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Case Study Series

The Relation between Inflation, Interest Rates and Exchange Rates

Halil D. Kaya

Abstract

This case deals with the relation between the exchange rate between two currencies, the interest rates on these two currencies and the expected inflation rates in the two countries. First, students will learn how these different rates are linked to each other. Then, they will estimate the expected change in the exchange rate between two currencies using approximation. They will then use this expected percentage change to estimate the future exchange rate between these two currencies. Finally, they will estimate the expected change in the exchange rate between these two currencies without approximation and use this number to estimate the future exchange rate between these two currencies. This case is a hands-on experience for students who want to learn how different rates are related in the international markets.

Keywords: currency, exchange rate, interest rate, inflation
JEL classifications: F30, F31, G15

I. Introduction

Mike and Britney are classmates in the "International Finance" class. Recently, they have learned about several formulas including Purchasing Power Parity and Interest Rate Parity. Their professor also showed them a formula that links the exchange rate between two currencies, the interest rates on those two currencies and the expected inflation rates in the two countries.

They have an assignment due by Monday. The assignment deals with the Brazilian Real and the U.S. dollar. The professor asks them to estimate the percentage change in the exchange rate between the two currencies and then to estimate next year's exchange rate between the two currencies.

"The assignment looks straightforward but I don't understand what he means by "approximation" and "exact". Do you know what he means?" Michael asks to his friend.

Britney is actually more confused than Michael: "I didn't even understand what we are supposed to do. In the class, he showed us some formulas. I think one of them was the "approximation" formula and the other one was the "exact" formula".

Mike answers; "I think he wants us to estimate the percentage change in the exchange rate using the approximation formula first and then to use that number to estimate next year's rate. After that, I guess we will use the other formula and do the same."

"I think you are right" Britney says. "I am kind of lost here, so I will need your help".

"No problem" Michael responds. "I think we need to read our notes some more and then search the web also. After that, we can start working on the questions."

"I agree. Let's start working on this!" Britney exclaims.

Estimating the Future Exchange Rate

When calculating the percentage return (or % profit) in finance, we use the following formula:

$$\% \text{ return} = (P_1 - P_0) / P_0 \quad (1)$$

where P_1 is the selling price of an investment and P_0 is the purchase price (or initial investment). Here, $(P_1 - P_0)$ is the dollar profit, therefore we can write the same formula in a different way shown as below:

$$\% \text{ return} = \text{dollar profit} / \text{initial investment} \quad (2)$$

We can write a similar formula for the expected percentage change in the exchange rate between two currencies. If we are talking about the rate between the euro and the dollar:

$$E(e) = [F(\$/€) - S(\$/€)] / S(\$/€) \quad (3)$$

Where E(e) is the expected rate of change (or % change) in the exchange rate, F($/€) is the forward rate between the dollar and the euro, and S($/€) is the spot rate between the dollar and the euro.

Here, [F($/€) - S($/€)] is the expected dollar change in the exchange rate, which is in fact the expected profit in dollars when an investment in the euro is made. Here, S($/€) is our initial investment because this is how many dollars we pay to buy the euros today. Therefore, formula 3 shows the expected percentage return when an investment in the euro is made.

At the same time, we have the IRP (i.e. Interest Rate Parity) formula that relates the forward rate, the spot rate, and the interest rates for the two currencies. The IRP formula is:

$$F(\$/€) / S(\$/€) = (1+i_{\$}) / (1+i_{€}) \quad (4)$$

Where $i_{\$}$ is the interest rate for the dollar and $i_{€}$ is the interest rate for the euro.

Investopedia explains the IRP as follows: “Interest rate parity is a theory in which the interest rate differential between two countries is equal to the differential between the forward exchange rate and the spot exchange rate. Interest rate parity plays an essential role in foreign exchange markets, connecting interest rates, spot exchange rates and foreign exchange rates.”

On the other hand, the Relative PPP (i.e. Relative Purchasing Power Parity) formula relates the forward rate, the spot rate, and the expected inflation rates in the two countries. The Relative PPP formula is:

$$F(\$/€) / S(\$/€) = (1+\pi_{\$}) / (1+\pi_{€}) \quad (5)$$

Where $\pi_{\$}$ is the expected inflation rate in the U.S. and $\pi_{€}$ is the expected inflation rate in Europe.

Investopedia explains the Relative PPP as follows: “Relative purchasing power parity relates the change in two countries' expected inflation rates to the change in their exchange rates.

Inflation reduces the real purchasing power of a nation's currency. If a country has an annual inflation rate of 10%, that country's currency will be able to purchase 10% less real goods at the end of one year. Relative purchasing power parity examines the relative changes in price levels between two countries and maintains that exchange rates will change to compensate for inflation differentials."

Combining formulas 4 and 5 gives us a larger formula as shown below:

$$F(\$/€) / S(\$/€) = (1+\pi_{\$}) / (1+\pi_{€}) = (1+i_{\$}) / (1+i_{€}) \quad (6)$$

Taking formula 5 and subtracting 1 from each side, we find the following:
$[F(\$/€) - S(\$/€)] / S(\$/€) = [(1+\pi_{\$}) / (1+\pi_{€})] – 1 = (\pi_{\$} - \pi_{€}) / (1 + \pi_{€})$

Therefore, formula 3 becomes:

$$E(e) = [F(\$/€) - S(\$/€)] / S(\$/€) = (\pi_{\$} - \pi_{€}) / (1 + \pi_{€}) \quad (7)$$

Since the expected inflation rate is very low (i.e. 1-3%) in most countries, we can eliminate the denominator, which is $(1 + \pi_{€})$. Therefore, after this approximation, we find the following formula:

$$E(e) = [F(\$/€) - S(\$/€)] / S(\$/€) = (\pi_{\$} - \pi_{€}) \quad (8)$$

Formula 7 is "the exact formula" since no approximation is employed. Formula 8 is "the approximation formula".

How do we use these formulas to find the expected percentage return from an investment in a currency? Also, how can we estimate the exchange rate on a future date? The following is an example that illustrates the application of these formulas.

An Example
If $S(\$/€)=1.14$, $\pi_{\$}$ is 4% per year, and $\pi_{€}$ is 2% per year, USING APPROXIMATION, what is the expected % change in the exchange rate? What is your best estimate for next year's rate?

$$E(e) = 0.04 - 0.02 = 0.02 = 2\%$$

Since expected inflation in Europe is lower, we expect the euro to go up by 2% over the next year against the $ (since less inflation in Europe means that European residents' payments next year won't go up as much as the U.S. residents' payments, the euro will be relatively more valuable next year)

Our best estimate for next year's exchange rate is:
$(F-1.14)/1.14 = 0.02$
$F = \$1.1628/€$
(here F is the future rate, not the forward rate)

If S($/€)=1.14, $\prod_{\$}$ is 4% per year, and $\prod_{€}$ is 2% per year, USING EXACT FORMULA, what is the expected % change in the exchange rate? What is your best estimate for next year's rate?

E(e) = (0.04 - 0.02)/1.02= 0.0196 = 1.96%

Since expected inflation in Europe is lower, we expect the euro to go up by 1.96% over the next year against the $ (since less inflation in Europe means that European residents' payments next year won't go up as much as the U.S. residents' payments, the euro will be relatively more valuable next year)

Our best estimate for next year's exchange rate is:
(F-1.14)/1.14 = 0.0196
F = $1.1624/€ (this is a more accurate, better estimate compared to approximation formula)

The Decision

Michael is trying to answer the following questions:

1. "The current exchange rate between the Brazilian Real and the U.S. dollar is R1.95/$. If the expected inflation in Brazil and the U.S. for the next year are 20% and 2.6%, respectively, using approximation, what would be the expected rate of change in the exchange rate? (i.e. the percentage change in the exchange rate)?"

2. "Is the Real expected to go up or down against the dollar?"

3. "What would be our estimate for the exchange rate next year?"

4. "Using the exact formula (no approximation), what is the expected rate of change in the exchange rate for the following year (i.e. percentage change)?"

5. "Using the exact formula (no approximation), is the Real expected to go up or down against the dollar?"

6. "Using the exact formula (no approximation), what would be our estimate for the exchange rate next year? Could we also use the Interest Rate Parity to find the answer? How?"

7. "Are your answers in questions #1-3 similar to your answers in questions #4-6? Why do you think it is like that?

8. "The current exchange rate between the dollar and the euro is $1.07/€. If the expected inflation in the U.S. and the Euro zone are 3% and 1%, respectively, using no approximation, what would be the expected rate of change in the exchange rate? Should the dollar come first or the euro come first in the formula?"

9. "Which currency is expected to go down over the next year?"

10. "Using the exact formula (no approximation), what would be our estimate for the exchange rate next year?"

11. "The current exchange rate between the dollar and the lira (i.e. the Turkish currency) is $0.27/TRY. If the expected inflation in Turkey and U.S. are 11% and 2%, respectively, using no approximation, what would be the expected rate of change in the exchange rate?

12. "Which currency is expected to go down over the next year?"

13. "Using the exact formula (no approximation), what would be our estimate for the exchange rate next year?"

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Author

Dr. Halil Kaya
Associate Professor of Finance, Department of Accounting and Finance, College of Business and Technology, Northeastern State University, USA, kaya@nsuok.edu