Foreign Exchange Market Concepts

The **foreign exchange market** is a global network where individuals, businesses, and institutions trade currencies. To understand this market, it's essential to grasp the basics of **exchange rate notation** and **pricing**.

Exchange Rate Notation

An **exchange rate** is the price of the **base currency** expressed in terms of the **price currency**. For example, a USD/EUR rate of 1.1650 means the euro, the base currency, costs 1.1650 US dollars.

> The notation used to represent exchange rates can vary widely between sources, and occasionally the same exchange rate notation will be used by different sources to mean completely different things.

To avoid confusion, we will identify exchange rates using the convention of P/B, referring to the price of the base currency, B, expressed in terms of the price currency, P.

Bid-Offer Spread

The **bid-offer spread** is the difference between the **offer price** and the **bid price**. It's the compensation that counterparties seek for providing foreign exchange to other market participants.

- The **offer price** is the price, in terms of the price currency, at which a counterparty is willing to sell one unit of the base currency.
- The **bid price** is the price, defined in terms of the price currency, at which the counterparty is willing to buy one unit of the base currency.

For example, given a price request from a client, a dealer might quote a two-sided price on the spot USD/EUR exchange rate of 1.1648/1.1652. This means that the dealer is willing to pay USD 1.1648 to buy one EUR and that the dealer is willing to sell one EUR for USD 1.1652.

Key Points to Remember

There are two key points to bear in mind about bid-offer quotes:

1. The offer price is always higher than the bid price.
2. The party in the transaction who requests a two-sided price quote has the option (but not the obligation) to deal at either the bid (to sell the base currency) or the offer (to buy the base currency) quoted by the dealer.

Interbank Market

The interbank market is a global network for exchanging currencies among professional market participants. It allows dealers to:

- Adjust their inventories and risk positions
- Distribute foreign currencies to end users who need them
- Transfer foreign exchange rate risk to market participants who are willing to bear it

The following table summarizes the key characteristics of the interbank market:

Characteristic	Description
Dealing size	At least 1 million units of the base currency
Market participants	Professional market participants, including dealers, institutional asset managers, and hedge funds
Purpose	To adjust inventories and risk positions, distribute foreign currencies, and transfer foreign exchange rate risk

Calculating the Bid-Offer Spread

The bid-offer spread can be calculated as the difference between the offer price and the bid price. For example, if the bid price is 1.1648 and the offer price is 1.1652, the bid-offer spread would be:

$1.1652 - 1.1648 = 0.0004$

This bid-offer spread represents the compensation that the counterparty seeks for providing foreign exchange to other market participants.## Foreign Exchange Market Concepts The foreign exchange market is a global market where individuals, businesses, and institutions trade currencies. In this market, the bid-offer spread is the difference between the bid price (the price at which a dealer is willing to buy a currency) and the offer price (the price at which a dealer is willing to sell a currency).

> A pip is the smallest unit of price movement in the foreign exchange market, equivalent to 0.0001 in most currency pairs, except for the yen, which is typically quoted to two decimal places, with the second decimal place (0.01) referred to as a pip.

The bid-offer spread in the interbank market can vary widely across exchange rates and is not constant over time, even for a single exchange rate. The size of this spread depends primarily on three factors:

- The bid-offer spread in the interbank foreign exchange market for the two currencies involved
- The size of the transaction
- The relationship between the dealer and the client

Factors Influencing Liquidity

The liquidity in the interbank market is influenced by several factors, including:

- The currency pair involved, with major currency pairs (e.g., USD/EUR, JPY/USD, and USD/GBP) typically having higher liquidity
- The time of day, with the interbank FX markets being most liquid when the major FX trading centers are open
- Market volatility, with wider bid-offer spreads in times of high uncertainty

The following table illustrates the approximate hours of the most liquid trading periods in each market:

Market	Approximate Hours of Most Liquid Trading Periods
London	08:00 - 11:00 (New York time)
New York	08:00 - 11:00 (New York time)
Tokyo	07:00 - 10:00 (New York time)
Singapore	07:00 - 10:00 (New York time)
Hong Kong SAR	07:00 - 10:00 (New York time)

Arbitrage Constraints on Spot Exchange Rate Quotes

The bid-offer quotes a dealer shows in the interbank FX market must respect two arbitrage constraints:

1. The bid shown by a dealer in the interbank market cannot be higher than the current interbank offer, and the offer shown by a dealer cannot be lower than the current interbank bid
2. The cross-rate bids (offers) posted by a dealer must be lower (higher) than the implied cross-rate offers (bids) available in the interbank market

Triangular Arbitrage Opportunity

A triangular arbitrage opportunity arises when the bid-offer quotes for three currencies do not respect the arbitrage constraints. For example, given exchange rate quotes for the currency pairs A/B and C/B, we can back out the implied cross rate of A/C. If this implied A/C cross rate is not consistent with the A/B and C/B rates, a triangular arbitrage opportunity exists.

The following table illustrates the calculation of a triangular arbitrage opportunity:

Currency Pair	Bid	Offer
A/B	1.1000	1.1020
C/B	1.2000	1.2020
A/C (implied)	0.9167	0.9183

In this example, if the implied cross rate of A/C is not consistent with the A/B and C/B rates, a triangular arbitrage opportunity exists, allowing a trader to make a riskless profit.## Arbitrage Constraints on Spot Exchange Rate Quotes The basic principle of arbitrage states that if identical financial products are priced differently, then market participants will buy the cheaper one and sell the more expensive one until the price difference is eliminated. In the context of FX cross rates, there are two ways to trade currency A against currency C:

- using the cross rate A/C
- using the A/B and C/B rates

Because both methods involve selling (buying) currency C in order to buy (sell) currency A, the exchange rates for these two approaches must be consistent. If the exchange rates are not consistent, the arbitrageur will buy currency C from a dealer if it is undervalued (relative to the cross rate) and sell currency A.

> An arbitrageur is an individual or entity that takes advantage of price differences between two or more markets to earn a profit.

Triangular Arbitrage

To illustrate triangular arbitrage among three currencies, suppose that the interbank market bid/offer in USD/EUR is 1.1649/1.1651 and that the bid/offer in JPY/USD is 105.39/105.41. We need to use these two interbank bid/offer quotes to calculate the market-implied bid/offer quote on the JPY/EUR cross rate.

The following equation represents the cross-rate relationship: $E_{JPY/EUR} = E_{JPY/USD} \times E_{USD/EUR}$

Using the provided quotes, we can calculate the JPY/EUR bid and offer rates as follows:

- Bid: $E_{JPY/EUR} = 105.39 \times 1.1649 = 122.77$
- Offer: $E_{JPY/EUR} = 105.41 \times 1.1651 = 122.81$

Calculating Implied Cross Rates

To calculate the implied cross rate, we need to consider the bid and offer rates for the two underlying currency pairs.

Currency Pair	Bid Rate	Offer Rate
USD/EUR	1.1649	1.1651
JPY/USD	105.39	105.41

Using the provided quotes, we can calculate the implied JPY/EUR bid and offer rates as follows:

- Bid: $E_{JPY/EUR} = 105.39 \times 1.1649 = 122.77$
- Offer: $E_{JPY/EUR} = 105.41 \times 1.1651 = 122.81$

Inverting Currency Pairs

When calculating the implied cross rate, we may need to invert one of the underlying currency pairs.

For example, to calculate the implied GBP/EUR cross rate, we need to invert the USD/GBP quote to get the GBP/USD quote.

Currency Pair	Bid Rate	Offer Rate
USD/GBP	1.2302	1.2304
USD/EUR	1.1649	1.1651

Using the provided quotes, we can calculate the implied GBP/EUR bid and offer rates as follows:

- Bid: $E_{GBP/EUR} = 0.81274 \times 1.1649 = 0.9468$
- Offer: $E_{GBP/EUR} = 0.81288 \times 1.1651 = 0.9471$

Example Problems

The following are example problems to illustrate the calculation of implied cross rates:

1. What is the bid/offer on the SEK/EUR cross rate implied by the interbank market?
- Bid: $E_{SEK/EUR} = 9.6300 \times 1.1649 = 11.2180$
- Offer: $E_{SEK/EUR} = 9.6302 \times 1.1651 = 11.2201$
2. What is the bid/offer on the JPY/CAD cross rate implied by the interbank market?
- Bid: $E_{JPY/CAD} = 105.39 \times 0.75752 = 79.84$
- Offer: $E_{JPY/CAD} = 105.41 \times 0.75763 = 79.86$

Triangular Arbitrage Opportunities

If a dealer quoted a bid/offer rate of 79.81/79.83 in JPY/CAD, then a **triangular arbitrage** would involve buying CAD in the interbank market and selling it to the dealer.

The following table summarizes the **triangular arbitrage** opportunity:

Currency Pair	Bid Rate	Offer Rate	Implied Rate
JPY/CAD	79.81	79.83	79.84/79.86
JPY/USD	105.39	105.41	-
USD/CAD	1.3199	1.3201	-

By buying CAD in the interbank market and selling it to the dealer, the arbitrageur can earn a profit of $79.84 - 79.81 = 0.03$ per unit of CAD.## Introduction to Forward Markets Forward markets involve agreements to exchange one currency for another on a future date at an exchange rate agreed upon today. Any exchange rate transaction that has a settlement date longer than T + 2 is a **forward contract**.

Key Concepts

The following are key concepts related to forward markets:

- **Outright forward contracts**: agreements to exchange one currency for another on a future date at an exchange rate agreed upon today
- **Forward exchange rates**: the exchange rates agreed upon today for a future transaction
- **Spot rate**: the current exchange rate
- **Forward premium**: the difference between the forward exchange rate and the spot rate, where the forward exchange rate is higher than the spot rate
- **Forward discount**: the difference between the forward exchange rate and the spot rate, where the forward exchange rate is lower than the spot rate

Covered Interest Rate Parity

Covered interest rate parity is an arbitrage relationship that equates the investment return on two alternative but equivalent investments. The equation for covered interest rate parity is: [\frac{1 + i_d}{1 + i_f} = \frac{S}{F}] where:

- i_d is the **domestic risk-free interest rate**
- i_f is the **foreign risk-free interest rate**
- S is the **spot rate**
- F is the **forward rate**

Forward Premium or Discount

The forward premium or discount can be calculated using the following equation: [F - S = S \left(\frac{i_f - i_d}{1 + i_d} \right)] This equation shows that the domestic currency will trade at a forward premium if, and only if, the foreign risk-free interest rate exceeds the domestic risk-free interest rate.

Day Count Convention

The day count convention is used to calculate interest on bank deposits. The most common day count conventions are:

Convention	Description
Actual/360	interest is calculated as if there were 360 days in a year
Actual/365	interest is calculated as if there were 365 days in a year

> A forward contract is an agreement to exchange one currency for another on a future date at an exchange rate agreed upon today. Covered interest rate parity is an arbitrage relationship that equates the investment return on two alternative but equivalent investments.

Example

Suppose an investor has one unit of domestic currency to invest for one year. The investor faces two alternatives:

- Invest in a domestic risk-free asset with an interest rate of i_d
- Convert the domestic currency to foreign currency at the spot rate S and invest in a foreign risk-free asset with an interest rate of i_f The investor can eliminate the foreign exchange risk associated with converting at an unknown future spot rate by using a forward contract.

Arbitrage Relationship

The arbitrage relationship between the two investment alternatives is based on the principle that the investment return on two alternative but equivalent investments must be equal. If the returns are not equal, investors can earn a riskless arbitrage profit by borrowing in one currency, lending in the other, and using the spot and forward exchange markets to eliminate currency risk.

Forward Rate Calculation

The forward rate can be calculated using the following equation: [F = S \left(\frac{1 + i_f}{1 + i_d} \right)] This equation shows that the forward rate is a function of the spot rate, the foreign risk-free interest rate, and the domestic risk-free interest rate.## Forward Markets In the context of foreign exchange markets, the forward market is a platform where individuals and institutions can buy or sell currencies at a predetermined exchange rate for delivery at a future date. The forward rate is calculated using the covered interest rate parity equation, which takes into account the spot rate, interest rates, and time to maturity.

The covered interest rate parity equation is given by: $F = S \times \frac{(1 + i_P)}{(1 + i_B)}$

where:

- F is the forward rate
- S is the spot rate
- i_P is the interest rate of the price currency
- i_B is the interest rate of the base currency

Calculating Forward Premium (Discount)

The forward premium (discount) is the difference between the forward rate and the spot rate, and it can be calculated using the following equation: $F - S = S \times \frac{(i_P - i_B)}{(1 + i_B)}$

> The forward premium (discount) represents the excess return demanded by investors for holding a foreign currency over a domestic currency.

Example: Calculating Forward Premium (Discount)

Given the following data:

Currency	Spot Rate	270-day MRR
CAD/AUD	0.9000	-
AUD	-	1.47%
CAD	-	0.41%

The forward premium (discount) can be calculated as follows: $F - S = 0.9000 \times \frac{(0.0147 - 0.0041)}{(1 + 0.0147)} = 0.0071$

Forward Points

In professional FX markets, forward exchange rates are typically quoted in terms of points, which represent the difference between the forward exchange rate and the spot exchange rate. The points are scaled so that they can be directly related to the last decimal place in the spot quote.

The following table shows an example of spot and forward quotes:

Maturity	Spot Rate	Forward Points
1 month	1.1649/1.1651	5.6/5.1
3 months	1.1649/1.1651	15.9/15.3
6 months	1.1649/1.1651	37.0/36.3
12 months	1.1649/1.1651	94.3/91.8

To convert the quoted forward points into a forward rate, divide the number of points by 10,000 and add the result to the spot exchange rate.

Mark-to-Market Value of a Forward Contract

The mark-to-market value of a forward contract reflects the profit or loss that would be realized from closing out the position at current market prices. To calculate the mark-to-market value, create an offsetting forward position that is equal to the original forward position, determine the appropriate all-in forward rate for this new position, and calculate the cash flow at the settlement day.

The steps to calculate the mark-to-market value are:

- Create an offsetting forward position that is equal to the original forward position
- Determine the appropriate all-in forward rate for this new position
- Calculate the cash flow at the settlement day
- Discount the cash flow to the present using the discount rate

Key considerations:

- The offsetting forward position is defined in terms of the original position taken
- The all-in forward rate is calculated using the spot rate and forward points
- The cash flow at the settlement day is based on the difference between the original forward rate and the new all-in forward rate
- The discount rate is used to discount the cash flow to the present## Forward Rates and Bid-Offer Spreads The bid-offer spread for forward points is affected by several factors, including:
- Interbank market liquidity of the underlying currency pair
- Size of the transaction
- Relationship between the client and the dealer
- Term of the forward contract

Generally, the longer the term of the forward contract, the wider the bid-offer spread. This is because as the term increases, liquidity in the forward market tends to decline, counterparty credit risk increases, and interest rate risk of the contract increases.

Calculating Forward Rates

To calculate the all-in forward rate, the forward points are added to or subtracted from the spot rate. The currency of the cash flow and the discount rate must match.

Example: Calculating Forward Rates

The current spot rate for CHF/GBP is 1.2939/1.2941. The one-month forward points are 8.3/7.9. To calculate the all-in one-month forward rate, the forward points are added to or subtracted from the spot rate.

Currency Pair	Spot Rate	Forward Points	All-in Forward Rate
CHF/GBP	1.2939/1.2941	8.3/7.9	1.29136/1.29150

Mark-to-Market Value of Forward Positions

The mark-to-market value of a forward position is calculated by determining the present value of the cash flow at the settlement date. The discount rate used to calculate the present value must match the currency of the cash flow.

The mark-to-market value of a forward position is the present value of the cash flow at the settlement date, calculated using the discount rate that matches the currency of the cash flow.

Example: Mark-to-Market Value of Forward Positions

A dealer sells NZD 10 million forward against the USD at an all-in forward rate of 0.7900. To calculate the mark-to-market value of the forward position, the dealer must determine the present value of the cash flow at the settlement date.

Currency Pair	Spot Rate	Forward Points	All-in Forward Rate	Mark-to-Market Value
USD/NZD	0.7825/0.7830	12.1/10.0	0.7820	+USD 79,938

International Parity Conditions

International parity conditions describe the inter-relationships that jointly determine long-run movements in exchange rates, interest rates, and inflation. These conditions are the basic building blocks for describing long-term equilibrium levels for exchange rates.

The key concepts to keep in mind when analyzing exchange rate movements are:

- Long run versus short run: Many factors that determine exchange rate movements exert subtle but persistent influences over long periods of time.
- Expected versus unexpected changes: In reasonably efficient markets, prices will adjust to reflect market participants' expectations of future developments.
- Relative movements: An exchange rate represents the relative price of one currency in terms of another.## International Parity Conditions International parity conditions are the building blocks of most models of exchange rate determination. The key international parity conditions are:
- Covered Interest Rate Parity
- Uncovered Interest Rate Parity
- Forward Rate Parity
- Purchasing Power Parity
- The International Fisher Effect

These conditions show how expected inflation differentials, interest rate differentials, forward exchange rates, current spot exchange rates, and expected future spot exchange rates would be linked in an ideal world.

Covered Interest Rate Parity

> Covered interest rate parity is a no-arbitrage condition that states an investment in a foreign money market instrument that is completely hedged against exchange rate risk should yield exactly the same return as an otherwise identical domestic money market investment.

Given the spot exchange rate and the domestic and foreign yields, the forward exchange rate must equal the rate that gives these two alternative investment strategies exactly the same holding period return.

The assumptions for covered interest rate parity to hold exactly are:

- Zero transaction costs
- The underlying domestic and foreign money market instruments being compared are identical in terms of liquidity, maturity, and default risk

Uncovered Interest Rate Parity

> Uncovered interest rate parity states that the expected return on an uncovered foreign currency investment should equal the return on a comparable domestic currency investment.

The change in spot rate over the investment horizon should, on average, equal the differential in interest rates between the two countries. The expected appreciation/depreciation of the exchange rate will just offset the yield differential.

The formula for the return on an uncovered foreign-currency-denominated investment is:

$$(1 + i_f) \left(\frac{S_{f/d}}{S_{f/d}} \right) - 1$$

where i_f is the foreign interest rate and $S_{f/d}$ is the spot exchange rate.

Examples of Uncovered Interest Rate Parity

The following table illustrates three cases of uncovered interest rate parity:

Case	Domestic Interest Rate	Foreign Interest Rate	Expected Change in Spot Rate	Expected Return on Foreign Investment
1	4%	10%	0%	10%
2	4%	10%	10%	0%
3	4%	10%	6%	4%

In the third case, uncovered interest rate parity holds because both investments offer a 4% expected return. However, the expected return on the foreign money market instrument is uncertain because the future spot rate is uncertain.

Assumptions of Uncovered Interest Rate Parity

The assumptions of uncovered interest rate parity are:

- Enough risk-neutral investors to force equality of expected returns
- The investor is risk neutral, meaning they base their decisions solely on the expected return and are indifferent to the investment's risk

Relations Among International Parity Conditions

The international parity conditions are related to each other and can be used to forecast future spot exchange rates. The following table summarizes the relations among the international parity conditions:

Parity Condition	Description	Formula
Covered Interest Rate Parity	Equal returns on hedged foreign and domestic investments	$F = S \left(\frac{1 + i_d}{1 + i_f} \right)$
Uncovered Interest Rate Parity	Equal expected returns on unhedged foreign and domestic investments	$(1 + i_f) \left(\frac{S_{f/d}}{S_{f/d}} \right) - 1 = i_d$
Forward Rate Parity	Equal returns on forward and spot exchange rates	$F = S \left(\frac{1 + i_d}{1 + i_f} \right)$
Purchasing Power Parity	Equal purchasing power of currencies	$S = \frac{P_f}{P_d}$
The International Fisher Effect	Equal expected returns on foreign and domestic investments	$i_f = i_d + \frac{E(S_{f/d}) - S_{f/d}}{S_{f/d}}$

Note: F is the forward exchange rate, S is the spot exchange rate, i_d is the domestic interest rate, i_f is the foreign interest rate, P_f is the foreign price level, P_d is the domestic price level, and $E(S_{f/d})$ is the expected future spot exchange rate.## Uncovered Interest Rate Parity Uncovered interest rate parity states that the expected change in the spot exchange rate over the investment horizon should be reflected in the interest rate differential. This can be represented by the equation: $%S_e = i_i^{f/d}$, where S_e indicates the change in the spot rate expected for future periods.

> The expected change in the spot exchange rate is equal to the interest rate differential between the foreign and domestic investments.

Key Assumptions

The uncovered interest rate parity assumes that:

- The country with the higher interest rate or money market yield will see its currency depreciate
- The depreciation of the currency offsets the initial higher yield so that the expected all-in return on the two investment choices is the same

Implications

If uncovered interest rate parity held consistently in the real world, it would rule out the possibility of earning excess returns from going long a high-yield currency and going short a low-yield currency. However, most studies have found that over short- and medium-term periods, the rate of depreciation of the high-yield currency is less than what would be implied by uncovered interest rate parity.

Forward Rate Parity

Forward rate parity states that the forward exchange rate will be an unbiased predictor of the future spot exchange rate. This can be represented by the equation: $F = S_e$, where F is the forward exchange rate and S_e is the expected future spot exchange rate.

Covered Interest Rate Parity

Covered interest rate parity describes the relationship among the spot exchange rate, the forward exchange rate, and interest rates. The arbitrage condition that underlies covered interest rate parity can be rearranged to give an expression for the forward premium or discount: $F - S = (i_i^f - i_i^d) \times S$, where i_i^f is the foreign risk-free interest rate and i_i^d is the domestic risk-free interest rate.

Comparison of Parity Conditions

Parity Condition	Description	Equation
Uncovered Interest Rate Parity	Expected change in spot exchange rate equals interest rate differential	$%S_e = i_i^{f/d}$
Forward Rate Parity	Forward exchange rate is an unbiased predictor of future spot exchange rate	$F = S_e$
Covered Interest Rate Parity	Relationship among spot exchange rate, forward exchange rate, and interest rates	$F - S = (i_i^f - i_i^d) \times S$

Example

Consider an Australia-based fixed-income asset manager deciding how to allocate money between Australia and Japan. Given the following information:

- JPY/AUD spot rate: 71.78
- One-year forward points: 139.4
- One-year Australian deposit rate: 3.00%
- One-year Japanese deposit rate: 1.00%

Using uncovered interest rate parity, the expected change in the JPY/AUD rate is closest to a decrease of 2%, which is equal to the interest rate differential between Australia and Japan (3% - 1%).

Forecasting Future Spot Rates

Using forward rates to forecast future spot rates assumes that:

- Investors are risk neutral
- Uncovered interest rate parity holds
- Forward rate parity holds

Forecasting that the JPY/AUD spot rate one year from now will equal 71.78 assumes that spot rates follow a random walk.## International Parity Conditions The international parity conditions are a set of theories that explain the relationship between exchange rates, interest rates, and inflation rates. The main conditions are:

- **Covered Interest Rate Parity**: a theory that states that the difference in interest rates between two countries is equal to the forward premium or discount
- **Uncovered Interest Rate Parity**: a theory that states that the expected change in the exchange rate is equal to the difference in interest rates between two countries
- **Forward Rate Parity**: a theory that states that the forward exchange rate is equal to the spot exchange rate plus the interest rate differential
- **Purchasing Power Parity**: a theory that states that the exchange rate between two countries is equal to the ratio of their price levels

Purchasing Power Parity

Purchasing Power Parity (PPP) is a theory that explains the relationship between exchange rates and price levels. There are three versions of PPP:

- **Absolute PPP**: a theory that states that the exchange rate between two countries is equal to the ratio of their price levels
- **Relative PPP**: a theory that states that the change in the exchange rate is equal to the difference in inflation rates between two countries
- **Ex Ante PPP**: a theory that states that the expected change in the exchange rate is equal to the expected difference in inflation rates between two countries

  The law of one price states that identical goods should trade at the same price across countries when valued in terms of a common currency.

The **law of one price** can be expressed as: $P_x^f = S \times P_x^d$ where P_x^f is the foreign price of good x, P_x^d is the domestic price of good x, and S is the exchange rate.

Absolute Purchasing Power Parity

The **absolute version of PPP** states that the exchange rate between two countries is equal to the ratio of their price levels. This can be expressed as: $S = \frac{P^f}{P^d}$ where P^f is the foreign price level and P^d is the domestic price level.

Relative Purchasing Power Parity

The **relative version of PPP** states that the change in the exchange rate is equal to the difference in inflation rates between two countries. This can be expressed as: $% \Delta S = \pi^f - \pi^d$ where $% \Delta S$ is the percentage change in the exchange rate, π^f is the foreign inflation rate, and π^d is the domestic inflation rate.

Ex Ante Purchasing Power Parity

The **ex ante version of PPP** states that the expected change in the exchange rate is equal to the expected difference in inflation rates between two countries. This can be expressed as: $% \Delta S^e = \pi^{e,f} - \pi^{e,d}$ where $% \Delta S^e$ is the expected percentage change in the exchange rate, $\pi^{e,f}$ is the expected foreign inflation rate, and $\pi^{e,d}$ is the expected domestic inflation rate.

Conversion from Absolute Levels to a Rate of Change

To convert from a relationship expressed in levels of the relevant variables to a relationship among rates of change, the following formula can be used: $(1 + %X) = (1 + %Y)(1 + %Z)$ where $%X$, $%Y$, and $%Z$ are the percentage changes in the variables X, Y, and Z, respectively.

Example Calculations

The following table shows an example of how to calculate the expected change in the exchange rate using the ex ante version of PPP:

Country	Inflation Rate
Foreign	9%
Domestic	5%

Using the ex ante version of PPP, the expected change in the exchange rate can be calculated as: $% \Delta S^e = \pi^{e,f} - \pi^{e,d} = 9% - 5% = 4%$

This means that the exchange rate is expected to depreciate by 4% over the next period.## Purchasing Power Parity (PPP) Purchasing Power Parity (PPP) is a theory that states that exchange rates between currencies are determined by the relative prices of goods and services in each country. The first panel of Exhibit 2 indicates no clear relationship between changes in exchange rates and inflation differentials at the one-year time horizon. However, as the time horizon is lengthened to five years and beyond, a strong positive relationship becomes apparent.

Relationship Between Exchange Rates and Inflation Differentials

The relationship between exchange rates and inflation differentials can be seen in the following tables:

Time Horizon	Relationship
1 year	No clear relationship
5 years	Strong positive relationship
10 years	Strong positive relationship
15 years	Strong positive relationship

The Fisher Effect

The Fisher Effect states that the nominal interest rate (i) in a given country can be broken down into two parts:

> the real interest rate (r) in that particular country and the expected inflation rate (e) in that country: i = r + e

Real Interest Rate Parity

The Real Interest Rate Parity condition states that real interest rates will converge to the same level across different markets. This means that the real yield spread between the domestic and foreign countries will be zero.

International Fisher Effect

The International Fisher Effect states that the nominal interest rate spread is determined solely by the foreign-domestic expected inflation differential: i - i = e - e

Key Concepts

- Nominal Interest Rate: the interest rate that includes the effects of inflation
- Real Interest Rate: the interest rate that excludes the effects of inflation
- Expected Inflation Rate: the rate at which prices are expected to rise
- Exchange Rate: the price of one currency in terms of another currency

Example

An Australia-based fixed-income investment manager is deciding how to allocate her portfolio between Australia and Japan. The Australian dollar is estimated to be roughly 10% overvalued relative to the Japanese yen based on Purchasing Power Parity.

Solutions

1. All else equal, which of the following events would restore the Australian dollar to its PPP value?

- A. The Japanese inflation rate increases by 2%.
- B. The Australian inflation rate decreases by 10%.
- C. The JPY/AUD exchange rate declines by 10%. Solution: C is correct.

2. If real interest rates in Japan and Australia were equal, then under the International Fisher Effect, the inflation rate differential between Japan and Australia would be closest to:

- A. 0%.
- B. 2%.
- C. 10%. Solution: B is correct.

3. According to the theory and empirical evidence of Purchasing Power Parity, which of the following would not be true if PPP holds in the long run?

- A. An exchange rate's equilibrium path should be determined by the long-term trend in domestic price levels relative to foreign price levels.
- B. Deviations from PPP might occur over short- and medium-term periods, but fundamental forces should eventually work to push exchange rates toward their long-term PPP path.
- C. High-inflation countries should tend to see their currencies appreciate over time. Solution: C is correct.## International Parity Conditions The international parity conditions are a set of theories that explain the relationship between exchange rates, interest rates, and inflation rates across countries. These conditions are used to predict exchange rate movements and to identify potential arbitrage opportunities.

Definitions

The absolute version of PPP assumes that all goods and services are tradable and that the domestic and foreign price indexes include the same bundle of goods and services with the same exact weights in each country. Covered interest rate parity is a no-arbitrage condition that states that the investment return on two riskless investments (domestic and currency-hedged foreign) should be equal. Uncovered interest rate parity states that the expected percentage change in the spot exchange rate should, on average, be reflected in the nominal interest rate spread.

Key International Parity Conditions

The following are the key international parity conditions:

- Covered interest rate parity: arbitrage ensures that nominal interest rate spreads equal the percentage forward premium (or discount)
- Uncovered interest rate parity: the expected percentage change in the spot exchange rate should, on average, be reflected in the nominal interest rate spread
- Ex ante PPP: the expected change in the spot exchange rate should equal the expected difference between domestic and foreign inflation rates
- International Fisher effect: the nominal interest rate in each market equals the real interest rate plus the expected inflation rate
- Real interest rate parity: real interest rates are broadly the same across all markets

Relationship between International Parity Conditions

The following table summarizes the relationship between the international parity conditions:

Condition	Description
Covered interest rate parity	Nominal interest rate spreads equal the percentage forward premium (or discount)
Uncovered interest rate parity	Expected percentage change in the spot exchange rate equals the nominal interest rate spread
Ex ante PPP	Expected change in the spot exchange rate equals the expected difference between domestic and foreign inflation rates
International Fisher effect	Nominal interest rate equals the real interest rate plus the expected inflation rate
Real interest rate parity	Real interest rates are broadly the same across all markets

The Carry Trade

The carry trade is a trading strategy that involves taking long positions in high-yield currencies and short positions in low-yield currencies. This strategy is based on the idea that uncovered interest rate parity does not hold over short and medium time periods, and that high-yield currencies will not depreciate and low-yield currencies will not appreciate to the levels predicted by interest rate differentials.

Example of the Carry Trade

The following is an example of the carry trade:

1. Borrow Canadian dollars at 1%
2. Sell the dollars and buy Brazilian reals at the spot rate
3. Invest in a real-denominated investment at 9%
4. Liquidate the Brazilian investment at the end of the year
5. Sell the reals and buy dollars at the spot rate
6. Pay back the dollar loan

Risks and Rewards of the Carry Trade

The carry trade involves both reward and risk. The reward is the gradual accrual of the interest rate differential income, while the risk arises from the potential for sudden adverse exchange rate movements that result in instantaneous capital losses. The following table summarizes the risks and rewards of the carry trade:

Reward/Risk	Description
Reward	Gradual accrual of interest rate differential income
Risk	Potential for sudden adverse exchange rate movements resulting in instantaneous capital losses

Carry trades involve borrowing in a low-yielding currency and investing in a high-yielding currency. This strategy is based on the supposition that uncovered interest rate parity does not hold.

> The uncovered interest rate parity states that the difference in interest rates between two currencies is equal to the expected change in the exchange rate between the two currencies.

The carry trade is prone to significant crash risk in turbulent times, resulting in a non-normal distribution of returns. The distribution tends to be more peaked, with fatter tails and negative skewness.

Characteristics of Carry Trade Returns

The following are key characteristics of carry trade returns:

- More peaked distribution around the mean
- Fatter tails, indicating a higher probability of large losses
- Negative skewness, indicating a higher probability of large losses than large gains

Managing Carry Trade Risk

To manage the risk of carry trades, investors can use stop-loss orders and hedging strategies. However, these strategies may not be effective in turbulent times, and the leverage inherent in carry trades can exacerbate losses.

Example of a Carry Trade

The following table illustrates an example of a carry trade:

Currency	Interest Rate
JPY (Japanese Yen)	0.10%
AUD (Australian Dollar)	1.70%

In this example, a Tokyo-based asset manager enters into a carry trade position by borrowing in JPY and investing in a one-year AUD deposit. The all-in return to this trade, measured in JPY terms, would be closest to 1.53%.

The Impact of Balance of Payments Flows

The balance of payments consists of the current account and the capital account. The current account reflects flows in the real economy, while the capital account reflects financial flows.

The following table illustrates the relationship between the current account and the capital account:

Current Account	Capital Account
Deficit	Surplus
Surplus	Deficit

Countries with **current account deficits** must attract funds from abroad to pay for imports, resulting in a **capital account surplus**. Conversely, countries with **current account surpluses** must invest their surplus funds abroad, resulting in a **capital account deficit**.

Mechanisms of Exchange Rate Determination

The following are key mechanisms by which **current account imbalances** influence **exchange rates**:

- The **flow supply/demand channel**
- The **portfolio balance channel**
- The **debt sustainability channel**

These mechanisms can have a significant impact on **exchange rates**, particularly in the **short to intermediate term**. However, **investment/financing decisions** are usually the dominant factor in determining **exchange rate movements**.## Current Account Imbalances and Exchange Rates Current account imbalances occur when a country's **exports** are not equal to its **imports**. This imbalance can affect the **exchange rate** of a country's currency. If a country has a **current account surplus**, it means that the country is exporting more than it is importing, which can lead to an increase in the demand for its currency and an appreciation of its value.

> A **current account surplus** occurs when a country's exports of goods and services exceed its imports, resulting in a net inflow of foreign currency. A **current account deficit** occurs when a country's imports of goods and services exceed its exports, resulting in a net outflow of foreign currency.

The relationship between current account imbalances and exchange rates can be explained by the following mechanisms:

- **Trade Balance Channel**: The trade balance channel suggests that a country with a current account surplus will experience an appreciation of its currency, while a country with a current account deficit will experience a depreciation of its currency.
- **Portfolio Balance Channel**: The portfolio balance channel suggests that current account imbalances can lead to shifts in global asset preferences, which can influence exchange rates.
- **Debt Sustainability Channel**: The debt sustainability channel suggests that a country with a large and persistent current account deficit will eventually experience a depreciation of its currency as investors become concerned about the country's ability to service its debt.

Factors Affecting Exchange Rate Adjustment

The amount by which exchange rates must adjust to restore current accounts to balanced positions depends on several factors, including:

Factor	Description
Initial Gap	The initial gap between imports and exports
Price Elasticity	The response of import and export prices to changes in the exchange rate
Demand Elasticity	The response of import and export demand to changes in import and export prices

Empirical Evidence

Empirical studies have found that the pass-through effects of exchange rate changes on traded goods prices are limited. For example:

- A 1% decline in a currency's value may only lead to a 0.5% increase in import prices
- Foreign producers may lower their profit margins to preserve market share, reducing the impact of exchange rate changes on traded goods prices

Case Studies

The relationship between current account imbalances and exchange rates can be illustrated by the following case studies:

- United States: The US current account balance has been an important determinant of the long-term swings in the US dollar's value. However, there can be long lags between the onset of a deterioration in the current account balance and an eventual decline in the dollar's value.
- Japan: Japan's rising current account surplus has exerted persistent upward pressure on the yen's value versus the dollar over time.
- China: China's large current account surpluses have also put upward pressure on the yuan's value, although the country has implemented policies to manage its currency's value.

Capital Flows and Exchange Rates

Capital flows can also play a significant role in determining exchange rates. Greater financial integration and freedom of capital to flow across national borders have increased the importance of global financial flows in determining exchange rates, interest rates, and broad asset price trends. Examples of how capital flows can affect exchange rates include:

- Boom-like conditions: Global capital flows can fuel boom-like conditions in emerging market economies, leading to extremes in exchange rates, interest rates, or asset prices.
- Sudden stops: Global capital flows can suddenly stop or reverse, leading to significant changes in exchange rates and asset prices.## Capital Flows and Exchange Rates Capital flows refer to the movement of money for the purpose of investment, financing, or other economic activities between countries. Emerging markets often experience large capital inflows, which can lead to economic instability.

Effects of Excessive Capital Inflows

Excessive capital inflows can cause:

- An unwarranted appreciation of the emerging market currency
- A huge buildup in external indebtedness
- An asset bubble
- A consumption binge that contributes to explosive growth in domestic credit and/or the current account deficit
- An overinvestment in risky projects and questionable activities

Government Intervention

Governments in emerging markets often resist currency appreciation from excessive capital inflows by using:

- Capital controls: restrictions on the flow of capital into or out of a country
- Selling their currency in the FX market: foreign exchange market

  A capital control is a government-imposed restriction on the flow of capital into or out of a country. This can include taxes on foreign exchange transactions, restrictions on foreign investment, or other measures to limit the flow of capital.

Interest Rate Spreads and Exchange Rates

Interest rate spreads can have a significant impact on exchange rates. A high-yield, inflation-prone emerging market country may attract capital flows due to its high interest rates.

Country	Interest Rate	Inflation Expectations
High-Yield Country	High	High
Low-Yield Country	Low	Low

The combination of sustained wide nominal yield spreads and a steady narrowing in relative inflation expectations can exert upward pressure on the high-yield currency's value, resulting in carry trade profits over long periods.

Equity Market Trends and Exchange Rates

Equity market trends can also impact exchange rates. Increasing equity prices can attract foreign capital, but the relationship between equity market performance and exchange rates is not stable.

Period	US Equity Market	US Dollar
1990-1995	Strong	Weak
1995-2000	Strong	Strong

Since the global financial crisis, there has been a decidedly negative correlation between the US dollar and the US equity market. This is attributed to the US dollar's role as a safe haven asset.

Example: Capital Flows and Exchange Rates

Consider a currency strategist who is responsible for formulating trading strategies for the currencies of both developed and emerging market countries.

Scenario	Effect on Exchange Rate
Increase in expected inflation differential	Depreciation of the emerging market currency
Increase in safe haven demand	Increase in risk premium demanded by international investors to hold emerging market assets
Persistent current account deficit	Upward revision in the long-run equilibrium emerging market currency value

> A safe haven asset is an asset that is perceived as a low-risk investment, such as the US dollar or gold, which investors flock to during times of economic uncertainty or market volatility.## Exchange Rates and Government Policies The value of a country's currency can be affected by various factors, including government policies. In this section, we will explore how monetary policy and fiscal policy can impact exchange rates.

The Mundell-Fleming Model

The Mundell-Fleming model is a framework used to analyze the effects of monetary policy and fiscal policy on exchange rates. This model assumes that there is sufficient slack in the economy to allow increases in output without price level increases.

> The Mundell-Fleming model focuses on the impact of government policies on aggregate demand, which in turn affects interest rates, capital flows, and trade flows, ultimately influencing the exchange rate.

The model suggests that:

- Expansionary monetary policy reduces interest rates, increasing investment and consumption spending, which can lead to a depreciation of the domestic currency.
- Expansionary fiscal policy increases interest rates, attracting capital from lower-yielding markets, which can lead to an appreciation of the domestic currency.

Monetary and Fiscal Policy Mix

The combination of monetary policy and fiscal policy can have a significant impact on exchange rates. The following tables summarize the effects of different policy mixes on exchange rates under conditions of high and low capital mobility.

High Capital Mobility

Monetary Policy	Fiscal Policy	Effect on Exchange Rate
Restrictive	Expansionary	Appreciation
Expansionary	Restrictive	Depreciation
Expansionary	Expansionary	Indeterminate
Restrictive	Restrictive	Indeterminate

Low Capital Mobility

Monetary Policy	Fiscal Policy	Effect on Exchange Rate
Expansionary	Expansionary	Depreciation
Restrictive	Restrictive	Appreciation
Expansionary	Restrictive	Indeterminate
Restrictive	Expansionary	Indeterminate

Monetary Models of Exchange Rate Determination

Monetary models of exchange rate determination focus on the impact of monetary policy on exchange rates through the price level and inflation rate.

The monetary approach asserts that an increase in the domestic money supply will lead to a proportional increase in the domestic price level, causing a depreciation of the domestic currency.

However, this approach has several shortcomings, including the assumption that purchasing power parity holds in both the short and long runs.

- Purchasing power parity is the idea that exchange rates reflect changes in relative inflation rates.
- Dornbusch's modified monetary model assumes that prices have limited flexibility in the short run but are fully flexible in the long run, providing a more realistic explanation of the impact of monetary forces on exchange rates.## Monetary Policy and Exchange Rates The relationship between monetary policy and exchange rates is complex and influenced by various factors. In the short run, an increase in the nominal money supply can lead to a decline in the domestic interest rate, causing a capital outflow and subsequent depreciation of the domestic currency.

Historical Evidence

Historically, changes in monetary policy have had a significant impact on exchange rates. For example:

- The US Federal Reserve's quantitative easing policy after the global financial crisis led to a depreciation of the US dollar from 2009 to 2011.
- The subsequent ending of quantitative easing in 2014 and the anticipation of interest rate hikes in the US led to an appreciation of the US dollar.
- Abenomics in Japan, which included fiscal stimulus, monetary easing, and structural reforms, led to a depreciation of the yen from 2013 to 2015.

Monetary and Fiscal Policies

The impact of monetary policy and fiscal policy on exchange rates can be summarized as follows:

Policy	Short-term Effect	Long-term Effect
Expansionary Monetary Policy	Depreciation	Appreciation
Expansionary Fiscal Policy	Appreciation	Depreciation

Example

Consider the following example:

> A country with high capital mobility and a flexible exchange rate implements an expansionary monetary policy. The short-term effect will be a depreciation of the domestic currency, as investors seek higher-yielding assets abroad.

Portfolio Balance Approach

The portfolio balance approach examines the role of fiscal policy in determining exchange rates. This approach assumes that global investors hold a diversified portfolio of domestic and foreign assets, including bonds.

> The desired allocation of assets is assumed to vary in response to changes in expected return and risk considerations.

The portfolio balance approach suggests that a growing government budget deficit can lead to a depreciation of the domestic currency over time, as investors demand higher interest rates and/or a higher risk premium to hold the increasing supply of domestic bonds.

Key Insights

The portfolio balance model provides the following key insights:

- Governments that run large budget deficits on a sustained basis may eventually see their currencies depreciate in value.
- Expansionary fiscal policy under conditions of high capital mobility may be positive for a currency in the short run but negative in the long run.

Combining Models

The Mundell-Fleming model and the portfolio balance model can be combined into a single integrated framework to understand the impact of monetary policy and fiscal policy on exchange rates.

This framework suggests that the effects of monetary policy and fiscal policy on exchange rates depend on the level of capital mobility and the sustainability of government debt.## Fiscal Policy and Exchange Rates The relationship between fiscal policy and exchange rates is complex and can have significant effects on a country's economy.

Short-Run Response

In the short run, an expansionary fiscal policy can lead to:

- Higher interest rates
- Higher real rates relative to other countries
- Currency appreciation

This is because the increased government spending and lower taxes can lead to higher economic growth, which can attract foreign investors and increase demand for the country's currency.

Long-Run Response

However, in the long run, an expansionary fiscal policy can lead to:

- Higher government debt
- Higher risk premium for holding the country's debt
- Currency depreciation

This is because the increased government debt can lead to higher interest rates and a higher risk premium, making it more expensive for the government to finance its debt.

Example: Monique Kwan's Analysis

Monique Kwan is analyzing the foreign exchange rate outlook for a country with a high degree of capital mobility and a floating-rate currency regime. The country has a low outstanding volume of government debt as a percentage of GDP, but it is rising sharply due to expansionary fiscal policy.

Short-Run Implications

In the short run, Kwan expects:

- Currency appreciation due to higher interest rates and higher real rates relative to other countries

Medium-Term Implications

In the medium term, as the government debt becomes harder to finance, Kwan expects:

- Monetary policy to become more accommodative to monetize the debt
- Fiscal policy to turn more restrictive to reduce the debt

Long-Term Implications

In the long term, Kwan expects:

- Fiscal consolidation to reduce the public deficit and debt levels
- Currency depreciation as bond yields decrease and the risk premium decreases

Exchange Rate Management: Intervention and Controls

Central banks and governments use intervention and capital controls to manage exchange rates and prevent currency crises.

Objectives of Intervention and Capital Controls

The objectives of intervention and capital controls are to:

- Prevent excessive capital inflows that can lead to currency bubbles and currency crises
- Maintain financial stability and prevent speculative attacks on the currency

Types of Capital Controls

Capital controls can take many forms, including:

- Restrictions on foreign investment
- Taxes on foreign capital inflows
- Requirements for foreign investors to hold a certain percentage of their investments in domestic assets

Effectiveness of Intervention and Capital Controls

The effectiveness of intervention and capital controls depends on various factors, including:

- The size and scope of the intervention
- The type and effectiveness of the capital controls
- The overall economic conditions of the country

  A currency crisis occurs when a country's currency experiences a sudden and significant decline in value, often due to a loss of confidence in the currency or the country's economic policies.

Push and Pull Factors

Push factors and pull factors can drive foreign capital inflows to emerging markets.

Push Factors

Push factors include:

- Low interest rates in industrial countries
- Global investors seeking higher returns in emerging markets

Pull Factors

Pull factors include:

- Improved economic management by the government
- Favorable economic conditions such as high economic growth and low inflation

The following table summarizes the push and pull factors that drive foreign capital inflows to emerging markets:

Factor	Description
Low interest rates	Low interest rates in industrial countries encourage global investors to seek higher returns in emerging markets
Global investors seeking higher returns	Global investors seek higher returns in emerging markets due to low interest rates in industrial countries
Improved economic management	Improved economic management by the government, such as low inflation and improved fiscal positions, attracts foreign capital inflows
Favorable economic conditions	Favorable economic conditions, such as high economic growth and low inflation, attract foreign capital inflows

Capital Flow Surges and Currency Crises

Capital flow surges can lead to currency crises if not managed properly.

Examples of Currency Crises

Examples of currency crises include:

- The European Exchange Rate Mechanism (ERM) crisis in 1992-1993
- The Mexican peso crisis in 1994
- The Asian currency and financial crisis in 1997-1998

These crises were preceded by a surge in capital inflows and a buildup of highly leveraged speculative positions by local and international investors. The sudden unwinding of these positions triggered the attacks on the currencies.## Capital Controls Capital controls are measures implemented by governments to regulate the flow of capital into or out of a country. These controls can take various forms, such as taxes, restrictions on foreign ownership, or requirements for non-interest-bearing deposits. For example, in 2006, Thailand required a one-year, non-interest-bearing deposit of 30% of an investment's value to reduce new foreign inflows, which had been appreciating the Thai baht.

Effectiveness of Capital Controls

The effectiveness of capital controls is a topic of debate. Some argue that these controls can help prevent exchange rates from overshooting, asset bubbles from forming, and future financial conditions from deteriorating. However, others believe that capital controls can generate distortions in global trade and finance and that market participants will eventually find ways to circumvent them.

Warning Signs of a Currency Crisis

A currency crisis occurs when a country's currency comes under heavy selling pressure, resulting in a sharp depreciation of the currency, a contraction of the economy, and a decline in asset values. The following are some warning signs of a currency crisis:

- Large inflows of foreign capital (relative to GDP) in the period leading up to a crisis
- Short-term funding denominated in a foreign currency
- Liberalization of capital markets to allow the free flow of capital

Early Warning Systems

An early warning system is a model that aims to predict the onset of a currency crisis. An ideal early warning system should have the following features:

- A strong record of predicting actual crises
- A low rate of false alarms
- Macro-economic indicators with timely data availability
- A broad-based approach incorporating a wide range of symptoms

Conditions that May Lead to a Currency Crisis

The following conditions were identified in various studies as potential warning signs of a currency crisis:

1. Prior liberalization of capital markets
2. Large inflows of foreign capital
3. Short-term funding denominated in a foreign currency

> A currency crisis is a situation in which a country's currency comes under heavy selling pressure, resulting in a sharp depreciation of the currency, a contraction of the economy, and a decline in asset values.

Comparison of Capital Controls in Different Countries

The following table compares the capital controls implemented by different countries:

Country	Type of Capital Control	Year
Thailand	Non-interest-bearing deposit	2006
Brazil	Tax on currency transactions	-
Ukraine	Restriction on foreign investors	2015
Venezuela	Multiple exchange rates	2016

Effectiveness of Government Intervention

The effectiveness of government intervention in the foreign exchange market is limited, especially in developed market economies. The following table shows the ratio of official FX reserves to average daily turnover in foreign exchange trading:

Country	Ratio of FX Reserves to Daily Turnover
Developed Market Countries	Negligible
Emerging Market Countries	Sizable

Note: The **ratio of FX reserves to daily turnover** is a measure of a country's ability to influence the supply of and demand for its currency. A higher ratio indicates a greater ability to intervene in the foreign exchange market.## Warning Signs of a Currency Crisis A **currency crisis** occurs when a country's currency experiences a significant decline in value, often due to a combination of economic factors. The following are common warning signs of a currency crisis:

- Banking crises: often precede or coincide with currency crises
- Fixed or partially fixed exchange rates: countries with these exchange rates are more susceptible to currency crises
- Decline in foreign exchange reserves: a precipitous decline in foreign exchange reserves can indicate a looming crisis
- Overvalued currency: a currency that has risen substantially relative to its historical mean can be a warning sign
- Deteriorating terms of trade: a decline in the ratio of exports to imports can indicate a crisis
- Broad money growth: rapid growth in broad money can be a warning sign
- Inflation: high inflation can contribute to a currency crisis

These factors are often interrelated and can feed off one another. For example, large inflows of foreign capital can lead to an overvalued currency, which can make a country's exports less competitive.

Interrelationships Between Factors

The following table illustrates the interrelationships between the warning signs of a currency crisis:

Factor	Interrelationship
Banking crises	Can lead to a decline in foreign exchange reserves and a deterioration in the terms of trade
Fixed or partially fixed exchange rates	Can make a country more susceptible to a currency crisis, particularly if the currency is overvalued
Decline in foreign exchange reserves	Can lead to a loss of confidence in the currency and a decline in its value
Overvalued currency	Can make a country's exports less competitive and lead to a deterioration in the terms of trade
Deteriorating terms of trade	Can lead to a decline in foreign exchange reserves and a loss of confidence in the currency

Definition of a Currency Crisis

> A currency crisis is a situation in which a country's currency experiences a significant decline in value, often due to a combination of economic factors, including a decline in foreign exchange reserves, an overvalued currency, and deteriorating terms of trade.

Case Study: Iceland's Currency Crisis of 2008

Iceland's currency crisis of 2008 is a prime example of how a combination of economic factors can lead to a currency crisis. The crisis was triggered by a number of factors, including:

- **Liberalization of the banking industry**: led to rapid growth in the banking sector and a significant increase in foreign debt
- **Overvalued currency**: the Icelandic krona had risen substantially relative to its historical mean
- **Deteriorating terms of trade**: Iceland's trade deficit had increased significantly in the years leading up to the crisis
- **Rapid broad money growth**: broad money had grown rapidly in the years leading up to the crisis

The crisis led to a significant decline in the value of the Icelandic krona, a contraction in the economy, and a bailout from the IMF and Iceland's neighbors.

Early Warning Systems

An **early warning system** can be useful in assessing and preparing for potential currency crises. The following are key characteristics of an effective early warning system:

- **Includes a wide variety of economic indicators**: including those that are available in a timely manner
- **Provides early warnings**: allows market participants to adjust or hedge their portfolios before the crisis hits
- **Has a strong record of predicting actual crises**: minimizes false signals and provides accurate predictions

The following table illustrates the characteristics of an effective early warning system:

Characteristic	Description
Includes a wide variety of economic indicators	Uses a range of economic indicators to predict currency crises
Provides early warnings	Allows market participants to adjust or hedge their portfolios before the crisis hits
Has a strong record of predicting actual crises	Minimizes false signals and provides accurate predictions

Currency exchange rates are among the most difficult financial market prices to understand and value. Most economists believe that there is an **equilibrium level** or a path to that equilibrium value that a currency will gravitate toward in the long run.

Factors Affecting Exchange Rates

The following factors affect exchange rate trends:

- **Monetary policy**: changes in interest rates and money supply
- **Fiscal policy**: government spending and taxation
- **Current account trends**: trade balance and capital flows
- **Capital flows**: movement of funds across national borders
- **Government intervention**: central bank actions to influence exchange rates
- **Capital controls**: restrictions on the flow of capital

Exchange Rate Quotations

Exchange rates are quoted in two ways:

- **Spot exchange rates**: apply to trades for the next settlement date (usually T+2) for a given currency pair
- **Forward exchange rates**: apply to trades to be settled at any longer maturity

Bid-Offer Spread

The **bid-offer spread** depends on:

- The currency pair involved
- The time of day
- Market volatility
- The transaction size
- The relationship between the dealer and the client

The bid-offer spread is tightest in highly liquid currency pairs, when the key market centers are open, and when market volatility is relatively low.

Absence of Arbitrage

The absence of arbitrage requires:

> The bid (offer) shown by a dealer in the interbank market cannot be higher (lower) than the current interbank offer (bid) price. The cross-rate bids (offers) posted by a dealer must be lower (higher) than the implied cross-rate offers (bids) available in the interbank market.

Forward Exchange Rates

Forward exchange rates are quoted in terms of points to be added to the spot exchange rate. If the points are positive (negative), the base currency is trading at a forward premium (discount).

International Parity Conditions

International parity conditions show us how expected inflation, interest rate differentials, forward exchange rates, and expected future spot exchange rates are linked.

The following table summarizes the international parity conditions:

Condition	Description
Covered Interest Rate Parity	A foreign-currency-denominated money market investment that is completely hedged against exchange rate risk in the forward market should yield exactly the same return as an otherwise identical domestic money market investment.
Uncovered Interest Rate Parity	The expected change in a domestic currency's value should be fully reflected in domestic-foreign interest rate spreads.
Ex Ante Purchasing Power Parity	Expected changes in exchange rates should equal the difference in expected national inflation rates.
Real Interest Rate Parity	Real interest rates across all markets would be the same if both ex ante purchasing power parity and uncovered interest rate parity held.
International Fisher Effect	The nominal interest rate differential between two currencies equals the difference between the expected inflation rates.

Balance of Payments Approach

According to the balance of payments approach, countries that run **persistent current account deficits** will generally see their currencies **weaken** over time, while countries that run **persistent current account surpluses** will tend to see their currencies **appreciate** over time.

Monetary Policy and Exchange Rates

Monetary policy affects the exchange rate through a variety of channels, including:

- **Interest rate sensitivity** of capital flows
- **Inflation expectations**
- **Risk premium**

The following table summarizes the effects of monetary policy on exchange rates:

Policy	Effect on Exchange Rate
Tightening monetary policy	Strengthening the currency
Easing monetary policy	Weakening the currency
Expansionary fiscal policy	Inducing a capital inflow, which is positive for the domestic currency, but also contributing to a deterioration of the trade balance, which is negative for the domestic currency.
The following factors were identified as contributing to currency crises:	

- Prior to a crisis, the capital markets have been liberalized to allow the free flow of capital.
- There are large inflows of foreign capital (relative to GDP) in the period leading up to a crisis, with short-term funding denominated in a foreign currency being particularly problematic.
- Currency crises are often preceded by (and often coincide with) banking crises.
- Countries with fixed or partially fixed exchange rates are more susceptible to currency crises than countries with floating exchange rates.
- Foreign exchange reserves tend to decline precipitously as a crisis approaches.
- In the period leading up to a crisis, the currency has risen substantially relative to its historical mean.
- The terms of trade (exports relative to imports) often deteriorate before a crisis.
- Broad money growth and the ratio of M2 (a measure of money supply) to bank reserves tend to rise prior to a crisis.
- Inflation tends to be significantly higher in pre-crisis periods compared with tranquil periods.

Factors Contributing to Currency Crises

A currency crisis can be defined as:

> A situation in which a country's currency experiences a significant decline in value, often accompanied by a loss of confidence in the currency and a decline in foreign exchange reserves.

The following table summarizes the factors contributing to currency crises:

Factor	Description
Capital Market Liberalization	Free flow of capital into and out of the country
Foreign Capital Inflows	Large inflows of foreign capital, particularly short-term funding
Banking Crises	Coincidence of currency and banking crises
Exchange Rate Regime	Fixed or partially fixed exchange rates
Foreign Exchange Reserves	Decline in reserves as a crisis approaches
Currency Appreciation	Rise in currency value relative to historical mean
Terms of Trade	Deterioration of exports relative to imports
Broad Money Growth	Increase in money supply and ratio of M2 to bank reserves
Inflation	Higher inflation in pre-crisis periods

Practice Problems

The following practice problems relate to currency exchange rates and foreign exchange markets:

1. Based on Exhibit 1, the forward premium (discount) for a 360-day INR/GBP forward contract is closest to: A. 1.546 B. 1.546 C. 1.576
2. Based on Exhibit 2, the most appropriate recommendation regarding the triangular arbitrage trade is to: A. decline the trade, because no arbitrage profits are possible B. execute the trade, buy BRL in the interbank market, and sell BRL to the dealer C. execute the trade, buy BRL from the dealer, and sell BRL in the interbank market

Currency Exchange Rates and Forward Contracts

The following table summarizes the spot exchange rates and forward rates:

Currency Pair	Spot Rate	Forward Rate
INR/GBP	79.5093	
GBP/USD	1.2301	
USD/EUR	1.1648	

Interest Rate Parity and Currency Exchange Rates

The interest rate parity condition can be defined as:

> A condition in which the difference in interest rates between two countries is equal to the difference in forward and spot exchange rates.

The following equation represents the interest rate parity condition:

$$(1 + r_{domestic}) = (1 + r_{foreign}) \times \frac{S_{forward}}{S_{spot}}$$

where $r_{domestic}$ is the domestic interest rate, $r_{foreign}$ is the foreign interest rate, $S_{forward}$ is the forward exchange rate, and S_{spot} is the spot exchange rate.## International Parity Conditions International parity conditions are used to estimate future spot rates and understand the relationship between exchange rates, interest rates, and inflation. The main international parity conditions are:

- Covered Interest Rate Parity: This condition states that the difference between the forward rate and the spot rate is equal to the difference between the interest rates of the two countries.
- Uncovered Interest Rate Parity: This condition states that the difference between the expected future spot rate and the current spot rate is equal to the difference between the interest rates of the two countries.
- Purchasing Power Parity: This condition states that the exchange rate between two countries is equal to the ratio of the price levels of the two countries.

> The spot rate is the current exchange rate at which a currency can be bought or sold. The forward rate is the exchange rate at which a currency can be bought or sold at a future date. The interest rate is the rate at which interest is paid on a loan or deposit.

Exchange Rate Determination

Exchange rates are determined by a combination of factors, including:

- Balance of Payments: The balance of payments is the difference between a country's exports and imports.
- Monetary Policy: Monetary policy refers to the actions taken by a central bank to control the money supply and interest rates.
- Fiscal Policy: Fiscal policy refers to the actions taken by a government to control government spending and taxation.

The following table summarizes the effects of different factors on exchange rates:

Factor	Effect on Exchange Rate
Trade Surplus	Appreciation
Trade Deficit	Depreciation
Increase in Interest Rates	Appreciation
Decrease in Interest Rates	Depreciation
Increase in Inflation	Depreciation
Decrease in Inflation	Appreciation

FX Carry Trades

FX carry trades involve borrowing in a low-yield currency and investing in a high-yield currency. This can be a profitable strategy, but it also carries significant risks, including:

- Currency Crises: A currency crisis occurs when a country's exchange rate suddenly and significantly depreciates.
- Leverage: Leverage refers to the use of borrowed money to invest in a currency.

The following table summarizes the effects of FX carry trades on exchange rates:

Factor	Effect on Exchange Rate
Increase in FX Carry Trades	Appreciation of the high-yield currency
Decrease in FX Carry Trades	Depreciation of the high-yield currency
Currency Crisis	Depreciation of the affected currency

Models of Exchange Rate Determination

There are several models of exchange rate determination, including:

- Mundell-Fleming Model: This model states that exchange rates are determined by the interaction of monetary policy and fiscal policy.
- Monetary Model: This model states that exchange rates are determined by the money supply and interest rates.
- Portfolio Balance Model: This model states that exchange rates are determined by the portfolio balance of investors.

The following table summarizes the main features of each model:

Model	Main Features
Mundell-Fleming Model	Interaction of monetary policy and fiscal policy
Monetary Model	Money supply and interest rates
Portfolio Balance Model	Portfolio balance of investors

The foreign exchange market is a global market where individuals, businesses, and institutions trade currencies. In this market, the exchange rate is the price of one currency in terms of another currency.

Arbitrage Opportunity

An arbitrage opportunity arises when there is a difference in the prices of the same currency in different markets. For example, if the bid price of a currency is higher than the offer price in another market, an investor can buy the currency at the lower price and sell it at the higher price, making a profit.

Carry Trade

The carry trade involves borrowing in a lower-yielding currency to invest in a higher-yielding currency. The goal is to earn the difference in interest rates between the two currencies.

The carry trade strategy is dependent on the fact that uncovered interest rate parity does not hold in the short or medium term. If uncovered interest rate parity held, it would mean that investors would receive identical returns from either an unhedged foreign currency investment or a domestic currency investment.

Covered Interest Rate Parity

Covered interest rate parity is a theory that states that the forward exchange rate should be equal to the spot exchange rate adjusted for the difference in interest rates between the two currencies.

Currency	Interest Rate
USD	0.80%
EUR	0.22%

The forward exchange rate can be calculated using the formula: $F = S \times \frac{1 + i_f}{1 + i_d}$

where:

- F is the forward exchange rate
- S is the spot exchange rate
- i_f is the foreign interest rate
- i_d is the domestic interest rate

Triangular Arbitrage

Triangular arbitrage involves exploiting differences in exchange rates between three currencies. For example, if the exchange rate between USD and EUR is different from the exchange rate between USD and GBP, and the exchange rate between EUR and GBP, an investor can make a profit by buying and selling the currencies in a way that takes advantage of these differences.

Some key points to note about triangular arbitrage:

- It involves three currencies
- It exploits differences in exchange rates
- It can be used to make a profit

Forward Points

Forward points are the difference between the forward exchange rate and the spot exchange rate. They are used to calculate the forward exchange rate.

Currency	Spot Exchange Rate	Forward Points
GBP/EUR	0.9467/0.9471	14.0/15.0

The **forward exchange rate** can be calculated using the formula: $F = S + \frac{forward\ points}{10000}$

Uncovered Interest Rate Parity

Uncovered interest rate parity is a theory that states that the expected change in the exchange rate should be equal to the difference in interest rates between the two currencies.

> The expected change in the exchange rate should reflect the interest rate spread between the two countries.

Some key points to note about uncovered interest rate parity:

- It involves the expected change in the exchange rate
- It reflects the interest rate spread between the two countries
- It is used to estimate the future spot exchange rate

Risk Premiums

Risk premiums are the excess return demanded by investors for holding a risky asset. In the context of exchange rates, risk premiums can affect the exchange rate by influencing the demand for a currency.

Risk premiums are more closely associated with the portfolio balance approach. The portfolio balance approach addresses the impact of a country's net foreign asset/liability position.

Some key points to note about risk premiums:

- They are the excess return demanded by investors for holding a risky asset
- They can affect the exchange rate
- They are associated with the portfolio balance approach## Exchange Rate Influence In Emerging Markets (EM), central banks have a greater ability to influence their exchange rates due to higher reserve levels as a ratio of average daily FX turnover. This allows EM central banks to affect currency supply and demand more effectively than Developed Markets (DM).

Reserve Levels and Currency Defense

EM policymakers utilize their foreign exchange reserves as a form of insurance to defend their currencies when necessary. The ratio of reserve levels to FX turnover is generally much greater in EM countries than in DM countries, making EM central banks more capable of intervening in the foreign exchange market.

Currency Crisis Indicators

The following indicators are associated with an approaching currency crisis:

- Foreign exchange reserves tend to decline precipitously
- Broad money growth tends to rise in the period leading up to a currency crisis
- The exchange rate is substantially higher than its mean level during tranquil periods

Prediction Analysis

Prediction 1 is the least likely to be correct, as it suggests that foreign exchange reserves tend to increase as a currency crisis approaches, which is not supported by empirical evidence.

Key Concepts

A currency crisis occurs when a country's currency experiences a significant decline in value, often due to a loss of confidence in the currency or the country's economic stability. Foreign exchange reserves refer to the holdings of foreign currencies and other foreign assets by a central bank or government. Broad money growth refers to the rate of increase in the money supply, including all forms of money and quasi-money.

Indicator	Behavior Leading Up to Currency Crisis
Foreign Exchange Reserves	Decline precipitously
Broad Money Growth	Rise
Exchange Rate	Substantially higher than mean level

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