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Lecture 4: Exchange Rate Determination

I. INTRODUCTION

- In the last two lectures, we first discussed some important reasons why transactions take place in the foreign exchange market including transaction clearing, arbitrage, speculation, and hedging. Then, we talked about hedging in more detail, discussing how people exposed to foreign exchange risk could use spot markets, forward markets, futures markets and options markets to "hedge" their risk.
- In today's class, we will take a closer look at how arbitragers and speculators move money around to take advantage of different rates of return from buying financial assets in different countries.
- These actions affect the value of both the spot and forward exchange rates. We will derive some relationships that describe how the spot rate and the forward rate are affected by the actions of the players in the foreign exchange market.
- These relationships are also known as interest parity conditions.

II. UNCOVERED INTEREST RATE PARITY

Comparing Rates of Return

- In an integrated world economy, investors seek to obtain the maximum possible return on their assets wherever they can. They essentially compare the rate of return in different countries and choose to put their money in the country that offers the highest rate of return.
- Consider a pair of countries; let's say the U.S. and Japan. Let i be the 1 period interest rate in the U.S., and let i^* be the 1 period interest rate in Japan. The period can be any length of time; the appropriate interest rate is the rate of return on domestic assets in a country over the period in concern.
- We assume that investors who invest in foreign countries have to do so in that country's currency, i.e. in order to invest in Japan you first need to acquire Japanese yen. This is not too strong an assumption; furthermore even if Japan were to allow investors to invest using dollars, arbitrage would ensure that the returns in Japan and the U.S. are equal.
- If an investor invests \$1 in the U.S. then after 1 period she'd have \$(1+i). Alternatively, she can take that \$1 and invest it in Japan. In order to do so she has to first convert the \$1 into Japanese yen. Assuming that the nominal exchange rate between the two countries is given by e she will invest $\frac{1}{e}$ yen and will have $\frac{1}{e}(1+i^*)$ yen at the end of the period.
- To compare her gains from investing in each of the two countries, she has to also convert the money she would earn in Japan into dollar terms. Since this return is generated over a period's time, the exchange rate she has to use is next period's exchange rate.

- At the time she makes her investment decision next period's spot exchange rate is unknown; therefore, she has to calculate her expected gain. The expected gain in dollars is $e^E\left(\frac{1}{e}(1+i^*)\right)$ where e^E is the expected spot exchange rate in the next period.
- Therefore, her gain from investing in Japan is $\$\frac{e^E}{e}(1+i^*)$ while her return from investing in the U.S. is $\$(1+i)$.
- We can conclude that if $\frac{e^E}{e}(1+i^*) > (1+i)$ then the investor will put her money in Japan. If however $\frac{e^E}{e}(1+i^*) < (1+i)$ she is better off putting her money in the U.S.
- We can simplify this a little bit by doing some algebra. The details of this algebra are omitted here: you can ask me if you have questions. Essentially, we can simplify the investment decision as follows:
  - If $i > i^* + \frac{e^E - e}{e}$ then the investor will put her money in the United States.
  - If however $i < i^* + \frac{e^E - e}{e}$ she is better off putting her money in Japan.
- Does this make intuitive sense? Well the percentage return from investing a dollar in the U.S. is clearly i. The percentage return from investing a dollar in Japan is not only the interest rate you earn there (i^*), but also the expected depreciation of the dollar, which is given by the term $\frac{e^E - e}{e}$. A depreciation of the dollar (a positive value of $\frac{e^E - e}{e}$) raises the return from investing in Japan because each yen buys more dollars. An appreciation of the dollar (a negative value of $\frac{e^E - e}{e}$) lowers the return from investing in Japan because each yen buys fewer dollars.
- So intuitively this equation states that if the dollar return an investor can achieve in the U.S. exceeds the dollar return she can earn in Japan she should invest in the U.S. and vice versa.
- This can be seen best with a simple example. Suppose that interest rates for a 1 period deposit are 5% in the U.S. ($i = 5\%$) and 2% in Japan ($i^* = 2\%$). Now suppose that the dollar is expected to depreciate by 2% during the next period $\frac{e^E - e}{e} = 2\%$. Then according to the formula, she should invest in the U.S. Why? Because her return from investing in Japan, in dollar terms, is only 4% (2% yen return plus the 2% depreciation of the dollar.)
- It is vital to note that these are expected returns. Given current interest rates for, and the current exchange rate between, a pair of countries, which country we decide to invest in depends on our beliefs about next period's exchange rate; the actual exchange rate next period may differ from what was expected at the time of investment, therefore our decision about where to invest may end up being wrong ex-post.

Adjustment so that Uncovered Interest Rate Parity Holds

- Given interest rate differentials in the U.S. and Japan and the expected depreciation of the dollar we established the conditions under which investors would prefer to invest in the U.S. or in Japan.
- Investors who shift from one currency to another to take advantage of the higher expected returns affect the spot rate and change the incentives for investing in that country.

- Consider the previous example. When interest rates are 5% in the U.S. and 2% in Japan with an expected depreciation of the dollar by 2%, investors prefer to invest in the U.S.

- This raises the demand for U.S. dollars today as more Japanese will move their money to the U.S. today in the hope of bringing it back next period. It will also raise the demand for yen in the next period as some of the Japanese who moved their money to the U.S. move their money back to Japan.

- Thus, we would expect the demand for dollars to rise today, and the demand for yen to rise next period. From supply and demand analysis, we know that an increase in demand will raise the price of a good, so an increase in the demand for dollars will increase today's price of dollars, i.e. leads to an appreciation of the dollar (e falls). Similarly, we would expect the price of the dollar to fall in the next period as the money is brought back to Japan from the United States. We would, therefore expect the dollar to depreciate next period (e^E rises)

- Therefore, we would expect to see an increase in the expected depreciation of the dollar. (when e falls and e^E rises, expected depreciation of the dollar $\frac{e^E - e}{e}$ rises). This causes the return from investing in Japan to be higher. Why? The higher expected depreciation of the dollar means that that a given yen return will be worth more in dollar terms later on. Alternatively, the high spot value of the dollar means that \$1 can buy you more yen today for investing in Japan.

- The converse can be told about the case where the initial conditions made it more attractive to invest in Japan. This would increase the demand for Japanese yen today and increase the demand for U.S. dollars in the next period. The dollar will depreciate today (e rises)and will be expected to appreciate next period (e^E falls). This reduces the expected depreciation of the dollar (when e rises and e^E falls, expected depreciation of the dollar $\frac{e^E - e}{e}$ falls). The lower expected depreciation of the dollar makes it less attractive to invest in Japan because the yen you will have at the end of the period will be worth much less in dollar terms.

- The basic gist of the story is that the actions of the investors push the exchange rate towards an equilibrium where the expected returns in the two countries are equal:

$$i = i^* + \frac{e^E - e}{e}$$

- This equality is known as the Uncovered Interest Rate Parity Condition (UIRP). UIRP may not always hold exactly because it deals with expected returns. So knowing that one could earn a 5% return for certain in the U.S. may lead one to invest in the U.S. even if the expected return from investing in Japan was also 5%. The person may even decide to invest in the U.S. if the expected return from investing in Japan was 5.01%, depending on how risk averse one is.

- In practice, deviations form UIRP can be quite large as Figure 17.3 in Pugel demonstrates the magnitude of these deviations.

III. COVERED INTEREST RATE PARITY

- Uncovered Interest Parity examined the expected gains between investing in two countries. We can also calculate the returns from investing in a particular country with certainty by looking at the forward exchange rate.
- Consider the U.S. and Japan again. An investor who invests \$1 in the U.S gets \$(1+i) after 1 period. If instead she took that \$1 and invested it in Japan she could have $\frac{1}{e}(1+i^*)$ yen at the end of the period.
- The investor can lock in the dollar value of her investment in Japan by buying dollars in exchange for yen on the forward market. That way she can be sure of the rate at which she can bring her yen back to the U.S. in the form of dollars.
- Her gain from investing in Japan in dollar terms is $f\left(\frac{1}{e}(1+i^*)\right)$ where f is the one period ahead forward exchange rate between dollars and yen.
- Therefore if $\frac{f}{e}(1+i^*) > (1+i)$ then the investor will put her money in Japan. If however $\frac{f}{e}(1+i^*) < (1+i)$ she is better off putting her money in the U.S.
- Once again we can simplify these conditions with a little algebra to read
  - If $i > i^* + \frac{f-e}{e}$ then the investor will put her money in the United States.
  - If however $i < i^* + \frac{f-e}{e}$ she is better off putting her money in Japan.
- So intuitively this equation states that if the guaranteed dollar return an investor can achieve in the U.S. exceeds the guaranteed dollar return she can earn in Japan she should invest in the U.S. and vice versa.
- Since the return is guaranteed, arbitrage should always ensure that $i = i^* + \frac{f-e}{e}$. This is known as the Covered Interest Rate Parity Condition. Covered Interest Rate Parity is likely to hold almost always, because it deals with a risk-free return.
- We can think of covered interest rate parity as a relationship that determines the value of the forward exchange rate. Studies have shown that the CIRP relationship is in fact what most banks use to calculate the value of the forward exchange rate.
- When there is a deviation from covered interest rate parity it is not because of exchange rate fluctuations but because of political or other type of risk associated with a country. See Figure 17.2 in Pugel for a good example of how well CIRP holds.
- It is important to realize that in comparing returns across countries, investors have to worry about 3 differences: differences in exchange rates as well as differences in the reliability of the countries and the financial institutions where they are investing money. Here we have assumed away the latter and concentrated only on the exchange rate differences.
- In real life, investors may not actually only worry about interest rates and forward and spot rates. For example, when comparing the returns from Angola and the returns from the U.S., they could be worried about other the possibility of a coup in Angola that could cause them to lose their investment.
- In such cases, there can be some deviations from the CIRP or UIRP relationships with no obvious signs of a rush to invest abroad despite what seems to be a higher return when compared to the U.S.