K = 1\% + 9\% = 10\%$

d. Using time series diagrams, illustrate how this increase in the money growth rate affects the money supply, M_K; Korea's interest rate; prices, P_K; real money supply; and $E_{won/¥}$ over time. (Plot each variable on the vertical axis and time on the horizontal axis.)

Answer: See the following diagrams.



9. Both advanced economies and developing countries have experienced a decrease in inflation since the 1980s (see Table 3-2 in the text). This question considers how the choice of policy regime has influenced this global disinflation. Use the monetary model to answer this question.

a. The Swiss Central Bank currently targets its money growth rate to achieve policy objectives. Suppose Switzerland has output growth of 3% and money growth of 8% each year. What is Switzerland's inflation rate in this case? Describe how the Swiss Central Bank could achieve an inflation rate of 2.5% in the long run through the use of a nominal anchor.

Answer: From the monetary approach: $\pi_S = \mu_S - g_S = 8\% - 3\% = 5\%$. If the Swiss Central Bank wants to achieve an inflation target of 2%, it would need to reduce its money growth rate to 5%: $\mu^*_S = \pi_S + g_S = 2\% + 3\% = 5\%$.

b. Like the Federal Reserve, the Reserve Bank of New Zealand uses an interest rate target. Suppose the Reserve Bank of New Zealand maintains a 6% interest rate target and the world *real* interest rate is 1.5%. What is the New Zealand inflation rate in the long run? In 1997, New Zealand adopted a policy agreement that required the bank to maintain an inflation rate no higher than 2.5%. What interest rate targets would achieve this objective?

Answer: From the Fisher effect: $\pi_{NZ} = i_{NZ\$} - r^* = 6\% - 1.5\% = 4.5\%$. The Reserve Bank of New Zealand needs to set the interest rate target equal to 4% or lower: $i^*_{NZ\$} = r^* + \pi_{NZ} = 1.5\% + 2.5\% = 4\%$.

c. The National Bank of Slovakia maintains an exchange rate band relative to the euro. This is a prerequisite for joining the Eurozone. The Slovak Republic must keep its exchange rate within ±15% of the central parity of 35.4424 koruna per euro. Calculate the exchange rate values corresponding to the upper and lower edges of this band. Suppose PPP holds. If Eurozone inflation is currently 2% per year and inflation in Slovakia is 5%, calculate the rate of depreciation of the koruna. Will Slovakia be able to maintain the band requirement? For how long? Does your answer depend on where in the band the exchange rate currently sits? A primary objective of the European Central Bank is price stability (low inflation) in the current and future Eurozone. Is an exchange rate band a necessary or sufficient condition for the attainment of this objective?

Answer: From relative PPP: $\pi_S = \%\Delta E^e_{koruna/€} + \pi_E$. Plug in the inflation rates for the Eurozone and Slovakia, and find the implied rate of depreciation in Slovakia's currency: $\%\Delta E^e_{koruna/€} = 2\% - 5\% = |-3\%| < 15\%$. Thus, the Slovakian currency is appreciating relative to the euro. If the Slovakian currency were to appreciate by 3% each year, it will be outside the exchange rate band after approximately 5 years. We can see that the exchange rate band is not sufficient to ensure low inflation. The Eurozone would need to impose a stricter range, or a hard peg, to ensure that Slovakia's inflation rate is equal to (or less than) that of the Eurozone.

Yes, it will be able to stay within the exchange-rate band needed to join the Eurozone for now. However, if Slovakia does not institute policies to decrease its inflation rate, the Slovak koruna will continue to depreciate, eventually falling outside the 15% band. This requirement prevents high-inflation countries from joining the Eurozone. Such countries could potentially "transmit" their inflation into other countries if the exchange rate is fixed. We can see from this example that it is possible for countries with higher inflation rates (compared with the Eurozone) to satisfy this condition, but not over long periods of time. Therefore, the exchange rate band is a necessary and sufficient condition for achieving low inflation only in the long run.

10. Several countries that have experienced hyperinflation adopt dollarization as a way to control domestic inflation. For example, Ecuador has used the U.S. dollar as its domestic currency since 2000. What does dollarization imply about the exchange rate between Ecuador and the United States? Why might countries experiencing hyperinflation adopt dollarization? Why might they do this rather than just fixing their exchange rate?

Answer: Dollarization implies a fixed exchange rate. That is, Ecuador is using the exchange rate as a nominal anchor. The difference is that dollarization implies that Ecuador does not control the supply of its currency—the Federal Reserve does. Because one U.S. dollar is one U.S. dollar (regardless of where it is used to buy goods), this means that Ecuador has a fixed exchange rate with the United States: $E_{\$/\$} = 1$, so $\%\Delta E^e_{\$/\$} = 0$. A hyperinflation country like Ecuador may adopt a currency such as the U.S. dollar in the hopes of controlling inflation. We can see this from the Fisher effect. If the country no longer trusts its central bank to maintain low inflation, then it may resort to adopting another currency.

11. You are the central banker for a country that is considering the adoption of a new nominal anchor. When you take the position as chairperson, the inflation rate is 4% and your position as the central bank chairperson requires that you achieve a 2.5% inflation target within the next year. The economy's growth in real output is currently 3%. The world real interest rate is currently 1.5%. The currency used in your country is the lira. *Assume prices are flexible.*

a. Why is having a nominal anchor important for you to achieve the inflation target? What is the drawback of using a nominal anchor?

Answer: The central bank uses a nominal anchor to control the inflation rate. Because the government cannot directly control inflation, it must find a (nominal) variable related to inflation that is under its control. The drawback of using a nominal anchor is that it eliminates monetary policy autonomy. The central bank's other objectives (low unemployment, economic growth) are secondary to the objective of price stability (low inflation).

b. What is the growth rate of the money supply in this economy? If you choose to adopt a money supply target, which money supply growth rate will allow you to meet your inflation target?

Answer: $\mu_H = \pi_H + g_H = 4\% + 3\% = 7\%$

$\mu^*_H = \pi^*_H + g_H = 2.5\% + 3\% = 5.5\%$

c. Suppose the inflation rate in the United States is currently 2% and you adopt an exchange rate target relative to the U.S. dollar. Calculate the percent appreciation/depreciation in the lira needed for you to achieve your inflation target. Will the lira appreciate or depreciate relative to the U.S. dollar?

Answer: From relative PPP: $\%\Delta E^e_{H/\$} = -\pi_H - \pi_{US} = 2.5\% - 2\% = 0.5\%$ depreciation in the lira. If the central banker allows the inflation rate to remain at 4%: $\%\Delta E^e_{H/\$} = \pi_H - \pi_{US} = 4\% - 2\% = 2\%$ depreciation in the lira. Therefore, the lira will still depreciate, but at a slower rate than it would experience with the initial inflation rate.

d. Your final option is to achieve your inflation target using interest rate policy. Using the Fisher equation, calculate the current nominal interest rate in your country. What nominal interest rate will allow you to achieve the inflation target?

Answer: The current nominal interest rate is: $i_H = \pi_H + r^* = 4\% + 1.5\% = 5.5\%$. The nominal interest rate needed to achieve the inflation target is: $i^*_H = \pi^*_H + r^* = 2.5\% + 1.5\% = 4\%$