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Principal Investigator	Co-Principal Investigator		Technical Coordinator
Prof Suresh Chand Aggarwal Department of Business Economics University of Delhi, South Campus	**Dr Jaswinder Singh** Principal SGTB Khalsa College University of Delhi	**Prof. Rashmi Agrawal** Deptt. Of Business Economics University of Delhi South Delhi Campus	**Dr Vimal Rarh** Deputy Director, Centre for e-Learning and Assistant Professor, Department of Chemistry, SGTB Khalsa College, University of Delhi Specialised in : e-Learning and Educational Technologies

Paper Coordinator		Content Writer	Reviewer
Dr. Vinod Kumar Associate Professor S.G.N.D Khalsa College University of Delhi	**Dr. Rajinder Pal Singh** Associate Professor, SGTB Khalsa College, University of Delhi	**Jasmit Kaur** Assistant Professor S.G.G.S College of Commerce University of Delhi	**Dr. P.N Varshney** Ex-Professor and Head Department of Business Economics University of Delhi, South Campus

Anchor Institute : SGTB Khalsa College, University of Delhi

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1. Learning Outcomes

After studying this module, you shall be able to

- Know how are exchange rates determined
- Identify the factors that influence the demand and supply of currency
- Understand international arbitrage and interest rate parity
- Evaluate and analyze the interrelationship between various parity conditions

2. Introduction

Exchange rates can be classified as fixed and floating according to the degree by which exchange rates are controlled by the government. Exchange rates are important for government and business organizations to facilitate international trade and payments. Any change in exchange rates in either direction influences the cash flows and exchange rates are influenced and determined by product prices and interest rates. Exchange rates (spot and forward), product prices and interest rates have equilibrium relationships, also known as *parity relationships*. Also, parity relationships are influenced by arbitrage.

3. Exchange Rate Determination

3.1 Exchange Rate Equilibrium

The exchange rate is the price of one country's currency in terms of another country's currency and is determined by demand and supply forces in the foreign exchange market. So, any change in the exchange rate is the result of a change in the supply of and demand for foreign currency in a country. The point of intersection of the demand and supply curves gives the equilibrium exchange rate.

3.1.1 Demand for a currency

A country's currency is in demand when foreigners buy the goods and services exported by that country or when they want to buy financial instruments denominated in that currency. For example, the demand for U.S dollar is derived from demand for U.S goods and services in other countries. Any increase in the U.S dollar value will be caused by an increase in the price of goods and services of U.S denominated currency. This results in a reduced demand for U.S denominated goods and services. The reverse will happen when the foreign currency U.S dollar value decreases. Suppose the exchange rate of INR against the U.S dollar is at INR 62.50. If the exchange rate appreciate to USD/INR 45, the price of U.S commodities in terms of INR decreases. As a result, the demand for U.S commodities increases in India leading to rise in the demand for U.S dollars. The reverse will happen if the exchange rate decreases. Thus, demand for a currency in the foreign exchange market increases with the depreciation of that currency.

3.1.2 Supply of a currency

Supply of a currency derives from the demand for imported commodities denominated in foreign currency. When the country's imports are priced in a foreign currency, the resident buyers will sell their domestic currency for the foreign currency to pay for imported commodities which contributes to supply of the currency in the foreign exchange market. For example, the supply of the U.S dollar as against the Indian Rupee depends upon the demand for Indian commodities in the United States. If the exchange between the USD and INR decreases, the cost of Indian commodities will also decreases. As a result, the demand for Indian commodities in the United States increases leading to the increase in the supply of U.S dollars in India. Thus, supply for a currency in the foreign exchange market increases with the appreciation of that currency.

3.1.3 Equilibrium

The equilibrium exchange rate is the exchange rate at which the demand for a currency is equivalent to the supply of the same currency.

3.2 Factors affecting Exchange Rates

There are several factors that affect the exchange rates through their effect on foreign currency demand and supply, leading to the new equilibrium exchange rate. The factors that influence exchange rates are:

3.2.1 Inflation Rates

Inflation is the result of expansion of money supply in excess of real output growth in the country. Inflation influences exchange rates by affecting the competitiveness of the country's commodities in the foreign markets. Because of inflation, the country's goods would become costlier and their exports will decline leading to a decline in the supply of foreign currency. Also, exchange rates are affected when the inflation rates are different in different countries. A higher rate of inflation in India relative to the rate of inflation in U.S will increase U.S exports to India and reduce Indian exports to the U.S.

3.2.2 Economic growth Rate

High economic growth rate of the country leads to the more economic transactions within the country and across countries. This will cause the equilibrium exchange rate to the new equilibrium rate.

3.2.3 Political Factors

Political factors do influence the demand for and supply of foreign currency. Political stability in a country may attract a large amount of investment funding in foreign currencies as investors find the country to be less risky and more rewarding. Thus, increasing the supply of foreign currency.

On the other hand, political instability of a country may drive away investors from the country. Thus, the demand for foreign currency will increase.

3.2.4 Social Factors

Social factors like education levels, communal and regional harmony and demographic characteristics affects the demand for and supply of foreign currency in the country. For example, high literacy and education levels may increase cross border movement of people and cross border flow of funds.

3.2.5 Government Controls

Sometimes government puts strict controls and barriers on imports and exports. All such controls influence the demand and supply of currencies in the foreign exchange market. Government or the central bank of the country may also directly intervene in the foreign exchange market and influence exchange rates. Therefore, exchange rates are highly susceptible to government controls, barriers and interventions.

4. Arbitrage, Interest Rate and Exchange Rate

Movement of funds form one country to another is a common phenomenon in order to maximize the wealth of the investors. Investors borrow in markets where interest rates are low and then exchange the currency to invest in the markets where interest rates are higher. This situation gives them an opportunity for arbitrage. The term *arbitrage* refers to an act of buying currency in one market (at lower price) and selling it in another country (at higher price). Thus, difference in these exchange rates in the two markets provides an opportunity to earn profit without risk. Arbitrage or international arbitrage can be of three types:

4.1 Locational arbitrage

Locational arbitrage is the process of buying a currency at the location where it is cheap and immediately selling it at another location where it is priced higher. Locational arbitrage is also known as simple arbitrage. For example, at two forex centres, the following INR-US $ rates are quoted:

> London   Rs. 62.5730-62.6100;   Tokyo   Rs.62.6350-62.6675

The arbitrage possibilities for an arbitrageur who has Rs. 100 million may be found by the following modus operandi:

(i)   He will purchase US $ from the London forex market at the rate of Rs. 62.6100, as it is the cheaper as compared the Tokyo forex market (Rs.62.6350). He will obtain US $ 1,597,188.95 (Rs 100 million/Rs 62.6100) on conversion.
(ii)   He will sell US $ 1,597,188.95 at the rate of Rs 62.6350 per US $ and will obtain Rs 100,039,909.90.

(iii)   As a result of arbitrage, he will earn a profit of Rs 39,909.90 (Rs 100,039,909.90 – Rs 100 million) without any risk.

Locational arbitrage is normally conducted by banks or other foreign exchange dealers who can continuously monitor the quotes provided by banks. Locational arbitrage applies not only to banks on the same street or within the same city but to all banks across the world.

4.2 Triangular arbitrage

Triangular arbitrage is also known as three point arbitrage as there are three currencies involving three markets. For example: the following are three quotes in three forex markets.

| $ 1= Rs. 63.51 in Mumbai |
| £ 1 = Rs. 99.68 in London |
| £ 1 = $1.62 in New York |

Assuming that there are no transaction costs and the arbitrageur has US $ 1.000,000. Arbitrage gains are possible since the cross rate between US $/ British £ by using the rates at London and at Mumbai is different (Rs 99.68/Rs 63.51 = US $ 1.5965/£ 1) from that of New York ($ 1.62). The arbitrageur can adopt the following steps to realize arbitrage gain.

(i)   The arbitrageur will buy Indian rupees with US $ 1 million. The total proceeds he obtains is (Rs 63.51 × $ 1 million US $) Rs 63,510,000.
(ii)   He converts Indian rupees in British £ at the London forex market. He receives (Rs 63,510,000/Rs 99.68) £ 637,138.844.
(iii)   He then converts £ 637,138.844 at the New York forex market. He then obtains (£ 637,138.844 × $ 1.62) US $ 1,032,164.93
(iv)   Thus he has net gain of (US $ 1,032,164.93 - $ 1,000,000) US $ 32,164.93.

4.3 Covered interest arbitrage

Borrowing in one currency and lending in another, or investing in securities denominated in another currency with the currency risk covered or hedged in the forward market is known as covered interest arbitrage. For example, assume that an investor borrowed USD 10 million in the United States for one year at an interest rate of 6 percent per annum. He converted USD 10 million into British pounds at an exchange rate of GBP/USD 1.75, and received GBP 5.72 million. He then invested GBP 5.72 million in the GBP-denominated bank deposit for one year, at an interest rate of 8 percent. Simultaneously, he entered in the forward account to sell the maturity value of the bank deposit (GBP 5.72 + 8 percent of 5.72 = GBP 6.18) in exchange for the US dollar amount at the forward rate of GBP/USD 1.80. After one year, the investor received USD 11.124 (GBP 6.18 × 1.80), repaid the loan amount with interest (USD 10.60). Thus, he finally made a profit of USD 0.524 million. It is to be noted that the investor has converted the USD amount into GBP at the spot exchange rate and invested that amount in the GBP denominated deposit. Simultaneously, he has sold the GBP forward at the one year forward exchange rate. All these operations take place at the time of investment. So, any change in the exchange rate during the investment period does not affect the investor.

This type of a portfolio is known as an *arbitrage portfolio* which is completely self-financed. Two points should be noted in the above example. First, the investor did not commit his own funds any time. Second, the net cash flow on the date of maturity is known with certainty.

5. Interest Rate Parity

Interest rate parity describes the relationship between forward rates and interest rates. Once market forces cause interest rates and exchange rates to adjust such that covered interest arbitrage is no longer feasible, there is an equilibrium state referred to as *interest rate parity* (IRP). In equilibrium, the forward rate differs from the spot rate by a sufficient amount to offset the interest rate differential between two currencies. The basic principle is that there is an interconnection between the interest rates and the exchange rates. The IRP theory states that premium or discount of one currency in relation to the other should reflect the interest rate differentials between the two currencies. In other words, the interest rate parity theory states that the difference in the interest rates (risk-free) on two currencies should be equal to the difference between the forward exchange rate and the spot exchange rate if there are to be no arbitrage opportunities. IRP can be summarized by saying that where the interest rate differ from one country to the other, the spot and forward rates will not be same. The spread between the spot rate and forward rate is influenced by the interest rate differential between the two currencies. Thus, interest rate parity can be represented by the following equation:

$$1 + K_h / 1 + K_f = F_t / S_o$$

The same can also be written as:

$$K_h - K_f = (F_t - S_o) / S_o$$

This means that the interest rate differential is approximately equal to the forward rate differential. Such a relationship is called an uncovered interest parity relationship. If the interest rate in India is 8 percent per annum and 6 percent per annum in Singapore, the uncovered interest parity relationship would imply that Singapore dollar is expected to appreciate against the Indian INR by about 2 percent.

Example 5.1: The interest rate in India and the United States are 8 percent per annum and 6 percent per annum, respectively. The current spot rate is USD/INR 62.4354. If the interest rate parity holds, what is the three month forward rate?

Solution: The three month forward rate will be:

$$F_{90} = 62.4354 \ [(1 + 0.08/4) / (1 + 0.06 /4)] = 64.6394$$

The USD has a three month forward rate of INR 64.6394. This forward rate can also be taken as the expected spot rate in three months.

Example 5.2: The spot rate of the Indian rupee against the British Pound is 100. The interest rate in the United Kingdom is 8 percent and in India it is 6 percent. What is the forward rate premium

or discount of the Indian Rupee with respect to the British pound if interest rate parity exists? What is the forward rate (one year) of the British pound in terms of the Indian Rupee?

Solution: The forward premium or discount of the GBP with respect to the INR will be:

$$\text{Premium} = (1 + K_h / 1 + K_f) - 1$$

$$= [(1 + 0.06) / (1 + 0.08)] - 1$$

$$= -0.0185$$

Thus, the GBP is at forward discount of 1.85 percent with respect to the INR.

The one month forward rate of the GBP is:

$$F_t = S_o (1 + P)$$

$$F_1 = 100 (1 - 0.0185) = 98.15$$

Example 5.3: The following are the interest rates and spot rates of exchange:

Spot rate: USD/INR 62.45/50

Interest rates in India: 10 percent – 10.25 percent per annum

Interest rates in the US: 7 percent – 7.25 percent per annum

If interest parity holds, what are the forward quotes?

Solution: $F_{bid} \leq 62.50 \, [(1 + 0.1025) / (1 + 0.07)]$

$$F_{bid} \leq 65.40$$

$F_{ask} \geq 62.45 \, [(1 + 0.10) / (1 + 0.0725)]$

$$F_{ask} \geq 64.05$$

The limits for the forward quotes are 64.05-65.40.

Interest rate parity takes two different forms: *Uncovered interest rate parity* refers to the parity condition in which exposure to foreign exchange risk is inhibited whereas *covered interest rate parity* refers to the condition a forward contract has been used to cover exchange rate risk. Each form of the parity condition shows a unique relationship with implications for the forecasting of future exchange rate and the future spot exchange rate.

6. Summary

- Exchange rates can be classified as fixed and floating according to the degree by which exchange rates are controlled by the government.
- Exchange rates are important for government and business organizations to facilitate international trade and payments.
- Exchange rates are influenced and determined by product prices and interest rates.
- Exchange rates (spot and forward), product prices and interest prices have equilibrium relationships, also known as *parity relationships*. Also, parity relationships are influenced by arbitrage.
- The exchange rate is the price of one country's currency in terms of another country's currency and in determined by demand and supply forces in the foreign exchange market.
- A country's currency is in demand when foreigners buy the goods and services exported by that country or when they want to buy financial commodities denominated in that currency. Demand for a currency in the foreign exchange market increases with the depreciation of that currency.
- Supply of a currency derives from the demand for imported commodities denominated in foreign currency. Supply for a currency in the foreign exchange market increases with the appreciation of that currency.
- The graphical representation of the demand schedule and the supply schedule are called the demand curve and the supply curve respectively. The point of intersection of the demand and supply curves gives the equilibrium exchange rate of a currency vis-à-vis another currency. The quantity of the currency supplied equals the quantity demanded at the equilibrium exchange rate.
- The factors other than the exchange rate that influence the currency supply and demand are inflation, economic growth rate, interest rates, political factors, social factors, etc. the equilibrium exchange rate changes whenever the position of the demand and supply curve change the influence of these factors.
- The term *arbitrage* refers to an act of buying currency in one market (at lower price) and selling it in another (at higher price). Difference in these exchange rates in two markets provides an opportunity to earn profit without risk.
- Arbitrage or international arbitrage can be of three types: Locational arbitrage, triangular arbitrage and covered interest arbitrage.
- Locational arbitrage is the process of buying a currency at the location where it is cheap and immediately selling it at another location where it is priced higher. Locational arbitrage is also known as simple arbitrage.
- Triangular arbitrage is also known as three point arbitrage as there are three currencies involving three markets.
- Borrowing in one currency and lending in another, or investing in securities denominated in another currency with the currency risk covered or hedged in the forward market is known as covered interest arbitrage.
- Once market forces cause interest rates and exchange rates to adjust such that covered interest arbitrage is no longer feasible, there is an equilibrium state referred to as *interest rate parity*

- Interest rate parity takes two different forms: *Uncovered interest rate parity* refers to the parity condition in which exposure to foreign exchange risk is inhibited whereas *covered interest rate parity* refers to the condition a forward contract has been used to cover exchange rate risk. Each form of the parity condition shows a unique relationship with implications for the forecasting of future exchange rate and the future spot exchange rate.