Rutgers Business School--Newark & New Brunswick
MQF 22:839:571, Financial Modeling I, Spring 2020
Assignment VII
Assigned: 4/15/20, Due 5/2/20

In this assignment, you are asked to implement some simple trading strategies based on deviations from the uncovered interest rate parity. You are given daily exchange rates between the U.S. dollar and the following countries: Japan, Switzerland, U.K., and the Euro zone. Also given are the one-month LIBOR rates for these countries, the Fama-French three factors, and the Fama-French five factors.

We will use the following notations:

S_t : Spot exchange rate between a foreign currency and the U.S. dollar, quoted as dollar price per foreign currency unit, e.g., \$2.1/BP, \$0.011/JY;
$s_t = \ln(S_t)$;
$r_{t,k}$: U.S. interest rate at time *t* with maturity time *t*+*k*; and
$r^*_{t,k}$: Foreign interest rate at time *t* with maturity time *t*+*k*.

In this assignment, all interest rates have a one month maturity, so *k*=22.

1. The idea of "carry trade" is to long the currency with a higher interest rate and short the currency with a lower interest rate. Suppose that you conduct carry trade for each of the 9 currency pairs from the beginning of the sample to the end. Calculate the excess returns. Do you make a significant profit for any currency pair?

2. The uncovered interest rate parity can be expressed as follows:

$$E_t(s_{t+k}) - s_t = r_{t,k} - r^*_{t,k}, \tag{1}$$

To test this hypothesis, we can run the following regression:

$$s_{t+k} - s_t = \alpha + \beta(r_{t,k} - r^*_{t,k}) + \varepsilon_{t+k}. \tag{2}$$

If the theory holds, one should get $\alpha = 0$ and $\beta = 1$. Then, carry trade will not be profitable. Indeed, no trading strategy will be profitable in this case. Run the above regression for each of the 9 currency pairs using the full sample and test the hypothesis, H_0: $\beta = 1$.

3. Suppose that you find that the uncovered interest rate parity condition does not hold. Then you can use (2) to forecast future exchange rate changes and form a trading strategy based on deviations from the uncovered interest rate parity. Use the first 1-year data to estimate the model and the remaining data for an "out-of-sample" test. Take the British pound sterling as an example, you first run regression (2) using data from 1986.01.02 to 1986.12.31 and obtain

parameter estimates $(\hat{\alpha}_{1986.12.31},\ \hat{\beta}_{1986.12.31})$. Then you use these parameters to forecast exchange rate change (1-month ahead) at 1987.01.31 as follows:

$$E_{1986.12.31}(s_{1987.01.31}) - s_{1986.12.31} = \hat{\alpha}_{1986.12.31} + \hat{\beta}_{1986.12.31}(r_{1986.12.31,k} - r^*_{1986.12.31,k}).$$

Suppose that $E_{1986.12.31}(s_{1987.01.31}) - s_{1986.12.31} > (r_{1986.12.31,k} - r^*_{1986.12.31,k})$, i.e., the forecasted exchange rate change next month is greater than the interest rate differential, then investing in the foreign currency will yield a higher return then investing in the dollar. In this case, you should short one dollar and long one dollar worth of the British pound sterling. Then, by 1987.01.31, you can calculate your realized excess return as follows:

$$er_{1987.01.31} = (s_{1987.01.31} - s_{1986.12.31}) - (r_{1986.12.31,k} - r^*_{1986.12.31,k}).$$

On the other hand, if $E_{1986.12.31}(s_{1987.01.31}) - s_{1986.12.31} < (r_{1986.12.31,k} - r^*_{1986.12.31,k})$, then you should short the British pound sterling and long the U.S. dollar. By 1987.01.31, your realized excess return would be

$$er_{1987.01.31} = (r_{1986.12.31,k} - r^*_{1986.12.31,k}) - (s_{1987.01.31} - s_{1986.12.31}).$$

By 1987.01.02, you re-estimate (2) using data from 1986.01.02 to 1987.01.02 (i.e., with one more observation. This is the so-called rolling regression with cumulative window) and obtain estimate $(\hat{\alpha}_{1987.01.02},\ \hat{\beta}_{1987.01.02})$. Then you use these parameters to forecast exchange rate change at 1987.02.01 and form your trading strategy. You repeat this exercise until the end of the sample, (2020.04.06 in this example).

Calculate the average excess returns for the out-of-sample period (1987.01.31-2020.04.06). Are the excess returns significant for any of the countries? Can the excess returns be explained by the CAPM? Can the excess returns be explained by the Fama and French three-factor model? Can the excess returns be explained by the Fama and French five-factor model?

4. Repeat your analysis by running rolling regressions with a 1-year moving window.