ECON 371 Fall 2010

Answer Key for Problem Set 1
(Chapters 13-14)

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ANSWER 1

The covered interest parity (CIP) is a no-arbitrage condition that describes an equilibrium in which investors are indifferent between interest-bearing assets in two currencies and exchange risk has been eliminated by the use of a forward contract. Specifically, the CIP condition can be written as follows:

\[ 1 + i_S = (1 + i_E) \frac{F_{S/E}}{E_{S/E}} \]  

(1)

We can rearrange the above equation and solve for the forward rate:

\[ F_{S/E} = E_{S/E} \frac{(1 + i_S)}{(1 + i_E)} \]  

(2)

It is the exchange rate that prevents profitable arbitrage opportunity in the foreign exchange market. From the question, \( i_S = 0.01 \), \( E_{S/E} = 1.30 \) and \( i_E = 0.03 \). Substituting these values into (2) yields the forward rate:

\[ F_{S/E} = 1.30 \times (1.01) / 1.03 = $1.27 \text{ per euro}. \]

The forward premium (FP) is the percentage deviation of the forward rate from the spot rate:

\[ FP = F_{S/E} / E_{S/E} - 1 = 1.27 / 1.30 - 1 = 0.02 = 2\%. \]

Alternatively, we can answer this question using the approximation of the CIP:

\[ i_S = i_E + \frac{(F_{S/E} - E_{S/E})}{E_{S/E}} \]  

(3)

Substituting the interest rates and the spot rate into (3) gives:

\[ 0.01 = 0.03 + \frac{(F_{S/E} - 1.30)}{1.30}. \]

Then, \( F_{S/E} = 1.30 + (0.01-0.03) \times 1.30 = $1.27 \text{ per euro.} \) We get the same answer, because this approximation of the CIP is valid when the interest rates are close to zero.
**ANSWER 2.a**

The uncovered interest parity (UIP) is a no-arbitrage condition that describes an equilibrium in which investors are indifferent between interest-bearing assets in two currencies without the use of a forward contract to hedge exchange rate risks. Therefore, the UIP can be written as follows:

\[ 1 + i_S = (1 + i_E) \frac{E^{e}_{S/E}}{E_{S/E}}. \]

(4)

where the superscript e denotes the expectations. The UIP in (3) implies that:

\[ i_S = (1 + i_E) \frac{E^{e}_{S/E}}{E_{S/E}} - 1. \]

(5)

In this question, the spot rate is $1.30 per euro, the euro interest rate is 3%, and the expected future spot rate is $1.35 per euro. Substituting these values into (4) yields the dollar interest rate:

\[ i_S = (1.03) \frac{1.35}{1.30} - 1 = 0.07 = 7%. \]

Alternatively, we can answer this question using the approximation of the CIP.

\[ i_S = i_E + \frac{(E^{e}_{S/E} - E_{S/E})}{E_{S/E}} \]

(6)

Substituting the euro interest rate, the spot rate and the expected future sport rate into (6) gives the same answer:

\[ i_S = 0.03 + \frac{1.35 - 1.30}{1.30} = 0.07 = 7%. \]

**ANSWER 2.b**

The UIP condition in (4) implies that we can calculate the spot rate as follows:

\[ E_{S/E} = (1 + i_E) \frac{E^{e}_{S/E}}{(1 + i_S)} \]

(7)

In this question, the euro interest rate is 4%, the expected sport rate is $1.35 per euro, and the dollar interest rate is 7%, as given by the answer in Question 2.a. Substituting these values into (7) yields the dollar interest rate:

\[ E_{S/E} = 1.04 \frac{1.35}{1.07} = 1.31. \]

1.31 > 1.30 (or spot rate in Question 2.a), thus a rise in the euro interest rate causes the dollar to depreciate. Intuitively, a rise in the euro interest rate makes interest-bearing assets denominated in euro becomes more attractive and increases the demand for euro. As a result, the demand for dollar falls and that results in depreciation of the dollar. Note that we can obtain the same answer using the approximation of the UIP in (6).
ANSWER 3.a

Start with the definition of the real exchange rate between the Euro area and the U.S. as their relative price level: \( q_{EU/US} = E_{S/\epsilon}P_{EU}/P_{US} \) = price level in the EU in dollar/ price level in the US in dollar. Since today the U.S. consumption basket costs $100, and the European basket costs $130, then the real exchange rate today is:

\[
q_{EU/US} \text{ (today)} = 130/100 = 1.3.
\]

This implies 30\% deviation from the absolute PPP today, because the absolute purchasing power parity (PPP) predicts that the real exchange rate is 1 in the long run.

ANSWER 3.c

Recall the definition of the real exchange rate between the Euro area and the U.S. as their relative price level: \( q_{EU/US} = E_{S/\epsilon}P_{EU}/P_{US} \). This definition suggests that we can forecast the nominal exchange rate using the real exchange rate and price levels in the two economies:

\[
E_{S/\epsilon} = q_{EU/US} \times (P_{US}/P_{EU}). \tag{8}
\]

According to (8), to forecast the dollar-euro exchange rates, we need to forecast the real exchange rate and the future price levels in the two economies.

First, we can calculate the forecast of the real exchange rate from: (a) the speed of convergence to the PPP; and (b) the level of the real exchange rate today. With 20\% speed of convergence, the deviation from the absolute PPP next year will be:

\[
(1 - \text{Speed of convergence})(\text{Deviation from the PPP today}) = (1-0.20)0.3 = 0.24
\]

Thus,

\[
q_{EU/US} \text{ (next year)} = 1 + 0.24 = 1.24. \tag{9}
\]

Next, we can calculate the forecast of future price levels from the given inflation forecast. Specifically, the inflation forecast is 4\% for the U.S. and 2\% for the euro area. Hence,

\[
P_{US}(\text{next year}) = 1.04(100) = 104 \tag{10}
\]

\[
P_{EU}(\text{next year}) = 1.02(130) E_{S/\epsilon} \text{ (today)} = 132.6/ E_{S/\epsilon} \text{ (today)} \tag{11}
\]

Note that in (11) we divide 130 by the spot rate today, because the price level in the Euro zone in (8) is in euro, not dollar.

Finally, substituting (9), (10) and (11) into (8) gives us the forecast of future exchange rate in terms of current exchange rate:
\[
E_{\text{SE}} \text{ (next year)} = \frac{1.24(104)}{132.6} \times E_{\text{SE}} \text{ (today)} = 0.97 \times E_{\text{SE}} \text{ (today)}
\]

This means that if the spot rate today is 1, the forecast of future exchange rate is 0.97, i.e. the dollar appreciates. Therefore, the dollar is predicted to appreciate by 3% next year.

ANSWER 3.c

The time path of real exchange rates is displayed by the bold and solid line below. In the long run, the real exchange rate converges to the absolute PPP, i.e. \( q = 1 \) in the long run. The periods 0 and 1 correspond to today and next year, respectively.

\[
q_{EU/US}
\]

ANSWER 4.a

From the PPP, the forecast of exchange rate depreciation is inflation differential between the home country and the foreign country:

\[
\Delta E_{W/Y} / E_{W/Y} = \Pi_K - \Pi_J.
\]

(12)

According to the monetary approach, the inflation rate in each country is predicted by the difference between the rate of money growth and the rate of output growth, according to the money market equilibrium condition. Thus, \( \Pi_K = \mu_K - g_K = 15\% - 5\% = 10\% \) and \( \Pi_J = \mu_J - g_J = 25\% - 2\% = 23\% \). Substituting the values of inflation rate in the two economies into (12) gives the forecast of exchange rate depreciation:

\[
\Delta E_{W/Y} / E_{W/Y} = 10\% - 23\% = -13\%.
\]
In other words, the won is predicted to appreciate by 13%.

ANSWER 4.b

The change in the Bank of Korea (BOK)’s money growth rate will change the inflation rate in Korea:

\[ \Pi_K = \mu_K - g_K = 10\% - 5\% = 5\% . \]

With this new inflation rate in Korea,

\[ \Delta E_{W/Y} / E_{W/Y} = 5\% - 23\% = -18\% . \]

Thus, a reduction in money growth rate in Korea makes the yen appreciate even more than the situation in ANSWER 4.a.

ANSWER 4.c

According to the monetary approach of long-run exchange rate determination, exchange rate depreciation is predicted by relative differences in money growth rate and output growth rate:

\[ \Delta E_{W/Y} / E_{W/Y} = \Pi_K - \Pi_J = (\mu_K - g_K) - (\mu_J - g_J) \]

From (13), the Bank of Japan (BOJ) can control money growth rate to achieve its target rate of exchange rate depreciation as follows:

\[ \mu_J = (\mu_K - g_K) + g_J - \Delta E_{W/Y} / E_{W/Y} \]

The BOJ has no control over output growth in Japan, since its job is to control money supply. The BOJ’s goal to appreciate the won by 13% against the yen implies that \( \Delta E_{W/Y} / E_{W/Y} = -13\% \). Substituting this rate of depreciation, the rate of output growth in the two countries and the rate of output growth in Japan into (14) gives the desired money growth rate set by the BOJ:

\[ \mu_J = (10\% - 5\%) + 2\% + 13\% = 20\% . \]

Therefore the BOJ must lower its money growth rate from 25% to 20%. The 5% reduction of money growth rate of the BOJ is exactly to match the 5% reduction of money growth rate of the BOK.

Alternatively, we can describe the change in the BOJ’s policy using the yen interest rate. In fact, today central banks use interest rate to characterize their monetary policy.
From the Fisher parity, the nominal interest rate is the sum of expected rate of inflation and real interest rate:

\[ i_Y = \Pi^e_J + r^* \]  \hspace{1cm} (15)

Assume perfect capital mobility. Then Japan’s real interest rate is the same as the world real interest rate: \( r^* = 1\% \). The inflation rate in Japan is predicted by the difference between the rate of money growth and the rate of output growth, according to the money market equilibrium condition: \( \Pi^e_J = 20\%-2\% = 18\% \). Substituting the value of \( r^* \) and \( \Pi^e_J \) into (15) gives the yen interest rate:

\[ i_Y = 18\% + 1\% = 19\%. \]

Similarly, we can calculate the yen interest rate in ANSWER 4.a: \( i_Y = 13\% + 1\% = 14\% \).

Consequently, the BOJ has to raise its interest rate by 5% to achieve its targeted exchange rate.