ECON 1550 Spring 2026: Problem Set 3 Answer Key

1. (a)

- (A) Do not select. The carry trade has positive average returns because the uncovered interest parity condition does *not* hold empirically.
- (B) Do not select. The carry trade risk premium is about whether *uncovered* interest parity holds, not *covered* interest parity.
- (C) Do not select. The carry trade is risky because exchange rates fluctuate, not because interest rate differentials fluctuate.
- **(D) Select.** When UIP holds, expected returns from investing in foreign versus domestic bonds are equal, implying a zero average risk premium.

(b)

- **(A) Select.** A current account deficit means imports exceed exports, so the country must finance the difference by borrowing from abroad (or selling assets to foreigners).
- (B) Do not select. Lending to the rest of the world corresponds to a current account *surplus*, not a deficit.
- (C) Do not select. An increase in public savings (larger government budget surplus or smaller deficit) would tend to improve the current account, not cause a deficit.
- (D) Do not select. An increase in private savings would also tend to improve the current account, not cause a deficit.

(c)

- **(A) Select.** Using the identity $S^p + (T - G) = I + CA$, we have $500 + (-100) = 300 + CA$, so $CA = 100$ million surplus.
- (B) Do not select. This would require a different combination of savings, investment, and government balance.
- (C) Do not select. This has the wrong sign; the calculation yields a surplus, not a deficit.
- (D) Do not select. This has both the wrong sign and the wrong magnitude.

(d)

- (A) Do not select. The terms are on the wrong sides of the equation.
- (B) Do not select. Both the placement and the sign of G are incorrect.

- **(C) Select.** This is the correct national income identity: private savings plus public savings (government budget balance $T - G$) equals investment plus the current account.
- (D) Do not select. The government budget balance should be $T - G$, not $T + G$.

(e)

- **(A) Select.** The symbol for the Canadian dollar is CAD. All else equal, higher Canadian interest rates increase demand for CAD-denominated bonds. To purchase these bonds, people need to use CAD, so demand for CAD increases. The CAD appreciates and the USD depreciates.
- (B) Do not select. U.S. demand for Canadian dollars *increases* as U.S. investors seek higher Canadian interest rates.
- (C) Do not select. Money supply does not enter UIP. Looking at the FX market in isolation says nothing about money supply. In the Canadian money market, if money supply is exogenous, it does not change by assumption. If money supply is endogenous, higher Canadian interest rates lead to lower (not higher) money supply.
- (D) Do not select. The CAD appreciates (not depreciates). The explanation is the same as for choice (A).

2. (a) The yen is riskier for you (equivalently, the euro is safer). When the return on the rest of your wealth is unexpectedly low, the euro tends to appreciate against the dollar, reducing your losses by giving you a relatively high payoff in terms of dollars. Conversely, losses on your euro assets tend to occur when they are least painful, that is, when the rest of your wealth is unexpectedly high. Holding the euro, therefore, reduces the variability of your total wealth, acting as a hedge (insurance) against bad outcomes (low wealth). The yen behaves in the opposite way and therefore is riskier.

This logic showed up in lecture as one of the possible explanations for why the carry trade has a non-zero risk premium.

(b) We propose one particular answer, but of course there are many correct answers.

Irrespective of what equation we propose for E^e_{t+1}, the equilibrium at t looks like the standard equilibrium of the static (one-period) model we studied in class. For this standard model, we can solve the UIP condition for E_t to get

$$E_t = \frac{E^e_t}{1 + R_t - R^*_t}.$$

When E^e_t goes up, E_t goes up as well: at time t, the expectation of a future depreciation leads to an actual depreciation.

For E_{t+1} to also increase in response to the increase in E^e_t, we have to make E^e_{t+1} depend on E^e_t, E_t, or both. Let's try a behavioral equation for E^e_{t+1} given by:

$$E^e_{t+1} = E^e_t.$$

One way to justify this equation with economic intuition is to interpret the expected exchange rate for both t and $t+1$ as expectations for the value that the exchange rate will take "in the long run", many, many periods after t and $t+1$. To the extent that the long run looks the same from the perspectives of times t and $t+1$ (since one period is not a big difference when thinking about the far future), revisions in expectations about the long run at t should lead to an equal revision at $t+1$. The idea is that we will not change our mind about the long run in just one period.

$$E_{t+1} = \frac{E^e_{t+1}}{1 + R_{t+1} - R^*_{t+1}} = \frac{E^e_t}{1 + R_{t+1} - R^*_{t+1}}.$$

The expectation of a long-run depreciation at time t (E^e_t goes up) produces an equal expectation of a long run depreciation at $t+1$ (E^e_{t+1} goes up due to our behavioral equation $E^e_{t+1} = E^e_t$).

From here, the intuition is the one of the standard model.

Keeping the exchange rate E_{t+1} fixed at its initial value (before the change in E^e_t), an expected depreciation increases the domestic-currency return of investing in the foreign bond. After converting domestic currency into foreign currency at the given exchange rate E_{t+1} and earning the foreign interest rate R^*_{t+1}, the higher expected exchange rate E^e_{t+1} implies that the same amount of foreign currency earned by investing in the foreign bond is now exchanged into a larger amount of domestic currency.

The domestic-currency return of investing in the domestic bond, R_{t+1}, has not changed.

We have found that, at the initial exchange rate, the domestic-currency return on the foreign bond is higher than that of the domestic bond. But equilibrium requires that the two are equal.

To reduce the domestic-currency return of investing in the foreign bond, the exchange rate must depreciate today (E_{t+1} has to go up). When E_{t+1} goes up, the same amount of domestic currency results in a smaller amount of foreign currency that can be invested in the foreign bond. Even though the foreign-currency return on the foreign bond, R^*_{t+1}, has not changed, the smaller initial investment leads to a smaller payoff. When the reduction in payoff due to the higher exchange rate offsets the increase in payoff due to the higher expected exchange rate, equilibrium is reached.

(c) There are two steps to this question. The first step is getting the data, the second step is constructing the carry trade returns.

<u>Step 1: Getting the data</u>

- Bank of Korea

To get the Monetary Stabilization Bond (MSB) interest rate, go to:

`https://ecos.bok.or.kr/#/SearchStat`

Then, in the Table Select pane, navigate to:

1. Monetary Financial Statistics > 1.3. Interest Rates > 1.3.2. Market Interest Rates > 1.3.2.2. Market Interest Rates (Monthly, Quarterly, Annual)

Once there, the Item Select pane will be populated with a list of rates. Turn off the Select All switch at the top of the pane, then from the list select Monetary stabilization bonds (91-day). At the bottom of the panel, click the Add to List button. Now the selected series appears on the Table Name pane.

To get the exchange rate, there are two equally correct options.

- Option 1. In the Table Select pane, navigate to:

  3. Exchange Rate/International Reserves and Trade > 3.1. Foreign Exchange Rate > 3.1.2 Average Period, End Period > 3.1.2.1. Arbitraged Rates of Major Currencies Against Won, Longer Frequency.

- Option 2. In the Table Select pane, navigate to:

  3. Exchange Rate/International Reserves and Trade > 3.1. Foreign Exchange Rate > 3.1.2 Average Period, End Period > 3.1.2.3. Exchange Rate of Won Against US Dollar, China Yuan Renminbi [...].

The exchange rates from the two options are very close to each other[1]. Then follow the same steps as before to add Won per United States Dollar (Close) to the Table Name pane. You can use either the Closing Rate or the Average Rate for the Won per United States Dollar (Close) series. They are both equally good options and very close to each other. In this answer, we use the Closing Rate from Option 1 above.

[1] The exchange rate in Option 1 is the "basic exchange rate" and is determined as the transactions volume-weighted average of the rates applied in the previous business day's transactions between foreign exchange banks through brokers in an "over-the-counter" (OTC) market. The exchange rate in Option 2 is the closing-day exchange rate quoted in a trading exchange (a marketplace where prices are quoted openly).

Last, at the bottom of the Table Name pane, click View List. A new screen will appear. Check the box for Mon (for monthly series) and select 2009.01 as the start date and 2023.07 as the end date. After selecting the dates, you have to click Search, otherwise the dates will not be updated. Finally, customize the format if desired (e.g., vertical view rather than horizontal) and click on Original Data Download.

- FRED

The three-month Treasury bill rate from FRED has code "TB3MS". However, the series "Market Yield on U.S. Treasury Securities at 3-Month Constant Maturity, Quoted on an Investment Basis" that has code "GS3M" is equally appropriate and gives essentially identical results. In this answer, we use "TB3MS".

The original spreadsheets with the downloaded data from the Bank of Korea can be found here (or in PDF) and from FRED it can be found here (or in PDF).

Step 2: Constructing carry trade returns

- Formula for returns

The carry trade returns are the same whether we compute US dollar (USD) returns or Korean won (KRW) returns. We compute USD returns.

We use the following notation:

E_t = USD / KRW exchange rate (dollars per won) in month t,
R_t = Interest rate for the USD-denominated U.S. Treasury bill that accrues between months t and $t+1$,
R_t^* = Interest rate for the KRW-denominated Korean bond that accrues between months t and $t+1$.

If you exchange 1 USD into KRW at the end of month t and use the resulting $1/E_t$ KRW to buy the Korean bond, at the end of month $t+1$, you have an amount of KRW equal to:

$$(1 + R_t^*)\frac{1}{E_t}.$$

Converting this KRW-denominated payoff into USD using the $t+1$ exchange rate gives the USD-denominated payoff:

$$(1 + R_t^*)\frac{E_{t+1}}{E_t}.$$

Thus, the USD-denominated net return earned by investing in the Korean bond between t and $t+1$ is:

$$(1 + R_t^*)\frac{E_{t+1}}{E_t} - 1.$$

By *net* return we just mean subtracting 1, so 1.05 is a *gross* return and 0.05 is a net return.

The USD-denominated net return earned between months t and $t+1$ by borrowing in the American bond is:

$$-R_t.$$

The negative sign is there because we are borrowing (short-selling the bond) rather than lending (buying the bond).

The returns on the carry trade strategy are therefore:

$$\begin{aligned}
\text{returns}_{t+1} &= \left[(1 + R_t^*)\,\frac{E_{t+1}}{E_t} - 1\right] - R_t \\
&= (1 + R_t^*)\,\frac{E_{t+1}}{E_t} - (1 + R_t). \qquad (1)
\end{aligned}$$

We can approximate to get an expression that looks the same as the formula for expected returns from lecture, but with E_{t+1} instead of E^e since we are constructing realized rather than expected returns. First, re-write the last equation as

$$\begin{aligned}
\text{returns}_{t+1} &= (1 + R_t^*)\,\frac{E_{t+1}}{E_t} - (1 + R_t) \\
&= (1 + R_t^*)\left(\frac{E_{t+1}}{E_t} - 1 + 1\right) - (1 + R_t) \\
&= (1 + R_t^*)\left[1 + \left(\frac{E_{t+1}}{E_t} - 1\right)\right] - (1 + R_t) \\
&= (1 + R_t^*) + (1 + R_t^*)\left(\frac{E_{t+1}}{E_t} - 1\right) - (1 + R_t) \\
&= (1 + R_t^*) + \left(\frac{E_{t+1}}{E_t} - 1\right) + R_t^*\left(\frac{E_{t+1}}{E_t} - 1\right) - (1 + R_t) \\
&= R_t^* + \left(\frac{E_{t+1}}{E_t} - 1\right) + R_t^*\left(\frac{E_{t+1}}{E_t} - 1\right) - R_t.
\end{aligned}$$

The cross term

$$R_t^*\left(\frac{E_{t+1}}{E_t} - 1\right)$$

is much smaller than the other terms, so we ignore it and get

$$\begin{aligned}\text{Approximate returns}_{t+1} &= R_t^* + \left(\frac{E_{t+1}}{E_t} - 1\right) - R_t \\ &= R_t^* - R_t + \left(\frac{E_{t+1}}{E_t} - 1\right). \end{aligned} \tag{2}$$

The term $R_t^* - R_t$ is the *interest rate differential* and the term $E_{t+1}/E_t - 1$ is the *realized depreciation rate* of the USD with respect to the KRW.

Both the exact and the approximate returns can now be computed using the data on R_t^* and E_t downloaded from the Bank of Korea and the data on R_t downloaded from FRED.

- From monthly returns to cumulative returns

To compute cumulative returns, we take January 2009 to be month $t = 0$ and set the initial value of cumulative returns to be 100:

$$\text{Cumulative returns}_0 = 100. \tag{3}$$

For $t > 0$, we compute cumulative returns using the recursive formula:

$$\text{Cumulative returns}_t = (1 + \text{returns}_t)\,\text{Cumulative returns}_{t-1}. \tag{4}$$

We can alternatively use $\text{Approximate returns}_t$ instead of returns_t, which gives essentially identical results.

- Converting to the correct units

The formulas above use non-annualized decimal returns for the interest rates R and R^*, and dollars per won for the exchange rate E. For example, if $R = 0.02$, this means 2% returns over one month. And if $E = 2$, this means that we need 2 dollars to buy one won.

We have to make sure our numbers are the correct units before we plug them into the formula.

For interest rates, there are three dimensions of the data:

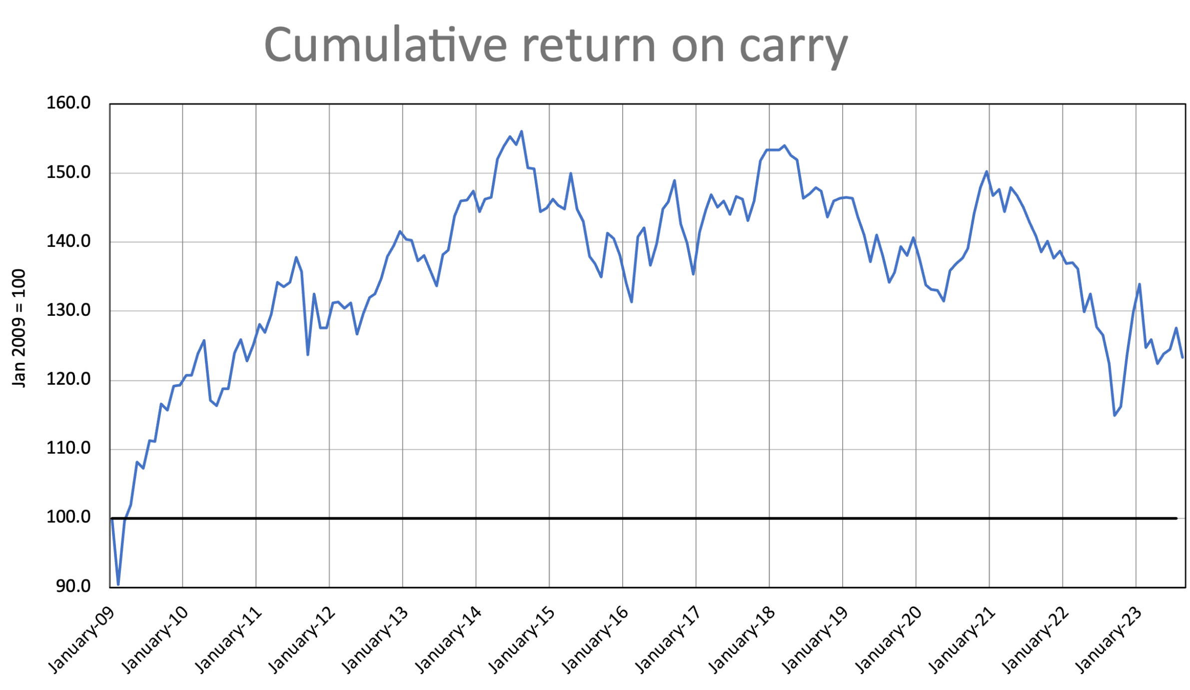
- Maturity of the bond: 3 months for both bonds
- Frequency of observation: monthly for both bonds
- Units: percent per annum for the Bank of Korea interest rate and decimal per annum for the FRED interest rate

Per annum here just means *annualized*. To convert to raw (non-annualized) values, we simply divide by 12 (because there are 12 months in a year). To convert percent to decimal, we divide by 100. For example, for January 2009, the Bank of Korea interest rate is reported as 2.26. This means that this bond provides a return of $2.26\%/12 = 0.1883\%$ over the next month or, in decimal, $0.1883/100 = 0.001883$. The FRED interest rate for the same month is reported as 0.13. Since FRED reports in annualized decimal units, the bond return over the next month is $0.13/12 = 0.01083$ in decimal, or 1.083%.

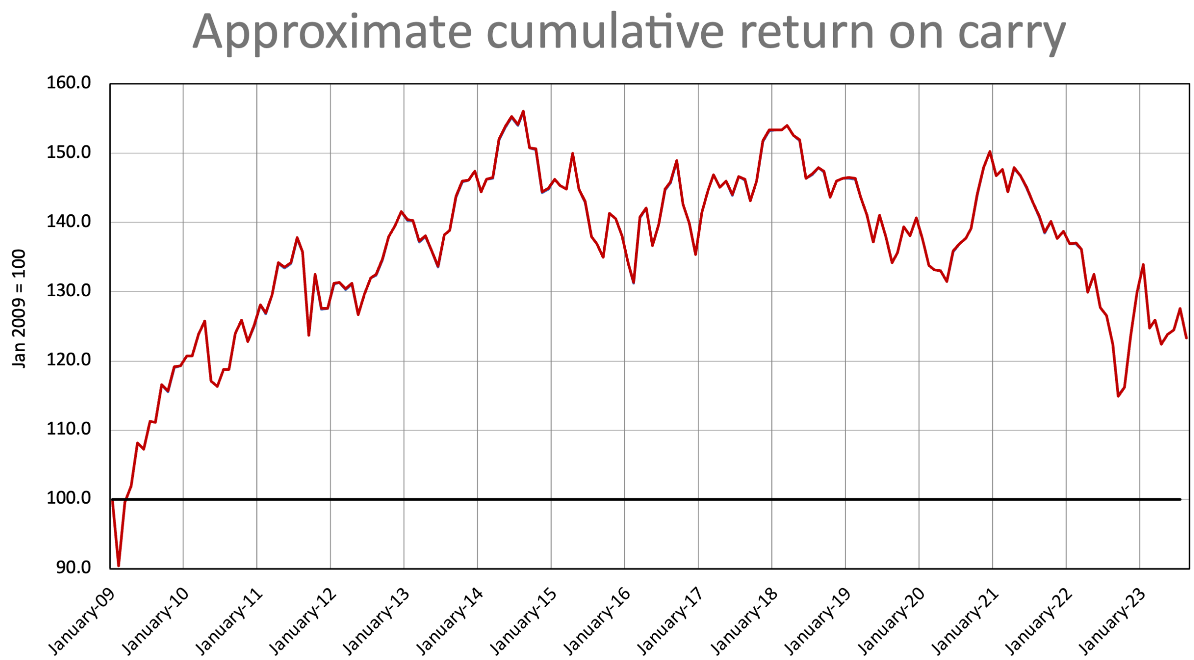
For the exchange rate, the Bank of Korea reports the KRW / USD (won per dollar) exchange rate. However, in our formulas E_t represents the USD / KRW exchange rate (dollars per won). Therefore, to convert the exchange rate we downloaded into E_t, we have to take its reciprocal. For example, for January 2009, the downloaded exchange rate value from the Bank of Kore is $1{,}368.5$ won per dollar. Then,

$$E_t = \frac{1}{1{,}368.5 \text{ KRW/USD}} = \frac{1}{1{,}368.5} \text{ USD/KRW} = 0.00073073 \text{ dollars per won.}$$

The plot below shows the time series of cumulative returns obtained by using equations (1), (3), and (4) with interest rates in non-annualized decimal units and the exchange rate in dollars per won. The cumulative returns in month t give the amount of money you would have in month t if you had invested \$100 in the carry trade strategy starting in January 2009.



If we use approximate returns in equation (2) rather than the exact returns from equation (1), we get essentially the same plot:



You can see all the calculations and plots in this Excel file.