THE INSTITUTE OF FINANCE MANAGEMENT

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LECTURE NOTES
PARITY RELATIONSHIPS IN INTERNATIONAL FINANCE

INTRODUCTION

Parity Relationships Defined

Parity relationships as applied in the context of this lesson refer to the macroeconomic relationship between nations. They hold under conditions of perfect market and entail existence of market efficiency.

The Parities

There are five key theoretical economic relationships/parity relationships:

1. Purchasing Power parity (PPP)
2. Fisher Effect (FE)
3. International Fisher Effect (IFE)
4. Interest Rate parity (IRP)
5. Forward Rates as Unbiased Predictors of Future spot Rates or the Unbiased Nature of Forward Rates (UFR)

THE PURCHASING POWER PARITY

Purchasing Power Parity

The Purchasing Power Parity (PPP) theory is one of the early theories of exchange rate determination. This theory is based on the concept that the demand for a country's currency is derived from the demand for the goods that this country produces. Thus, the exchange rate for a certain country's currency depends on the demand for the goods produced in that country. If prices of goods are low relative to those in other countries, then this exchange rate will be high. The PPP relationship is important because it tells us whether changes in the nominal exchange

rate have an impact on real variables such as the value of a firm or the return on a portfolio of assets. The theory assumes that the actions of importers and exporters, motivated by cross country price differences; induce changes in the spot exchange rate. In another vein, PPP suggests that transactions on a country's current account, affect the value of the exchange rate on the foreign exchange market. The PPP has two versions:

1. The Absolute Version of the PPP
2. The Relative Version of the PPP

The Absolute Version of the PPP

The Absolute version represents an application of the so called the Law of One Price. The LOP is described in the next sub-section.

The Law of One Price (LOP)

The law of one price says that identical goods should sell for the same price in two separate markets when there are no transportation costs and no differential taxes applied in the two markets. According to this law the exchange rate between two different currencies should be simply the ratio of the prices of the particular commodity in the two countries. The LOP holds under the following assumptions:

- Transaction costs to trading the commodity (transportation, distribution etc.) do not exist.
- There are no barriers (taxes, tariffs, quotas etc.) to trading the commodity.
- The commodity is identical in both countries

Formally the LOP is represented by the following formula:

Basic Relationship: $P_{D(t)} = e_{F(t)}P_{F(t)}$ and $e_{F(t)} = \frac{P_{D(t)}}{P_{F(t)}}$

where:

$P_{D(t)}$ = Domestic currency price of a particular commodity at time t

$P_{F(t)}$ = Foreign currency price of a particular commodity at time t

$e_{F(t)}$ = Exchange rate (i.e. the domestic currency value of the foreign currency) at time t

Problems with the PPP Theory in Its Absolute Version

Absolute PPP is the version of the theory which describes the relationship between the levels of prices and exchange rates at a particular point in time. It can be derived from the LOP assuming the latter holds for each and every commodity. In its absolute version, purchasing power parity states that exchange-adjusted price levels should be identical worldwide. In other words, a unit of domestic currency should have the same purchasing power around the world. The price level indicates the price of a particular basket of goods. The most common price index is the Consumer Price Index (CPI). The main problem with the PPP theory in its absolute version is that the PPP condition is rarely satisfied within a country. There are quite a few reasons that can explain this and so, given the logic of the theory, which makes sense, economists have been reluctant to discard the theory on the basis of lack of supporting evidence. Below we consider

some of the reasons the absolute PPP may not hold.

For the absolute PPP to hold, the following assumptions have to be made:

(i) There are no restrictions on the movement of commodities, since any restriction will hinder smooth operation of the commodity arbitrage.
(ii) There are no transportation costs, otherwise the equilibrium condition as represented by the equality of prices as measured in the same currency will not hold.
(iii) There are no tariffs, because tariffs have the same effect on the relationship as transportation costs.
(iv) Agents, such as commodity arbitrageurs are risk neutral in the sense that they do not require the payment of a risk premium to operate in the foreign commodity markets.

Relative Purchasing Power Parity

If the assumptions of the absolute version of the PPP are relaxed a bit more, we observe what is termed *relative purchasing power parity*. The relative version of the PPP implies that, because of several factors (such as transportation costs and trade impediments), prices of similar commodities are not necessarily the same when measured in the same currency. The relative version of purchasing power parity, which is used more commonly now, states that the exchange rate between the domestic currency and any foreign currency will adjust to reflect changes in the price levels of the two countries. In other words the percentage change in the exchange rate reflects the difference between inflation at home and abroad.

More specifically, *if the spot exchange rate between two currencies starts in equilibrium, any change in the differential rate of inflation between them tend to be offset over the long run by an equal but opposite change in the spot exchange rate.* For example, if the inflation rate is 5 % in Tanzania and 2 % in Kenya, then the Kenyan shilling should appreciate by 3 % in order to equalize the Tanzania shilling price of goods in the two countries. That is, if prices in Tanzania are rising faster than prices in Kenya, then Kenya's exports are becoming relatively cheaper. This should attract importers, thereby increasing Kenyan net exports and reducing Tanzania's net exports. This should generate a relatively higher demand for Kenyan shilling and promote an appreciation of the Kenyan shilling against the Tanzanian shilling.

Formally the Purchasing Power Parity is represented by the formula:

The Multi-Period Version

$$\frac{e_t}{e_0} = \frac{(1+i_h)^t}{(1+i_f)^t}, \qquad \text{implying that } e_t = e_0 \frac{(1+i_h)^t}{(1+i_f)^t}$$

where: e_t = the home currency value of the foreign currency at time *t*
e_0 = the home currency value of the foreign currency at time *0*
i_h = the periodic domestic inflation rate
i_h = the periodic domestic inflation rate

While absolute PPP describes the relationship between exchange rates and prices at a particular

point in time, relative PPP describes the movement of the exchange rate from one level to another under the influence of changes in prices (i.e. inflation).

The One Period Version

The one- period version of the above equation is commonly used. It is:

$$\frac{e_1}{e_0} = \frac{(1+i_h)}{(1+i_f)}, \text{ implying that } e_1 = e_0 \frac{(1+i_h)}{(1+i_f)}$$

Purchasing Power parity is often represented by the following approximation.

$$\frac{e_1 - e_0}{e_0} = i_h - i_f$$

where: e_t = the home currency value of the foreign currency at time *t*

e_0 = the home currency value of the foreign currency at time *0*

i_h = the periodic domestic inflation rate

i_h = the periodic domestic inflation rate

$\frac{e_1 - e_0}{e_0}$ = exchange rate change

$i_h - i_f$ = inflation differential

That is, the exchange rate changes during a period should equal the inflation differential for that same time period. In effect, PPP says that currencies with high rates of inflation should devalue relative to currencies with lower rates of inflation.

THE FISHER EFFECT

The Fisher effect states that the nominal interest rate r is made up of two components: (1) a real required rate of return a and (2) an inflation premium equal to the expected amount of inflation *i*.

The Formal Version

Formally, the Fisher effect is:

(1 + Nominal Rate) = (1 + Real Rate)(1 + Expected Inflation Rate)

$(1 + r) = (1 + a)(1 + i)$ or $r = a + i + ai$, which is often approximated by the equation:

$r = a + i$

The Fisher equation says, for example, that if the required real return is 3% and expected inflation is 10%, then the nominal interest rate will be about 13% (13.3%, to be exact).

The Generalized Version of the FE

The generalized version for the Fisher effect asserts that real returns are equalized across countries through arbitrage that is, $a_h = a_f$, where the subscripts h and f refer to home and foreign. If expected real returns were higher in one currency than another, capital would flow from the second to the first currency. This process of arbitrage would continue, in the absence of government intervention, until expected real returns were equalized, where r_h and r_f are the nominal home- and foreign-currency interest rates, respectively.

In equilibrium, then, with no government interference, is should follow that the nominal interest rate differential will approximately equal the anticipated inflation rate differential.

$$\frac{1+r_h}{1+r_f} = \frac{(1+i_h)}{(1+i_f)}$$

Where r_h and r_f are the nominal home and foreign currency interest rates, respectively. If r_f and i_f are relatively small, then this exact relationship can be approximated by the following equation.

$$(r_h - r_f) = (i_h + i_f)$$

In effect, the generalized version of the Fisher Effect says that currencies with high rates of inflation should bear higher interest rates than currencies with lower rates of inflation. In effect, the generalized version of the Fisher effect says that currencies with high rates of inflation should bear higher interest rates than currencies with lower rates of inflation. Empirical evidence is consistent with the hypothesis that most of the variation in nominal interest rates across countries can be attributed to differences in inflationary expectations.

THE INTERNATIONAL FISHER EFFECT

The International Fisher Effect represents a combination of the first two parity relationships: The PPP and the FE.

Mathematical Representation

Multi-period Version

$$\frac{e_t}{e_0} = \frac{(1+r_h)^t}{(1+r_f)^t}, \qquad \text{implying that } e_t = e_0 \frac{(1+r_h)^t}{(1+r_f)^t}$$

One Period Version

$$\frac{e_t}{e_0} = \frac{(1+r_h)}{(1+r_f)}, \qquad \text{implying that } e_t = e_0 \frac{(1+r_h)}{(1+r_f)}$$

According to the above equation, the expected return from investing at home, $(1 + r_h)$ should be equal to expected HC return from investing abroad, $(1+ r_f)$ e_1 / e_o. The IFE is often represented by the following approximation:

$$r_h - r_f = \frac{\bar{e}_1 - \bar{e}_0}{e_0}$$

In effect, the IFE says that currencies with low interest rates are expected to appreciate relative to currencies with high interest rates. In effect, the IFE says that currencies with low interest rates are expected to appreciate relative to currencies with high interest rates.

Non- Constant Interest Rates

With non-constant interest rates in the two countries, the IFE formula is modified and will take the form:

$$e_t = e_{t-1}\frac{(1+r_{ht})}{(1+r_{ft})}$$

Thus exchange rates are to be computed in steps.

THE INTEREST RATE PARITY

The movement of funds between two currencies to take advantage of interest rate differentials is also a major determinant of the spread between forward and spot rates. In fact, the forward discount or premium is closely related to the interest differential between the two currencies. According to interest rate parity theory, the currency of the country with a lower interest rate should be at a forward premium in terms of the currency of the country with the higher rate. More specifically, in an efficient market with no transaction costs, the interest differential should be (approximately) equal to the forward differential. When this condition is met, the forward rate is said to be at interest parity, and equilibrium prevails in the money markets.

Interest parity ensures that the return on a hedged (or "covered") foreign investment will just equal the domestic interest rate on investments of identical risk, thereby eliminating the possibility of having a money machine. When this condition holds, the covered interest differential the difference between the domestic interest rate and the hedged foreign rate is zero. If the covered interest differential between two money markets is nonzero, there is an arbitrage incentive to move money from one market to the other. Interest rate parity holds when there are no covered interest arbitrage opportunities. Formally the IRP is given by:

$$\frac{f_1}{e_0} = \frac{1+r_h}{1+r_f}$$

where: r_h = the home currency nominal interest rate
rf = the foreign currency interest rate
e_0 = home currency value of the foreign currency at time 0

IRP Approximation

Interest Rate Parity is often approximated by the equation:

$$\frac{f_1 - e_0}{e_0} = (r_h - r_f)$$

$\frac{f_1 - e_0}{e_0}$ = forward differential (forward premium or discount)

$(r_h - r_f)$ = interest differential

In effect, interest rate parity says that high interest rates on a currency are offset by forward discounts and that low interest rates are offset by forward premiums.

Interest rate parity is one of the best-documented relationships in international finance. In fact, in the Eurocurrency markets, the forward rate is calculated from the interest differential between the two currencies using the no-arbitrage condition.

Interest Rate Arbitrage

Definition: Is the process of borrowing and investing in currencies. Interest rate arbitrage opportunities exist only when the IRP does not hold. The IRP does not hold when:

1. The Interest Differential differs from the Forward Differential and/or
2. The Currency that bears the higher rate of interest trades at a forward premium and that with the lower rate of interest trades at a forward discount.

Steps Involved in Interest Rate Arbitrage:

Assuming that the IRP does not hold, the arbitrager will take the following steps to benefit from the possible arbitrage opportunities:

1. *Determine the Direction of Funds Movement*. This involves the following steps:
    a. Computing the Covered Yield on each currency as follows:
        Covered Yield = Nominal Interest Rate + Forward Premium (for the currency trading at a forward premium)
        Covered Yield = Nominal Interest Rate + Forward Discount (for the currency trading at a forward discount)
    b. Compare the Covered Yield on each currency with the nominal interest rate on the other currency. If the covered yield on a currency is greater than the nominal interest rate on the other currency, then we say there is covered interest differential in favour of that currency. This is then the currency of investment. The other currency is the currency to borrow.

2. *Carry out the Arbitrage Process*

There two types of the interest rate arbitrage process: (i) Covered Interest Arbitrage and (ii) Uncovered Interest Arbitrage. If the abbreviation 'CB' represents the currency to borrow and the abbreviation 'CI' represents the currency of investment, the process can be described as follows:

Covered Interest Arbitrage [Steps]

- Borrow the CB at the CB borrowing rate for a period equal to the length of the forward contract.
- Covert the CB borrowed amount into CI equivalent spot
- Invest (for instance – deposit) the CI amount at the CI investment (or deposit rate) for a period equal to the length of the forward contract.
- Simultaneously sell the future CI investment proceeds forward
- Collect the CI investment proceeds, deliver the amount to the bank in settlement of the forward contract and receive the CB (CB equivalent of the CI investment proceeds)
- Use part of the CB amount to repay the CB loan [Principal + Interest]

Arbitrage Profit = [CB Equivalent of the CI Investment Proceeds – CB Loan Amount]. The

arbitrage profit is risk free.

Uncovered Interest Arbitrage [Steps]

- Borrow the CB at the CB borrowing rate for a period equal to the length of the forward contract.
- Covert the CB borrowed amount into CI equivalent spot
- Invest (for instance – deposit) the CI amount at the CI investment (or deposit rate) for a period equal to the length of the forward contract.
- Collect the CI investment proceeds and covert the amount spot into CB at whatever rate that happens to be (Spot CB equivalent of the CI investment proceeds).
- Use part of the CB amount to repay the CB loan [Principal + Interest]

Arbitrage Profit = [CB Equivalent of the CI Investment Proceeds – CB Loan Amount]. The arbitrage profit is risky.

Inward Interest Arbitrage vs. Outward Interest Arbitrage

Inward Interest Arbitrage

The process involves borrowing in foreign currency and investing in domestic currency. It involves the following steps: (Assuming it is Covered Interest Arbitrage)

- Borrow the Foreign currency at the foreign currency borrowing rate for a period equal to the length of the forward contract.
- Covert the foreign currency borrowed amount into domestic currency equivalent spot
- Invest (for instance – deposit) the domestic currency amount at the domestic currency investment (or deposit rate) for a period equal to the length of the forward contract.
- Simultaneously sell the future domestic currency investment proceeds forward
- Collect the domestic currency investment proceeds, deliver the amount to the bank in settlement of the forward contract and receive the foreign currency (foreign currency equivalent of the domestic currency investment proceeds)
- Use part of the foreign currency amount to repay the foreign currency loan [Principal + Interest]

Outward Interest Arbitrage

The process involves borrowing in domestic currency and investing in a foreign currency denominated security. It involves the following steps: (Assuming it is Covered Interest Arbitrage)

- Borrow the domestic currency at the domestic currency borrowing rate for a period equal to the length of the forward contract.
- Covert the domestic currency borrowed amount into foreign currency equivalent spot
- Invest (for instance – deposit) the foreign currency amount at the foreign currency investment (or deposit rate) for a period equal to the length of the forward contract.
- Simultaneously sell the future foreign currency investment proceeds forward

- Collect the foreign currency investment proceeds, deliver the amount to the bank in settlement of the forward contract and receive the domestic currency (domestic currency equivalent of the foreign currency investment proceeds)
- Use part of the domestic currency amount to repay the domestic currency loan [Principal + Interest]

THE UNBIASED NATURE OF FORWARD RATES

Our current understanding of the workings of the foreign exchange market suggests that, in the absence of government intervention in the market, both the spot rate and the forward rate are influenced heavily by current expectations of future events; and both rates move in tandem, with the link between them based on interest differentials. New information, such as a change in interest rate differentials, is reflected almost immediately in both spot and forward rate. Equilibrium is achieved only when the forward differential equals the expected change in the exchange rate. At this point, there is no longer any incentive to buy or sell the currency forward. A formal statement of the unbiased nature of the forward rate (UFR) is that the forward rate should reflect the expected future spot rate on the date of settlement of the forward contract:

$$f_1 = \bar{e}_1$$

where: f_1 = forward rate for settlement at time 1

$\bar{e}_1$ = expected future spot rate on the date of settlement of the forward contract.

When the UFR holds, forward speculation may not yield positive profits.