Notes - International Finance Topics 1-9

international finance (Royal Melbourne Institute of Technology)

Today's financial manager needs to understand finance from an international perspective

- They need to comprehend the global environment of business finance

◊ Fluctuations in exchange rates ◊ Movements in interest rates
◊ Balance of Payments difficulties

- As such, this subject introduces students to the fundamental principles of International Finance, and International Financial Management

The importance of international finance

- International trade and globalisation
- Increasing importance at an accelerating rate
- Things started to change with the collapse of the Bretton Woods system
- Shift to floating exchange rates

- A trend towards the abolition of capital controls and the implementation of financial deregulation
- The pace of deregulation has been slowed down by the onset of financial crises, particularly the global financial crisis (2008)

International, multinational and transnational firms

- Traditionally, the term 'international business firm' refers to firms involved in importing and exporting
- A multinational firm carries out some of its production activity abroad
- As the distinction between 'home' and 'abroad' becomes blurred, **transnational firms emerge**

Examples of international interdependence:
• The Asian crisis affected the operations of Australian companies
• The US accounting scandals (e.g. Enron) affected stock markets worldwide
• The fall in China's Stock Market in late February, 2007
• The US subprime crisis that surfaced in 2007 became a global financial crisis in 2008-09 (and perhaps beyond)

The micro and macro aspects of international finance

- The micro aspects pertain to the financial operations of business firms, including financing, investment, hedging, arbitrage and speculation
    - The macro aspects pertain to the international monetary system and the determination of interest and exchange rates

International finance and the role of the financial manager

The financial manager needs to be **concerned** about:

- Fluctuations in exchange and interest rates - Balance-of-payments difficulties
- Financial contagion
- Exchange rate fluctuations can demolish businesses.

Examples include:

- The Beecham Group
- Laker Airlines
- Caterpillar and Eastman Kodak
- Canon
- Coca-Cola Amatil
- NAB

Knowledge needed by the financial manager

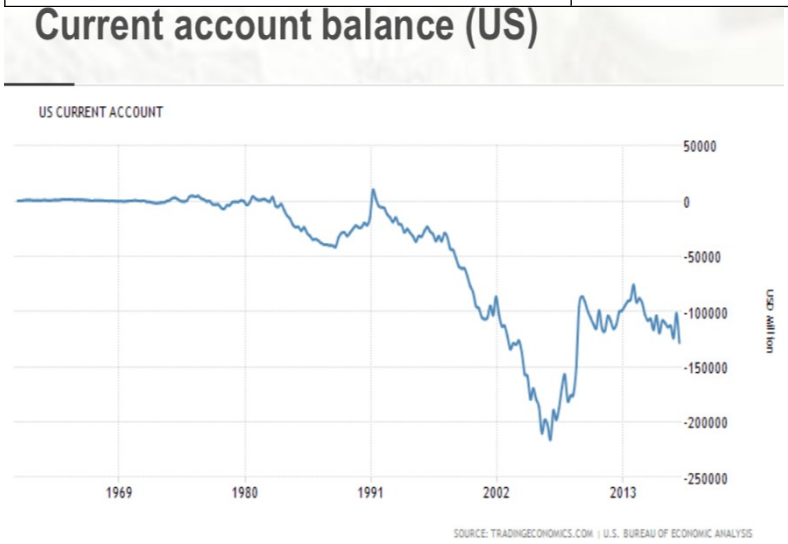
- Major economic indicators
- Government policies
- The channels and effects of contagion
- Foreign exchange risk management
- Factors affecting the demand for the firm's products

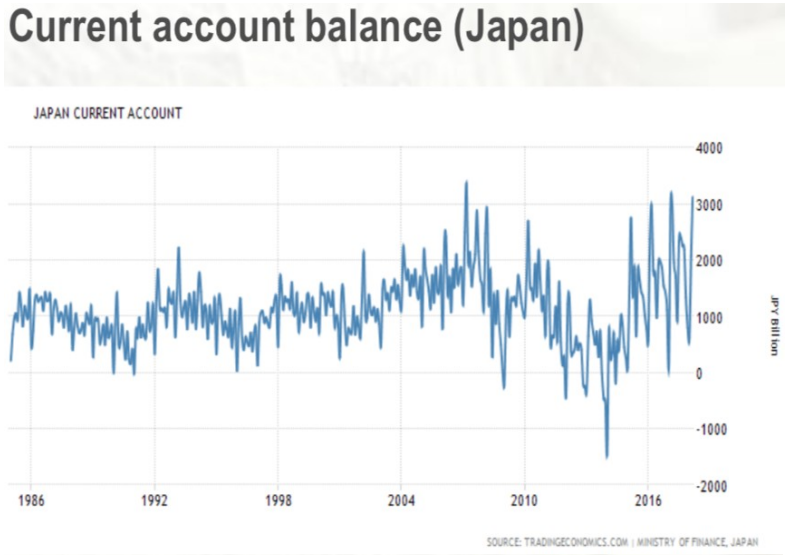
Indicators of the internationalisation of finance

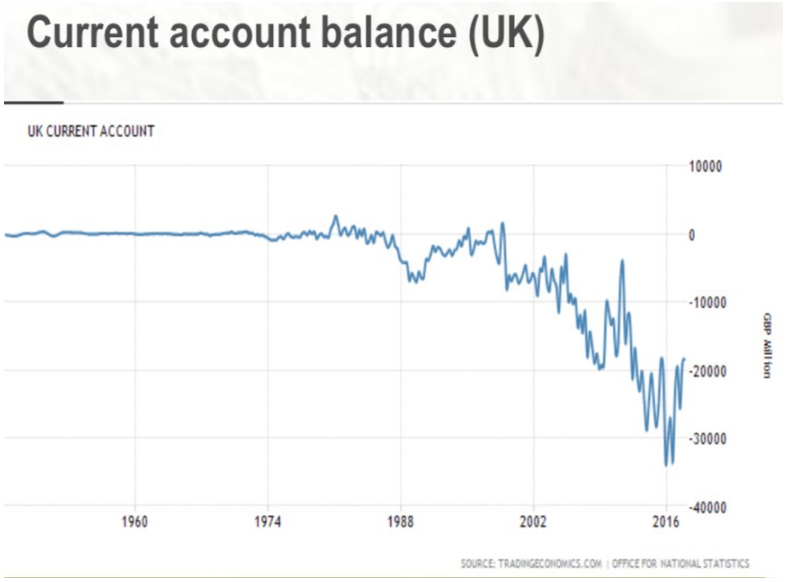
- International bank lending
- Securities transactions with foreigners
- Flows of portfolio investment and FDI
- Trading volume in the FX market
- The percentage of FX trading conducted with cross- border counterparties

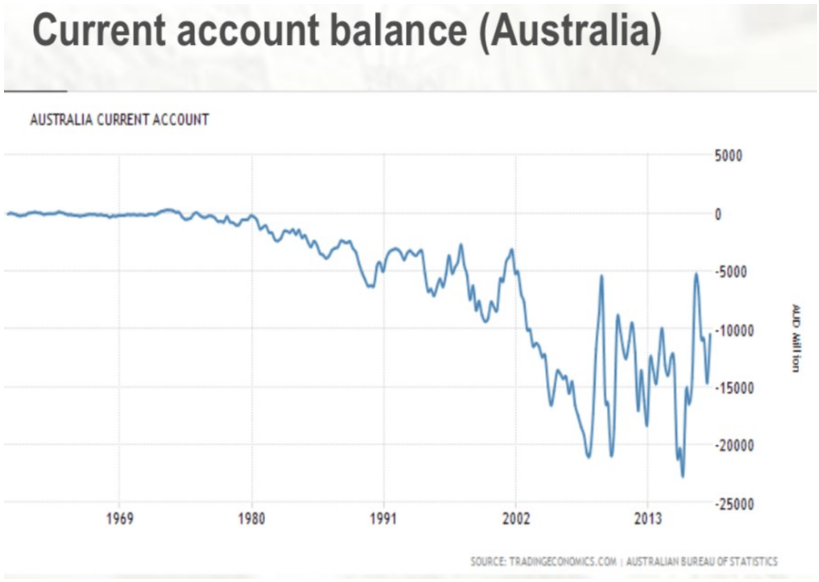
1. Currency convertibility: European currencies became convertible in the late 1950s The yen became convertible in the early 1960s	2. The EEC and EMU • The EEC was established in 1957 by the Treaty of Rome • Related developments include the EMS and the EMU From an original membership of 6 countries, membership stood at 27 countries in early 2009 
3. Changes in relative economic size • There has been a trend towards greater symmetry in economic size • The relative size of the United States has declined significantly. Those of the EU, Japan and China have risen	4. Deterioration of the US external position • The United States has become a deficit and net debtor country • The twin deficit problem refers to deficits in the budget and the current account • Japan has been a surplus country, but a deficit was registered in early 2009

	because of the global financial crisis • China has replaced Japan as the “financier” of the US deficit



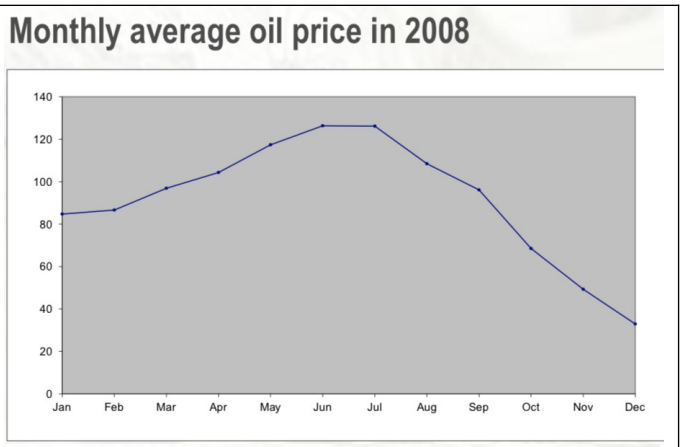


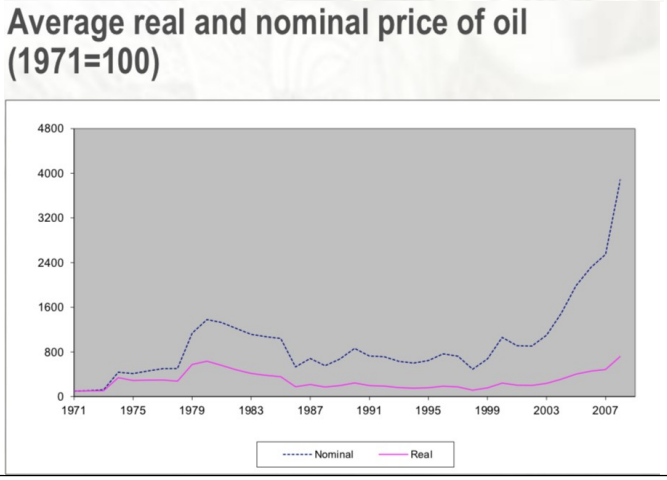




5. Fluctuations in oil prices

- The price of oil rose in 1973-1974 and again in 1979- 1980
- The price collapsed in 1986, and declined significantly in 1998
- In 2003, the price rose and then fell as developments in Iraq unfolded
- • Having reached a record of USD147 a barrel in 2008, the price of oil collapsed during the global financial crisis





6. The international use of non-dollar currencies

- The US dollar's use has declined with respect to trading volume in the FX market, the invoicing of trade, the holding of reserves, and the denomination of

7. Increased capital mobility

- Since the 1980s, the volume of net and gross capital flows has increased significantly

Eurocurrency deposits, international loans and international bonds	
8. Integration, deregulation and globalisation • There has been a trend towards deregulation and integration of financial markets • Globalisation has emerged due to increasing market integration • • In the aftermath of the global financial crisis, more thought is given to the costs and benefits of globalisation and deregulation	**9. Regional cooperation** **Examples of regional cooperation are the following:** - European Economic Community (EEC) - North American Free Trade Agreement (NAFTA) - Asia-Pacific Economic Cooperation Council (APEC) Closer Economic Relations (CER) Agreement Central Europe Free Trade Area (CEFTA) - Baltic Free Trade Area (BFTA)

10. Increased volatility of financial markets

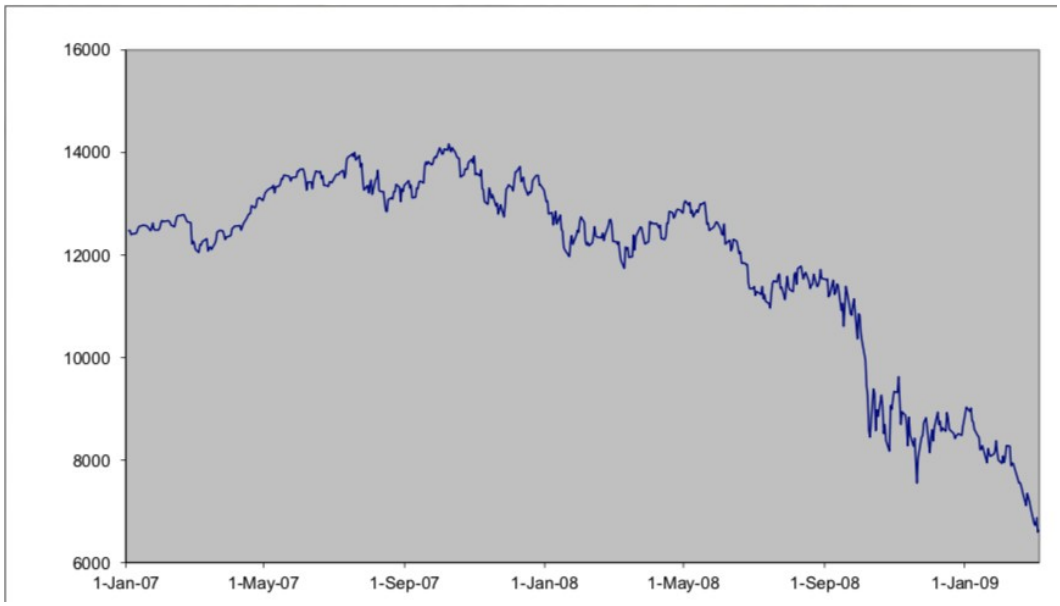
- Increased volatility of exchange rates can be traced back to the collapse of the BW system
- Increased volatility of interest rates can be traced back to the 1979 shift by the Federal Reserve to money supply targeting

11. Securitisation and financial innovation • Securitisation is the tendency for raising funds by issuing marketable securities • Innovation refers to the creation of new financial instruments or the recreation of old instruments in a new form • The global financial crisis has changed attitude towards securitisation and financial engineering. A financial innovation (CDOs) played a big role in the crisis	**12. Financial crises and contagion** • Financial crises have become widespread in the post-war period, particularly since the 1980s • Contagion is the process whereby a financial crisis moves from one country to another • Major examples are the EMS crisis, Asian crisis, Mexican crisis, Argentine crisis and the global financial crisis

The global financial crisis

- The global financial crisis has resulted from the US subprime crisis, leading to the “Great Recession” of 2009
- This crisis is far more complex than earlier crises because financial innovation and securitisation have created complex securities whose risk profile is difficult to assess

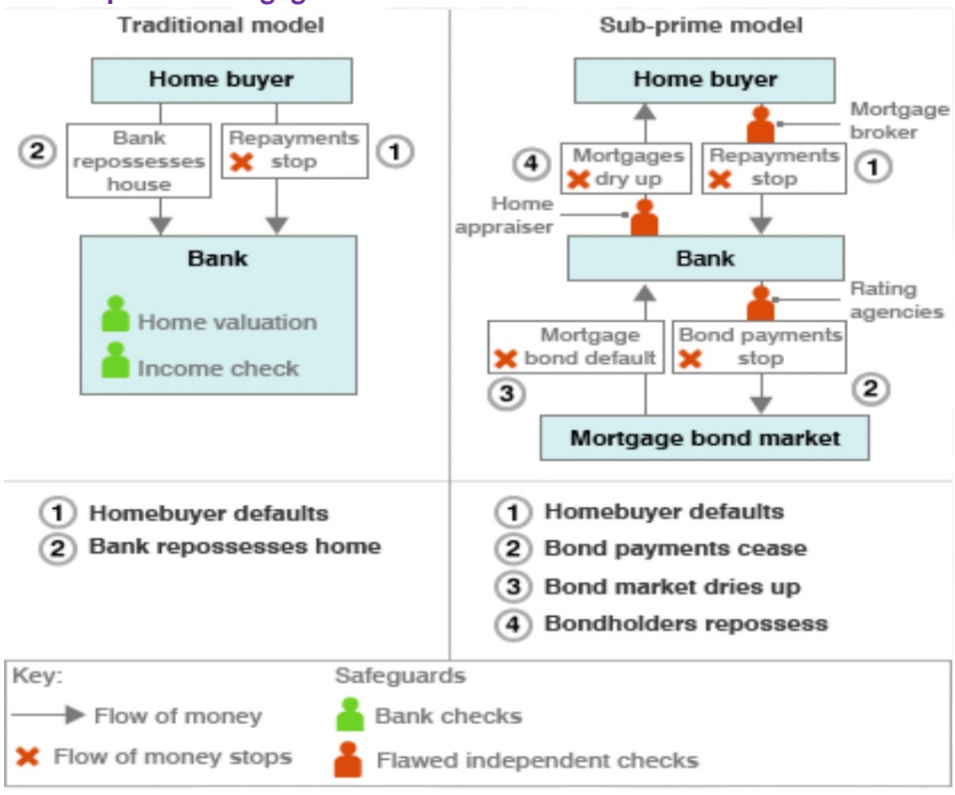
The DJIA during the crisis



The players and causes

- Mortgage originators
- Rating agencies
- Policy makers and regulators
- The role of securitisation
- The role of globalisation

US Sub-prime Mortgage Crisis



13. The emergence of the Eurodollar market
The Eurodollar market emerged in London in the late 1950s
Currently known as the Eurocurrency market, it encompasses non-dollar currencies

The Eurocurrency markets

- Comprised of banks that accept short-term deposits and make short-term loans in currencies other than that of the country in which they are located

Eurocurrencies • US dollar • Euro • Japanese yen • British pound • Swiss franc	**Prerequisites for Eurocurrency centers** • Political stability • Favorable environment for international finance • Good telecommunications system • Favorable time zone • High quality of life
Eurocurrency centers • European centres: London, Luxembourg, Paris, Zurich and Frankfurt • Centres outside developed countries: the Bahamas, Dubai and Hong Kong • North America and Japan: International Banking Facilities (IBFs) and the Japan Offshore Market (JOM)	**Evolution and growth** • The market started in the 1950s. • In 1957, the Bank of England introduced tight controls • In 1958, European currencies were made convertible • The rise of oil prices in the 1970s produced huge financial surpluses for oil-exporting countries. These surpluses were deposited at Eurobanks Eurobanks are efficient because: • they are not subject to regulations, such as Regulation Q, interest equalization tax • no reserve requirements 4economies of scale

Features of Eurobanking

- International banking encompasses Euro-banking
- Liabilities are time or call deposits
- Eurobanks cannot create deposits by writing claims against themselves
- Eurobanks accept deposits and make loans in a variety of currencies
- A Eurobank is often a branch of an international bank
- There are no formal restrictions on entry

- Transactions are large
- The geographical spread is very wide

- The market is not subject to the regulatory measures of the local authorities
- The market is dominated by interbank operations
- Participants include multinationals and central banks
- Eurobanks do not have to hold reserves against deposits

14. International banking International banking operations encompass those conducted with non-residents as well as those involving foreign currencies	**Reasons for the emergence of international banking** • Meeting the needs of foreign subsidiaries • Participation in the FX market • Circumventing capital controls • Provision of custodial services
International banking activities • Traditional activities • Export-import finance • Buying and selling foreign exchange Provision of foreign loans • New activities • Dealing in Eurocurrencies • Syndicated Euro credit • Investment banking	**Innovative activities** • Innovative financing • Global money market • Managing the loan portfolios of developing countries • Private banking

Topic 2: The Foreign Exchange Market

What is the meaning of 'foreign exchange'?

- The term 'foreign exchange' refers to the 'commodity' that is traded on the foreign exchange market:
  - Bank notes & deposits denominated in various currencies.

Definition & Characteristics

• The FX market is the market where national currencies are bought and sold against one another.
• Foreign exchange consists mainly of bank deposits.
• Characteristics:
- largest and most perfect market
- every international transaction requires a foreign exchange transaction
- over-the-counter (OTC) market

Market participants

- Foreign exchange traders buy and sell currencies directly or indirectly
- Arbitragers exploit exchange rate anomalies; hedgers cover open positions; speculators take open positions

Categories of participants

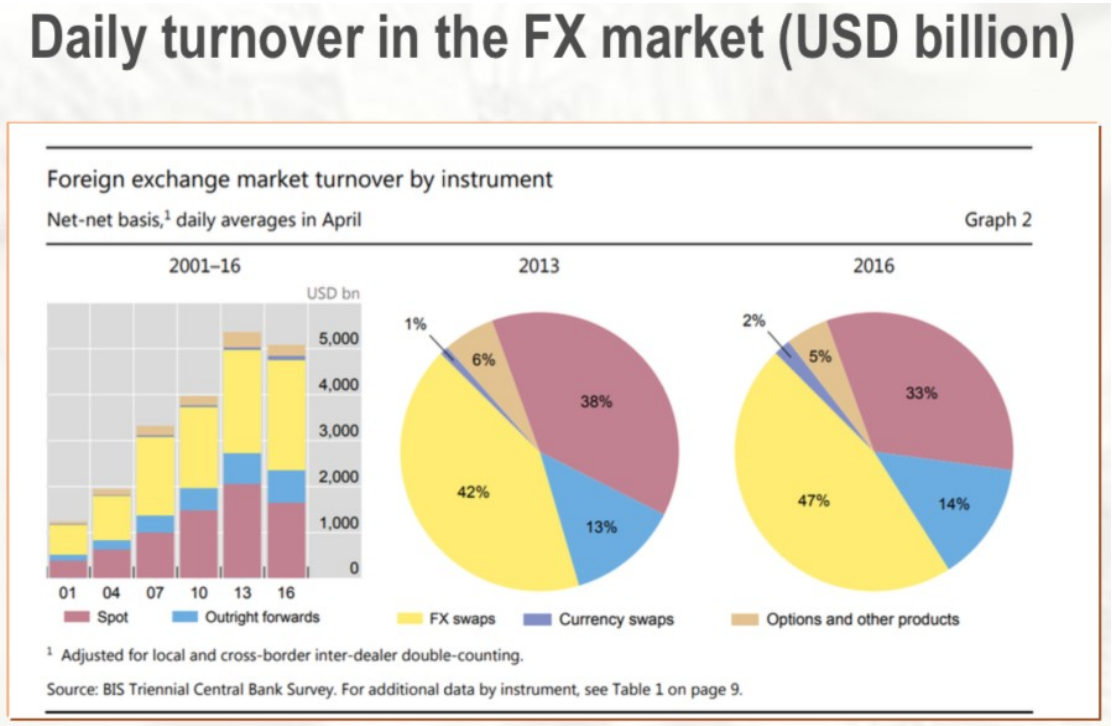
- Customers
- Commercial banks
- Other financial institutions
- Brokers
- Central banks

Interbank operations

- The FX market is dominated by interbank operations
- Participants in the interbank market are market makers, other major dealers and second-tier banks
- Price maker vs. price-taker

Size and composition

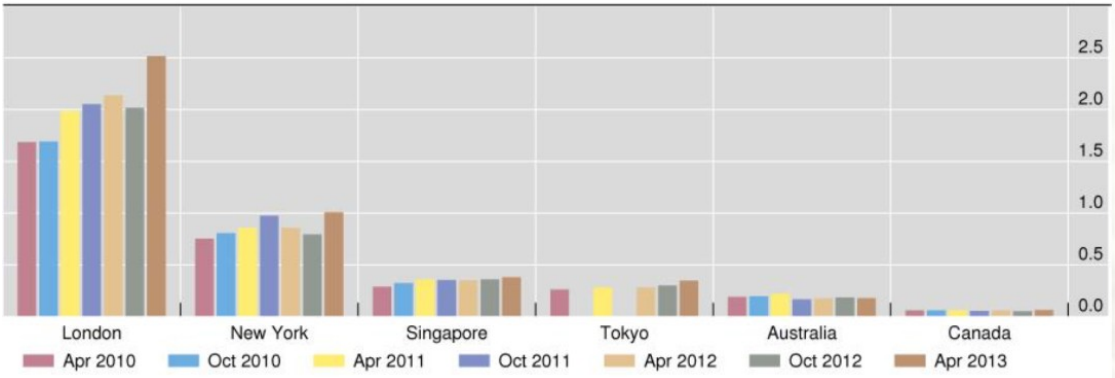
- The size of the global FX market is measured by the sum of daily turnover in FX centres
- A survey is coordinated by the BIS every three years for this purpose



Geographical distribution of FX market turnover (%)

Foreign exchange committee survey turnover

In trillions of US dollar equivalents — Graph 1

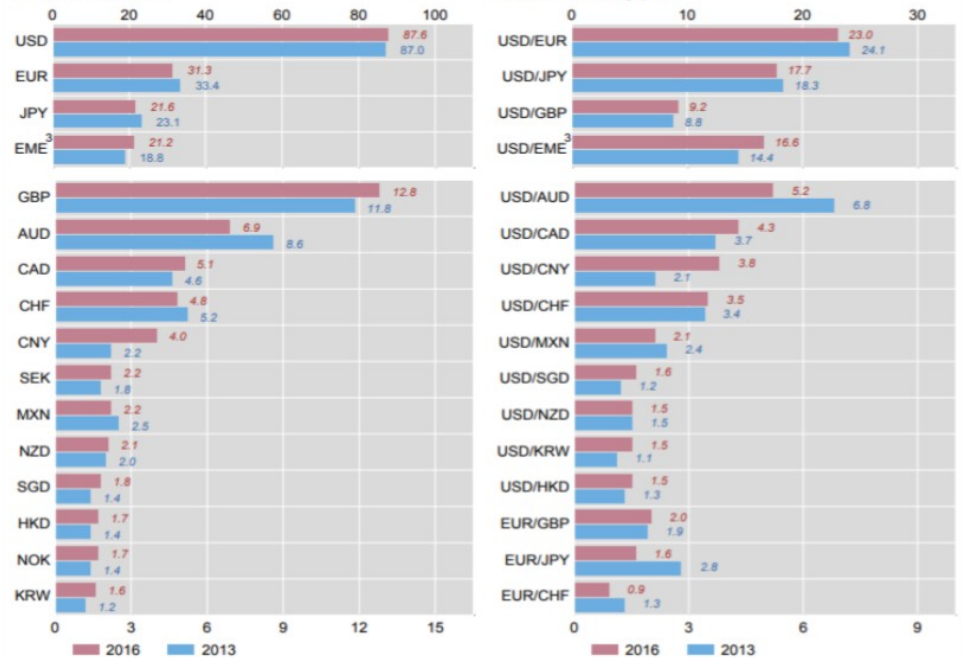


Source: FXC surveys.

Currency composition of the FX market

Foreign exchange market turnover by currency and currency pairs

Net-net basis,[1] daily averages in April, in per cent — Graph 1



[1] Adjusted for local and cross-border inter-dealer double-counting. [2] As two currencies are involved in each transaction, the sum of shares in individual currencies will total 200%. [3] Emerging market currencies.

Source: BIS Triennial Central Bank Survey. For additional data by currency and currency pairs, see Tables 2 and 3 on pages 10 and 11.

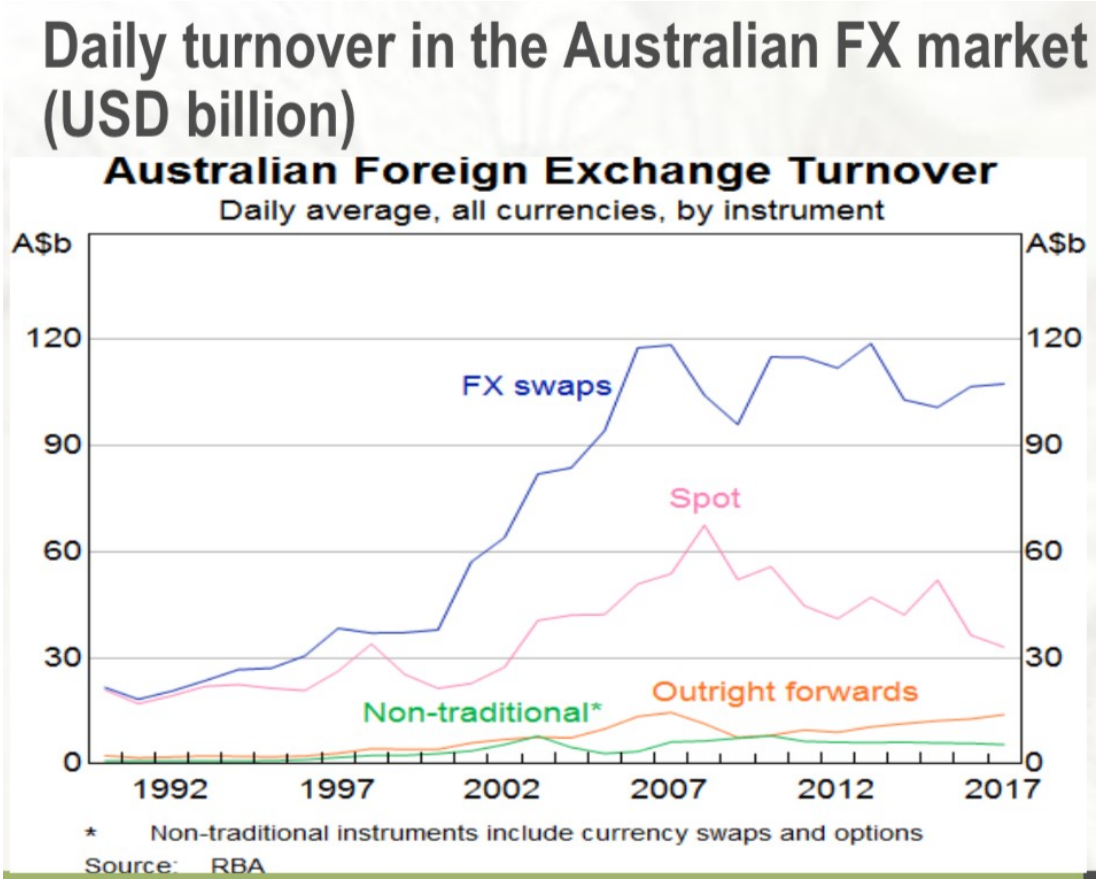
Traded Currencies

- US dollar
- The euro and the yen

- The pound
- Currencies that are heavily traded in certain financial centers and lack liquidity in others: CHF, CAD
- Currencies that are traded locally, but internationally are traded for international trade purposes: AUD, NZD, HKD
- Third world currencies: soft or exotic currencies

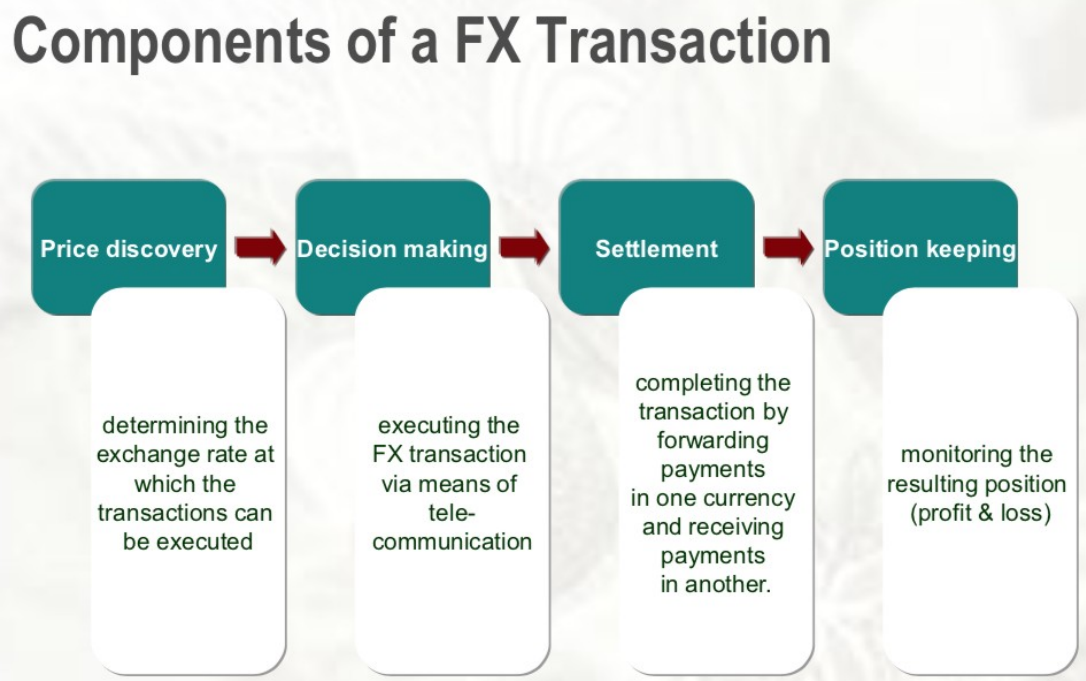
The AUD FX market

- The market consists of the banking system and non-bank dealers authorised by the Reserve Bank of Australia (RBA)
- The market has grown since the flotation of the AUD in 1983



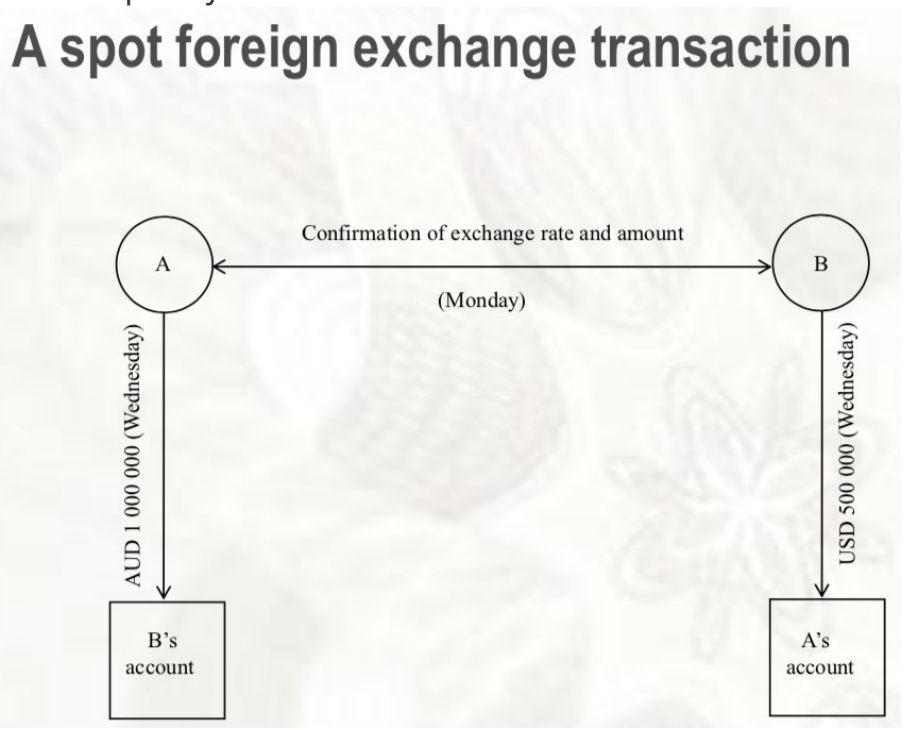
Reasons for the growth of the AUD market

- Deregulation
- High interest rates in the 1980s
- Australia's time zone
- Exchange rate volatility



The bilateral spot exchange rate

- The exchange rate between two currencies for immediate delivery
- Contract date, dealing date, done date or trade date
- Value date or the delivery date
- Settlement risks:
  - Herstatt risk
  - Liquidity risk



Spot rate quotation

- $S(x/y)$ is the price (in terms of x) of one unit of y.
- The reciprocal rate, $S(y/x)$, which is the price (in terms of y) of one unit of x can be calculated as:

$$S(y/x) = \frac{1}{S(x/y)}$$

$$S(f/d) = \frac{1}{S(d/f)}$$

Exchange Rate Changes

- When the exchange rate changes between 2 points in time from S0(x/y) to S1(x/y), the percentage change in the exchange rate (change in the value of y) is measured as:

$$\dot{S}(x/y) = \frac{S_1(x/y)}{S_0(x/y)} - 1$$

- To express as a percentage, we then multiply by 100

Exchange Rate Changes

- To calculate the corresponding change for $S_0(y/x)$ to $S_1(y/x)$, we can use:

$$\dot{S}(y/x) = \frac{S_1(y/x)}{S_0(y/x)} - 1$$

Or

$$\dot{S}(y/x) = \frac{1}{1 + \dot{S}(x/y)} - 1$$

- To express as a percentage, we then multiply by 100

Exchange Rate Changes – Example 1

- Suppose that the exchange rate between the Australian dollar and British pound stands at $S(AUD/GBP)$ = 3.57, and then falls to $S(AUD/GBP)$ = 3.52.
- As such, $S_0(AUD/GBP)$ = 3.57 and $S_1(AUD/GBP)$ = 3.52, implying that the AUD *has appreciated*
  - We can calculate the percentage depreciation in the British pound as

$$\dot{S}(AUD/GBP) = \frac{S_1(AUD/GBP)}{S_0(AUD/GBP)} - 1 = \frac{3.52}{3.57} - 1 = -0.0140$$

Exchange Rate Changes – Example 1

- To calculate $\dot{S}(GBP/AUD)$, we use

$$\dot{S}(GBP/AUD) = \frac{1}{1+\dot{S}(AUD/GBP)} - 1$$

Which gives

$$\dot{S}(GBP/AUD) = \frac{1}{1+\dot{S}(AUD/GBP)} - 1 = 0.0142$$

implying that the AUD *has appreciated*

Example 2

The exchange rate between the British pound and the Australian dollar (GBP/AUD) rose from 0.3780 to 0.3960 in one week.

- Has AUD appreciated or depreciated against the GBP? What is the percentage change in the AUD and GBP?

Calculate the percentage change in AUD:

$$\dot{S}(GBP/AUD) = \frac{0.3960}{0.3780} - 1 = 0.048$$

The sign is positive, AUD has appreciated by 4.8% against the GBP.

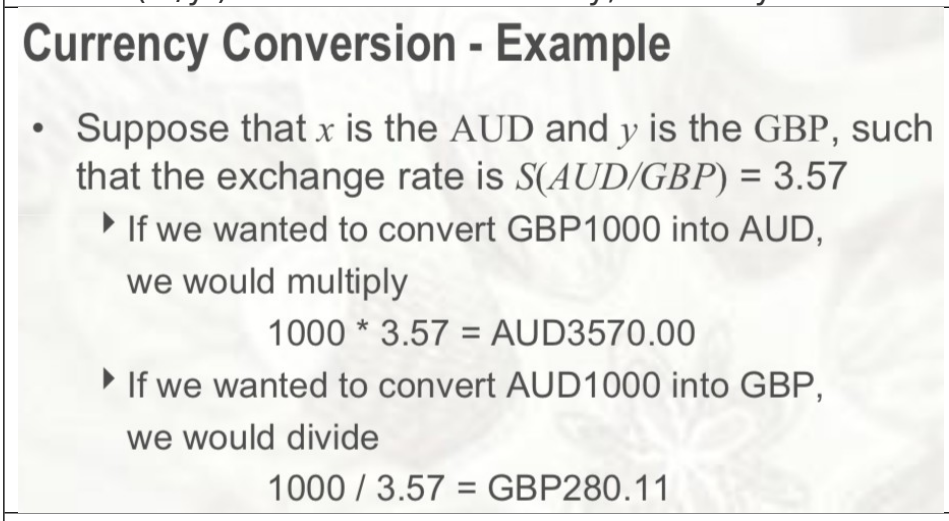
Calculate the percentage change in GBP:

$$\dot{S}(AUD/GBP) = \frac{1}{1+0.048} - 1 = -0.046$$

The sign is negative, GBP has depreciated by 4.6% against the AUD.

Currency conversion

- S (x /y): To convert from y to x, multiply by the exchange rate
- S (x /y): To convert from x to y, divide by the exchange rate



Exchange rate quotation in practice

- Direct quotation refers to the domestic currency price of one unit of the foreign currency
- Indirect quotation refers to the foreign currency price of the domestic currency
- What is a direct quotation from the perspective of one country is an indirect quotation from the perspective of the other country, and vice versa

Exchange Rate Quotation in Practice

Direct quotation, S(d/f), also known as the normal / price quotation:

- If S(d/f) rises, foreign currency (f) appreciates while domestic currency (d) depreciates and vice versa
- Indirect quotation, S(f/d), also known as the quantity / volume quotation
    - If S(f/d) rises, foreign currency (f) depreciates while domestic currency (d) appreciates and vice versa

Exchange Rate Quotation in Practice

• Foreign exchange quotation can also be read from the commodity (unit) vs. price (term) perspectives.
There are two sides to every FX transactions:

- Commodity (unit) currency
- Price (term) currency

• The commodity (unit) currency refers to the currency that is being traded.
• The price (term) currency refers to the currency that is used to value the commodity.
• We write a quotation as S(price/commodity) or S(term/unit).

Exchange Rate Quotation in Practice

- Refer to the quotation S(AUD/USD) = 1.0102,
  - USD is the commodity, which is bought and sold by traders
  - AUD is the currency in which USD is valued/priced in terms of.
  - Hence, we read the quotation as 1 unit of USD is worth 1.0102 AUD, or the price of 1 unit of USD is AUD1.0102.
  - Hence, a trader will pay AUD1.0102 to obtain 1 USD.

Exchange Rate Quotation in Practice

• Compared to the academic literature, FX quotations in the market is sometimes expressed in an opposite manner.
• Therefore, be aware of how you read the FX quotations from market sources, such as Bloomberg, Australian Financial Review, Wall Street Journal, etc.

- Make sure the commodity (unit) currency and the price (term) currency are read correctly.

Exchange Rate Quotation in Practice

Market Quotation (i.e. Bloomberg, Australian Finance Review, etc)	Academic Quotation	Explanation
AUD/USD = 0.9359	USD/AUD = 0.9359	AUD is the commodity currency (unit). USD is the price currency (term). 1 unit of AUD buys 0.9359 USD.
USD/JPY = 99.18	JPY/USD = 99.18	USD is the commodity currency (unit). JPY is the price currency (term). 1 unit of USD buys 99.18 JPY.
The Academic Quotation is mathematically correct. Consider the following: 1 bottle of 2L Evian Mineral Water costs A$2.50. Hence we write A$2.50 per 1 bottle (2L). Commodity: Water; Price: AUD(A$)		

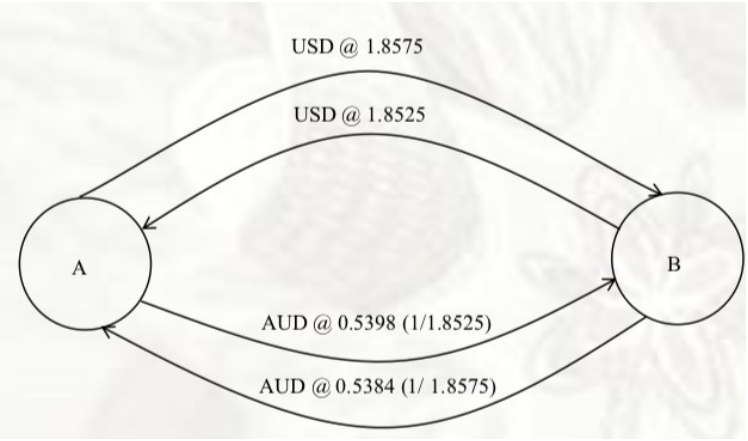
The bid and offer rates

- The bid rate is the rate at which the quoting dealer is willing to buy. The offer rate is the rate at which the quoting dealer is willing to sell.
- The spread is:

$$m = S_a - S_b$$

$$m = \frac{S_a}{S_b} - 1$$

A foreign exchange spot transaction with bid- offer spread



Conversion rules

$$S_b(y/x) = \frac{1}{S_a(x/y)}$$

$$S_a(y/x) = \frac{1}{S_b(x/y)}$$

$$S(f/d) = \frac{1}{S(d/f)}$$

Conversion Rules – Example

- Suppose that the $S_a(AUD/Euro)$=1.2081, while the $S_b(AUD/Euro)$=1.2078
  - To work out the bid rate for the $S_b(Euro/AUD)$, we have:

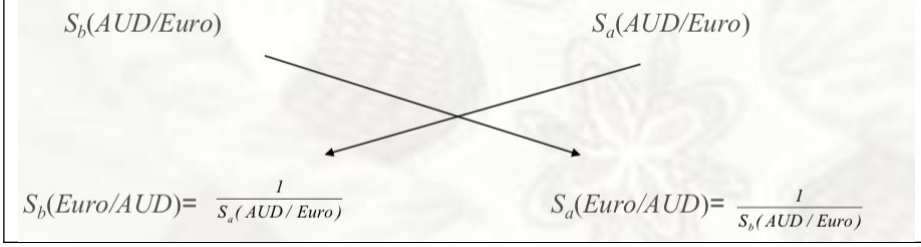
$$S_b(Euro/AUD) = \frac{1}{S_a(AUD/Euro)} = 0.8277$$

  - To work out the ask price for the $S_a(Euro/AUD)$, we have:

$$S_a(Euro/AUD) = \frac{1}{S_b(AUD/Euro)} = 0.8280$$

Conversion Rules - Example

- Note that upon inverting, the bid price for the Euro becomes the ask price for the AUD, and the ask price for the Euro becomes the bid price for the AUD



Points and pips

- A point is one-hundredth of a cent, a penny, etc.
- A pip is one-tenth of a point
- If the exchange rate is 1.2545-1.2585, this can be expressed as 45-85 and 1.25 is called the “big number”

Cross exchange rates

A cross exchange rate is the exchange rate between two currencies derived from their exchange rates against another currency.

$$S(x/y) = \frac{S(x/z)}{S(y/z)}$$

Cross Exchange Rates – Example

Suppose that $S(AUD/JPY) = 0.0165$, and that the $S(JPY/USD) = 110.66$. Calculate the $S(AUD/USD)$.

AUD ➔ JPY ➔ USD

As such,

$S(AUD/USD) = S(AUD/JPY) * S(JPY/USD)$

$=1.8259$

Suppose that $S(USD/GBP)$ = 1.8058, and that the $S(USD/AUD)$ = 0.7607. Calculate the $S(AUD/GBP)$.

AUD → USD → GBP

As such,

$S(AUD/GBP) = S(AUD/USD) * S(USD/GBP)$

= (1/0.7607) * 1.8058

= 2.3739

Suppose that $S(USD/GBP)$ = 1.8058, and that the $S(USD/AUD)$ = 0.7607. Calculate the $S(AUD/GBP)$.

$S(x/y) = S(x/z) / S(y/z)$

As such,

$S(AUD/GBP) = S(AUD/USD) / S(GBP/USD)$

= (1/0.7607) / (1/1.8058)

= (1/0.7607) * 1.8058

= 2.3739

The forward exchange rates

• The rate contracted today for the delivery of a currency at a specified date in the future

Forward value date

The date on which currencies involved in a forward transaction are exchanged.

- The forward value date must be more than two business days after the contract date, otherwise it will be a spot transaction
- Spot value date (delivery date): 2 business days 4The period preceding the forward value date is
- calculated from the spot value date
- e.g. On 16th June, one-week forward agreement struck. Forward value date = 7 days from 18th → 25th June

Outright and swap forward transactions

- An **outright contract** involves the sale or purchase of a currency for delivery more than two days into the future
- A **swap transaction** involves a spot purchase against a matching outright sale (or vice versa)

➔ This is like a trader agrees to buy a a currency and simultaneously resell it in the future at an exchange rate determined now.

The forward spread

$$m = \frac{F(x/y) - S(x/y)}{S(x/y)} \times 100 \times \frac{12}{N}$$

Premium and Discount

Outright and Swap Forward Rates

An outright forward rate is quoted as bid and ask rates – Just like spot rates

• A swap forward rate is quoted in terms of the points representing the forward premium or discount

- If the **bid rate is less than the ask rate**, we add the points to the spot bid and ask rates
- If the **bid rate is greater than the ask rate**, we subtract the points from the spot bid and ask rates

Outright and Swap Rates - Example

- Suppose that the spot and forward rates for the (AUD/GBP) were:

Spot	2.7586 – 2.7593
One Month	10 – 15
Three Months	15 – 7
Six Months	30 – 35
Nine Months	25 – 18

Practice 1

At 9.30 a.m. Dealer A calls Dealer B and asks for a quote on the AUD/GBP exchange rate. Dealer B responds by quoting 2.5500–2.5540. Dealer A decides to buy GBP200 000 at the quoted rate. At 3.30 p.m., Dealer B quotes 50–90. Will dealer A make a profit or a loss by selling the pound at 3.30 p.m.?

Solution:

1.Dealer A is the price taker – buys at the ask rate and sells at the bid rate.

2.Dealer A buys GBP at 2.5540 and sells GBP at 2.5550.

3.Profit/Loss = Ask rate – bid rate

Practice 1

Dealer B quotes at:	Bid Rate	Ask Rate	Dealer A's transactions
9.30am	2.5500	2.5540	GBP200,000 bought at 2.5540.
3.30pm	2.5550	2.5590	GBP200,000 sold at 2.5550

Profit/Loss for Dealer A by trading GBP:

200,000 (2.5550 – 2.5540) = AUD200

Practice 2

The spot and forward rates between the Australian dollar and the euro (AUD/EUR) are as follows:

Spot	**1.6030**
One-month forward	**1.6260**
Three-month forward	**1.5920**

Calculate the forward spread in percentage per annum for the one-month maturity. State whether the Australian dollar sells at a premium or a discount.

Practice 2

Spot 1.6030
One-month forward 1.6260

Given (AUD/EUR), the one-month forward spread is:

$$\frac{1.6260-1.6030}{1.6030}\times 12 = 0.172 = 17.2\%$$

This means that the euro is selling at a premium.

Note that the forward spread in percentage calculated using this formula always refer to the commodity currency.

Topic 3 – Exchange Rate Forecasting, Technical Analysis and Trading Rules

Definition
- Forecasting is a formal process of generating expectation
- Expectations are implicit forecasts

Why do we need exchange rate forecasting?

- Spot speculation (go long if appreciation expected, go short if depreciation expected)
- Uncovered interest arbitrage (if s(x/y) expected not to decline more than interest differential: go short on x and long on y)
- Spot-forward speculation (if s>f, buy forward and sell spot at delivery)
- Option speculation (if appreciation expected, a long call or s short put position is taken)
- Hedging (exposure of forex risks for payables /receivables when they fall due)

- Investment and capital budgeting (choice of investment currency: ST, LT, portfolio inv or FDI?)
- Financing decisions
- Pricing decisions (if domestic currency appreciates, then foreign price of product might be too high)
- Strategic planning (choice of production location, which foreign market to sell products in)
- Macroeconomic conditions (e/r forecast might be required to forecast other variables: inflation, growth)
- Central bank intervention

Econometric forecasting models

- These are models that are specified on the basis of economic theory and estimated by an econometric method
- They are classified into single-equation and multi- equation models

Single-equation models

Also known as reduced-form models.
The exchange rate (or its rate of change) depends on one or more variables:

$$S_t = f(X_{1,t}, X_{2,t} \ldots X_{n,t})$$

$$S_t = a_0 + a_1 X_{1,t} + a_2 X_{2,t} + \ldots + a_n X_{n,t}$$

$$S_{t+1} = a_1 X_{1,t+1} + a_2 X_{2,t+1} + \ldots + a_n X_{n,t+1}$$

Examples of single-equation models

$$\dot{S}_t = a_0 + a_1(\dot{P} - \dot{P}^*)_t$$

$$\dot{S}_t = a_0 + a_1(i - i^*)_{t-1}$$

$$S_t = a_0 + a_1 F_{t-1}$$

Problems of single-equation models

The 'black box' problem

- how are the explanatory variables determined?

Forecasting the explanatory variables

- accuracy of the forecasts of the explanatory variables
- Point forecast (eg. single value of variables for each future period), interval forecast (eg. constructing scenarios for variables, feeding in a range of value for each period)

Data frequency

- Daily forecast vs. monthly/quarterly/annual data

Problems of single-equation models

Structural changes

- Assumption that the estimated equation will remain valid over the forecasting horizon may not be true

- Estimated coefficients may not be constant 4Need re-estimation to include structural changes

- **Measurement errors in explanatory variables** (eg. BOP is measured with a sig. omission/error item)
- **Qualitative variables**

- i.e. market sentiment, investor confidence

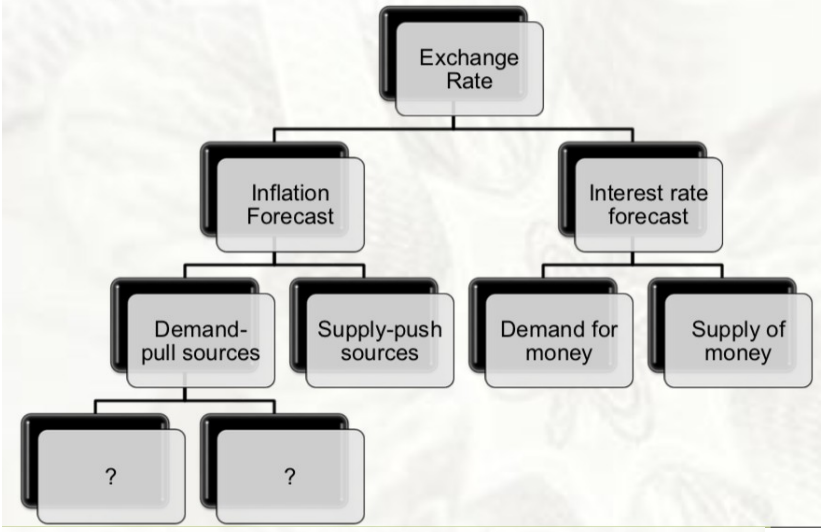
Multi-equation models

The 'black box' problem can be solved by specifying a multi-equation model

- A structural multi-equation model
- Specify equations to explain the explanatory variables X1, ..., Xn

➔ costly due to large amount of data and difficult to estimate
➔ no evidence that these models forecast better than single-equation models

Example of Multi-equation models



Econometric forecasting models

Include the following models:

- Time series models
- Market-based forecasting
- Judgmental forecasting
- Composite forecasting

Time series models

Autoregressive approach: current level depends entirely on its level in the previous period

- These are based entirely on the … exchange rate:

$$S_t = f(S_{t-1}, S_{t-2} \ldots s_{t-n})$$

$$S_t = \mu_t + \gamma_t + \varphi_t + \varepsilon_t$$

Decomposition approach: time series decomposed into trend, seasonal, cyclical and random components.

(cont

Time series models (cont.)

- Exchange rate movement depends on past levels
- No underlying economic theory
- Exchange rates move predominantly in cycles with significant random variation

Problem with time series models

- Undermined by the **market efficiency hypothesis**, if the foreign exchange mar[illegible] indeed efficient
- [illegible] its

Market efficiency = informational efficiency, i.e. prices reflect all available information.

- **Implications:**

1. Not possible to predict movements from available information: already reflected in prices
2. Not possible to earn abnormal returns from active trading

Market-based forecasting

- Using the current market spot and forward rates as forecasters for the future spot rate
- This means that market-based forecasts are free and readily available
- The reliability of market-based forecasts depends on the validity of the random walk hypothesis and the unbiased efficiency hypothesis

Market-based forecasting (cont.)

$$S_t = S_{t-1} + \varepsilon_t$$

$$\Delta S_t = \varepsilon_t$$

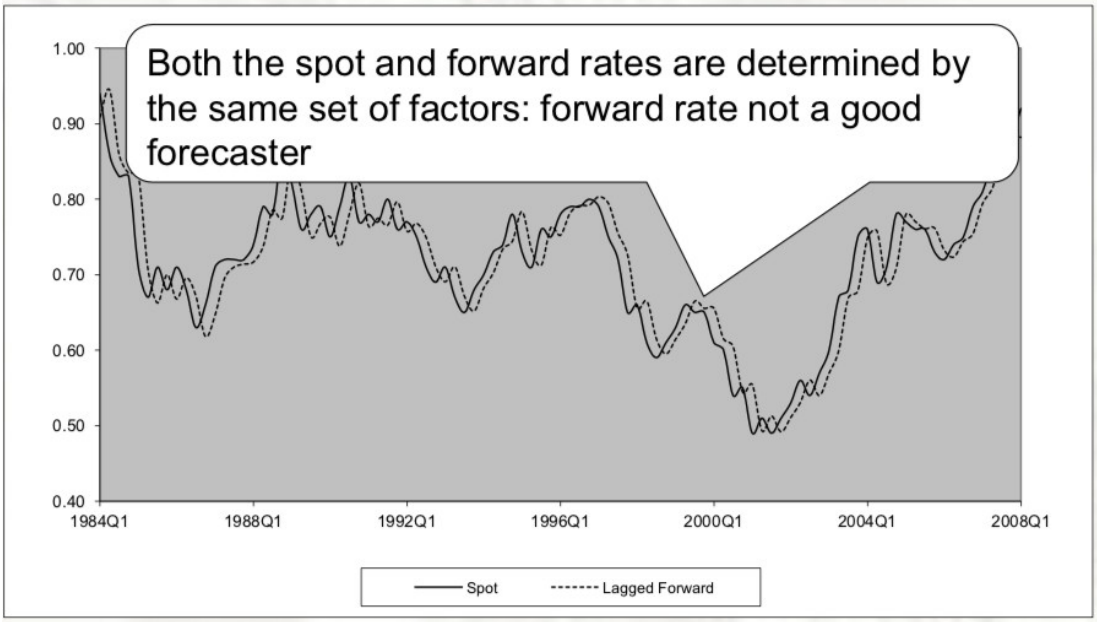
- The level of the change rate today differs from the level yesterday by a random term, which can be positive or negative.
- Period-to-period changes in the exchange rate are random and unpredictable.

Market-based forecasting (cont.)

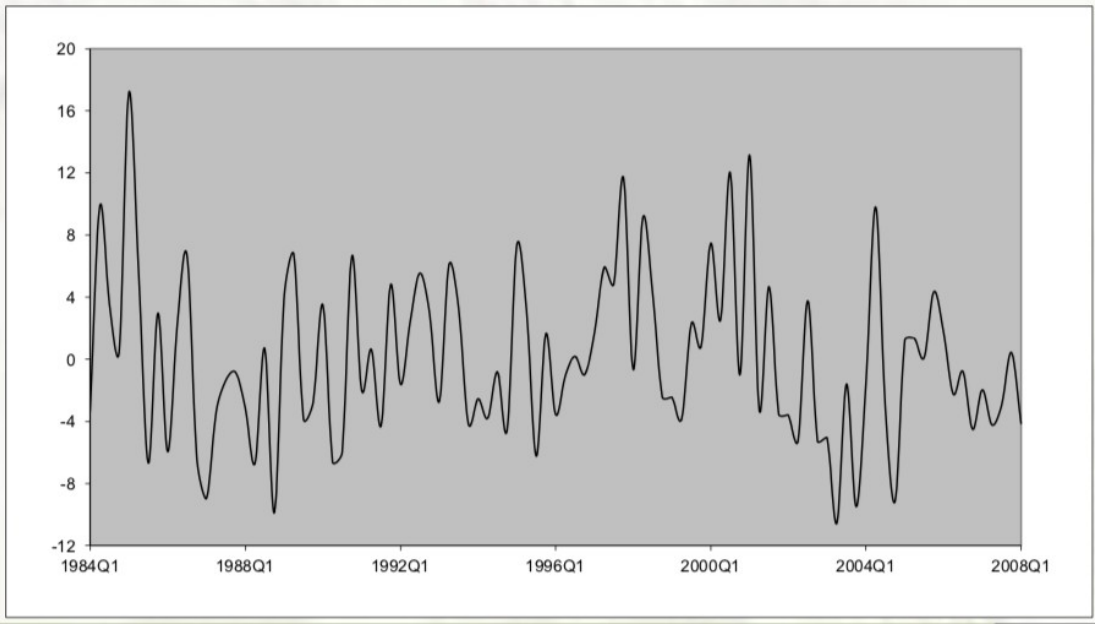
- Forward rate as a forecaster
  - Forward market efficiency – the market is efficient if it reflects all available information, where information is embodied in the forward rate.

- Market efficiency will hold in general if the forward exchange rate is an unbiased and efficient forecaster of the spot exchange rate
  - Unbiased efficiency (i.e. on average, the forward rate is equal to the spot rate prevailing on the maturity date of the forward contract)

Spot and lagged forward exchange rates (USD/AUD)



The forward rate forecasting error as a percentage of the spot rate



Problems with market-based forecasting

- Relies on random walk hypothesis and unbiased efficiency hypothesis: there is no empirical validity

- May lead to faulty decisions:

➢ Forecast using forward rate:

❖ no decision will be taken to hedge foreign currency payables / receivables, as no hedge and hedge decision will lead to the same result

❖ Leads to conclusion to go long on currency selling at forward premium and short on currency selling at a discount: this is only profitable if unbiased efficiency hypothesis is valid but unprofitable if random walk hypothesis is valid

Problems with market-based forecasting

➢Forecast using spot rate:

- leads to conclusion of always going long on high- interest currency and short on low-interest ones. May not be sound: currency factor may overwhelm the interest rate differentials

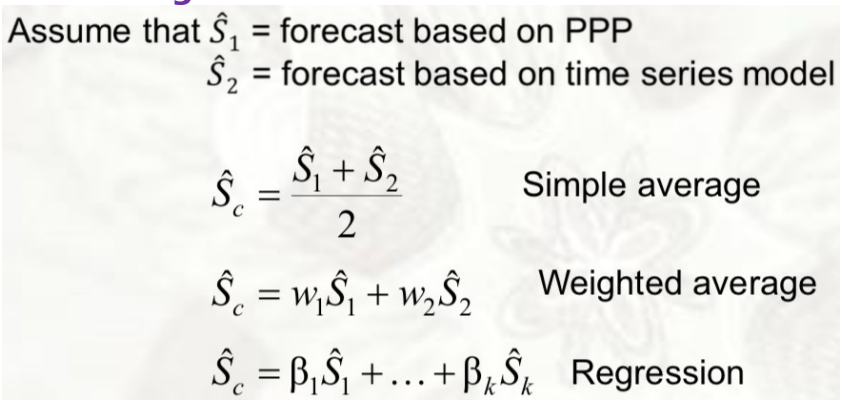
Judgmental forecasting

• Judgmental forecasting considers all factors affecting exchange rates
    - Include those that cannot be quantified, such as market sentiment
• It is not based on a formula derived from a formal model
• Forecaster follows development the market and relates the forecasts to these developments
• Qualitative description of what may happen
    - the direction of the possible change in the exchange rate 4 a range of values

Composite forecasting

Composite forecasting is based on two or more forecasts that are derived independently
Forecasting accuracy can be increased by pooling different forecasts
    - Derive an average or a consensus forecast

Combining forecasts



Why composite forecasting?

Different forecasters have different degrees of forecasting accuracy
    - Different information and abilities 4Different techniques
- Diversification reduces the risk of large forecasting errors

Forecasting performance evaluation

Performance of forecasters must be evaluated according to two general principles:

- If forecasts are based on a model estimated from historical data, then performance out of sample is more meaningful
- The loss function is important where user of the forecasts must be able to specify the purpose for which the forecasts are used and the costs associated with the forecasting errors

Measures of forecasting accuracy

- Accuracy is the deviation of the forecast from the actual or realised value of the exchange rate
  - Measured over a period of time to establish a track record
- Assume over points in time $t = 1, 2, 3, \ldots. n,$ actual and forecast value are given by S_t and $\hat{S}_t$ respectively
- At a particular point in time, the deviation or the forecasting error is given by

$$e_t = \hat{S}_t - S_t$$

Measures of forecasting accuracy

- Mean absolute error (MAE)

$$MAE = \frac{1}{n}\sum_{t=1}^{n}\left|\hat{S}_t - S_t\right|$$

- Mean square error (MSE)

$$MSE = \frac{1}{n}\sum_{t=1}^{n}\left(\hat{S}_t - S_t\right)^2$$

- Root mean square error (RMSE)

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}\left(\hat{S}_t - S_t\right)^2}$$

An example

FORECAST OF AUD/USD

TIME	ACTUAL	A	B	C
1	1.85	1.87	1.80	1.79
2	1.87	1.88	1.85	1.86
3	1.89	1.86	1.90	1.87
4	1.84	1.88	1.82	1.92
5	1.83	1.84	1.81	1.85
6	1.80	1.79	1.76	1.79
7	1.81	1.76	1.84	1.80
8	1.84	1.85	1.84	1.86
9	1.87	1.90	1.88	1.90
10	1.90	1.95	1.86	1.92

CRITERION	A	B	C
MAE	0.026	0.046	0.036
MSE	0.00092	0.00278	0.00196
RMSE	0.030	0.053	0.0044

Technical analysis

- Technical analysis comprises a variety of practices and procedures used to forecast exchange rates
- It ignores the role of fundamentals
- It is used to generate buy and sell signals
- Similar to time series forecasting but less formal and less rigorous

Rationale for technical analysis

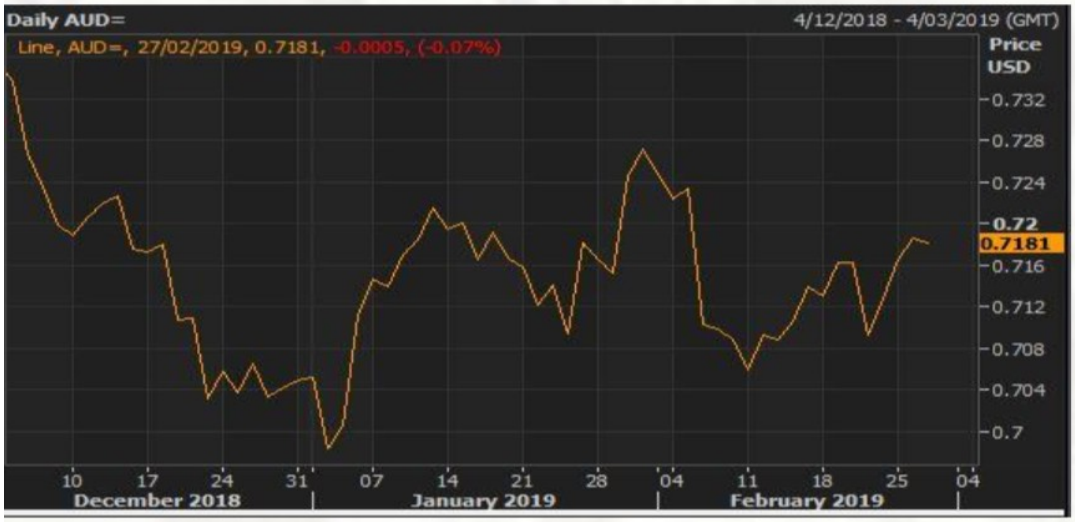
- Exchange rates are determined by supply and demand
- Supply and demand are governed by rational and irrational factors
- Changes in trend are caused by shifts in supply and demand
- History repeats itself

Kinds of charts

- Line charts
- Japanese candlestick charts
- Point and figure charts

Line chart

AUD/USD



Japanese candlestick charts

AUD/USD

The body: the open-to-close range
The wick: or shadow, that indicates the intra-day high and low
The colour: which reveals the direction of market movement – a white body indicates a price increase, while a yellow body shows a price decrease.

Japanese candlestick charting techniques
Four bullish patterns

1. **Hammer:** a short body with a long lower wick, and is found at the bottom of a downward trend.

2. **Bullish engulfing**: formed of two candlesticks. The first candle is a short yellow body that is completely engulfed by a larger white candle.

Japanese candlestick charting techniques
Four bullish patterns

3. **Morning star:** It is a three-stick pattern: one short-bodied candle between a long yellow and a long white.

4. **Three white soldiers:** occurs over three days. It consists of consecutive long green (or white) candles with small wicks, which open and close progressively higher than the previous day.

Japanese candlestick charting techniques
Four bearish patterns

1. **Hanging man:** the bearish equivalent of a hammer; it has the same shape but forms at the end of an uptrend.

2. The shooting star: has the same shape as the inverted hammer, but is formed in an uptrend: it has a small lower body, and a long upper wick.

Japanese candlestick charting techniques
Four bearish patterns

3. **Bearish engulfing:** occurs at the end of an uptrend. The first candle has a small white body that is engulfed by a subsequent long yellow candle

4. Three black crows: comprises of three consecutive long yellow candles with short or non-existent wicks.

Japanese candlestick charting techniques

- Dragonfly doji pattern: acts as an indication of investor indecision and possible trend reversal.

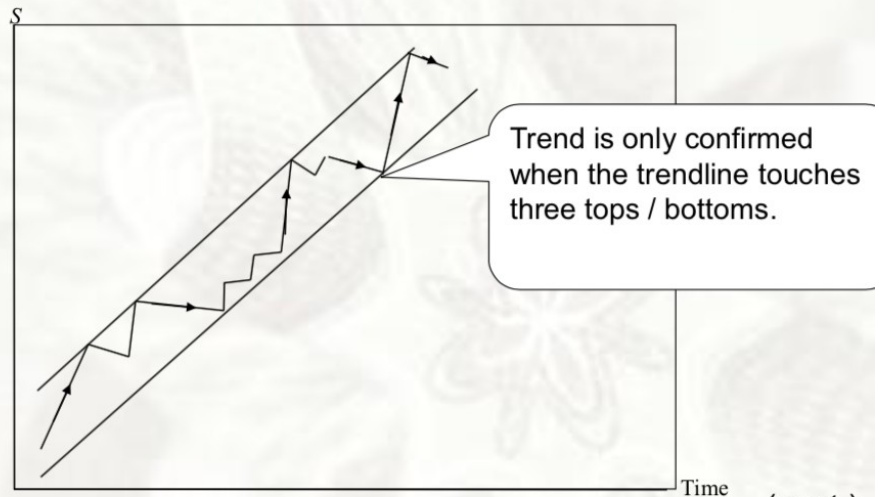
Trendlines and trading ranges

Trendlines connect ascending bottoms and descending tops

- A trend is confirmed until three tops or bottoms touch the line
- A parallel line is then drawn, creating a trend channel

The market is in a trading range when the tops and bottoms are at the same level

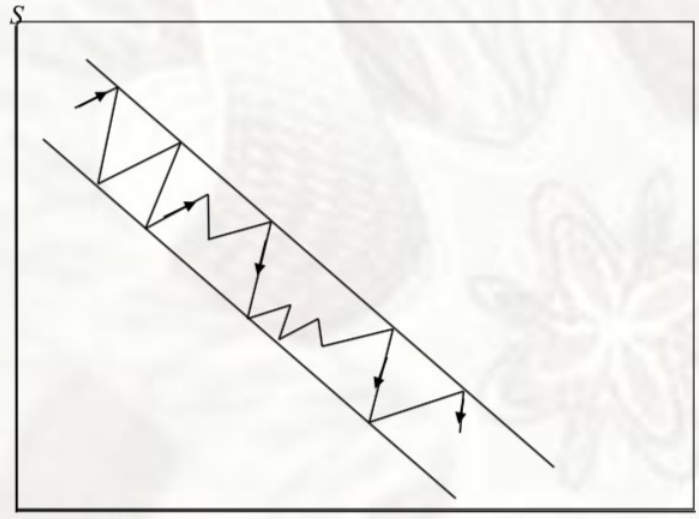
Trendlines and trend channels



(a) Upward trend (bull market)

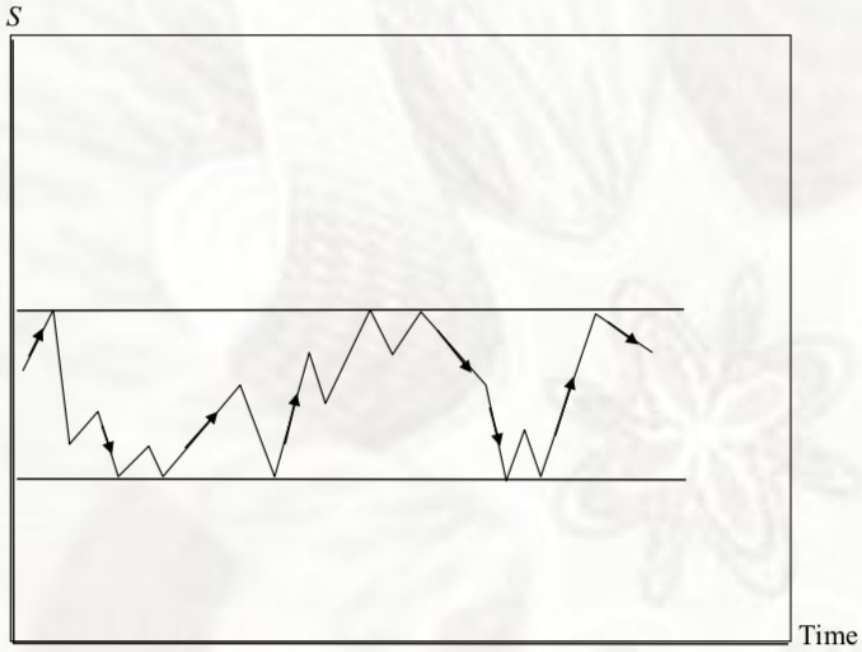
(cont.)

Trendlines and trend channels (cont.)



(b) Downward trend (bear market)

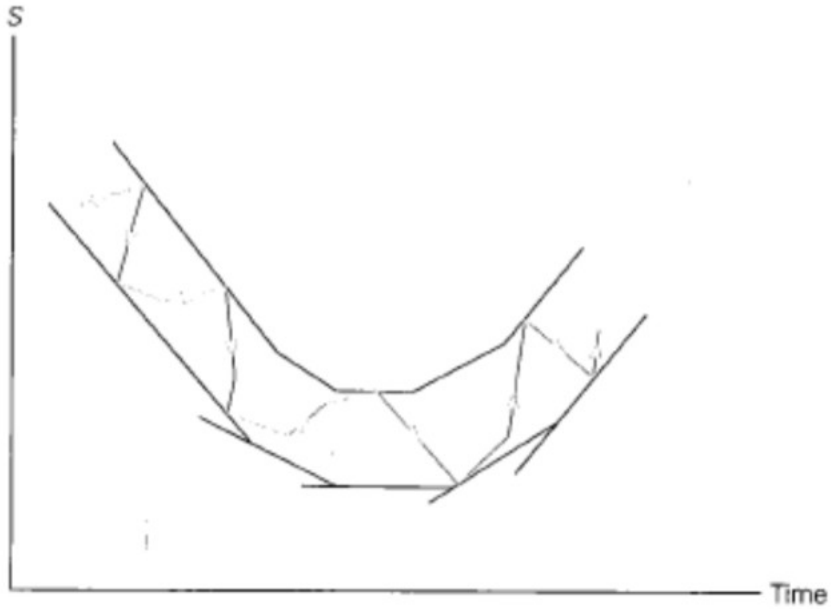
Trendlines and trend channels (cont.)



(c) Sideways trend (trading range)

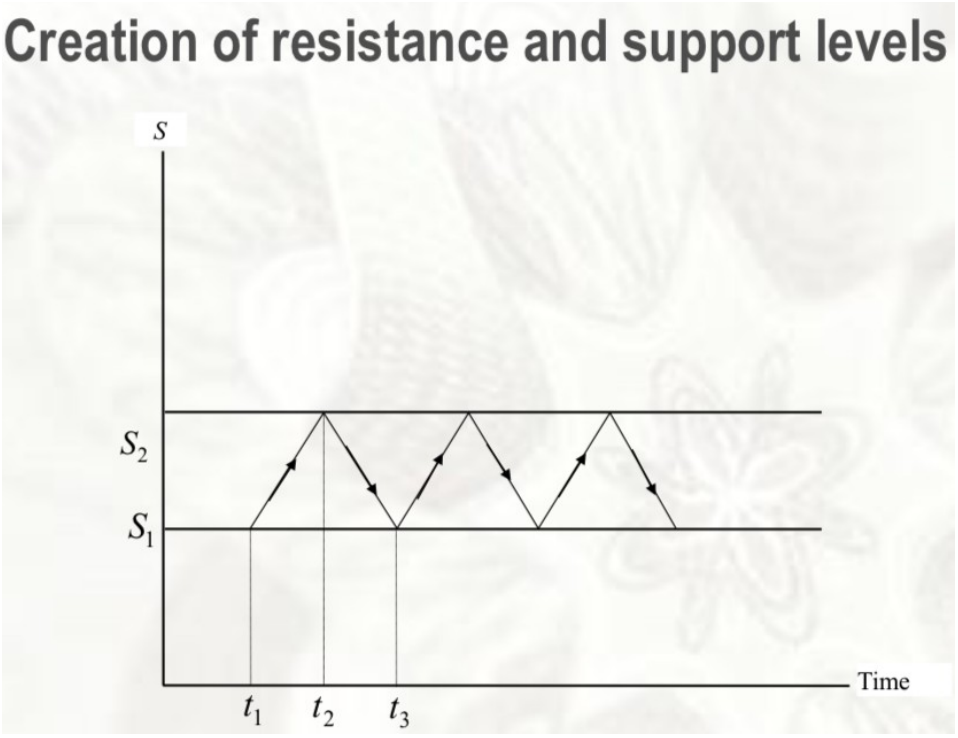
Trend reversal

Trend reversal



Support and resistance levels

- A support level is the bottom of a market swing
- A resistance level is a point where the market peaks and the exchange rate reverse an upward move



Flags

- A flag is a continuation pattern
- A flag occurs when a major trend is interrupted

(source MetaQuotes Software Corp)

Figure 3.1 EUR/GBP daily chart showing price action making higher highs and higher lows.

Triangles

- An ascending triangle appears when buyers come to the market at progressively higher levels. Otherwise it will be a descending triangle
- A symmetrical triangle is difficult to interpret

(source MetaQuotes Software Corp)

Figure 2.7 EUR/GBP daily chart showing a ascending triangle.

(source MetaQuotes Software Corp)

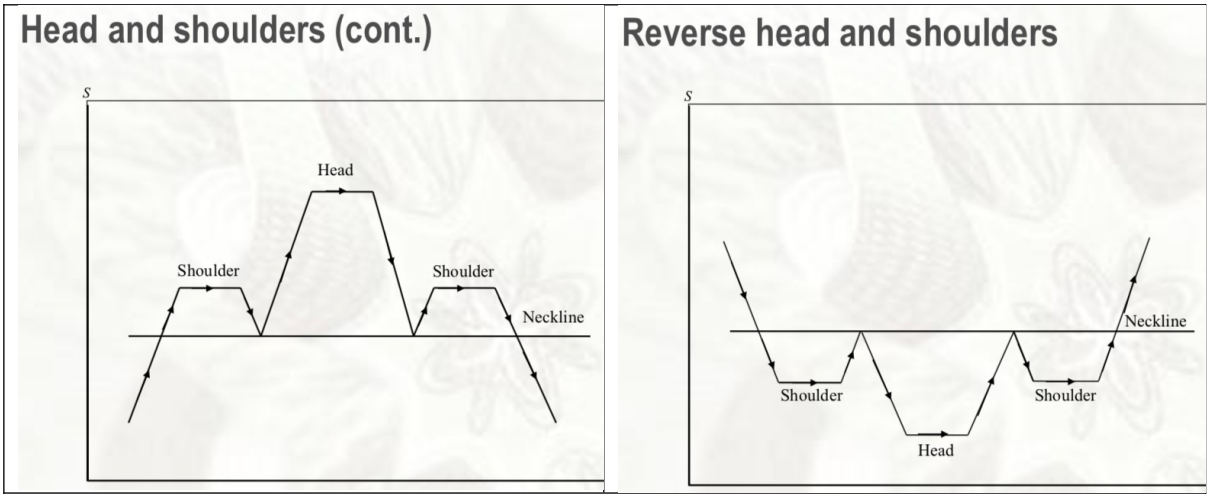
Figure 2.8 USD/CHF daily chart showing a descending triangle.

(source MetaQuotes Software Corp)

Figure 2.5 Gold daily chart showing a bullish symmetrical triangle as part of an upwards trend market. Price breaks out before apex.

Head and shoulders

- This formation indicates the reversal of an upward trend (and the onset of a bear market).
- A reverse head and shoulders formation implies the opposite



Market efficiency and trading rules

- Market efficiency implies that it is not possible to make profit by adopting a mechanical trading rule or by following buy-sell signals extracted from charts
- Market efficiency = informational efficiency

1. Not possible to predict price movement from available information (info already reflected in prices)
2. Not possible to earn abnormal returns through active trading

- Inefficient market➔random walk

Trading rules are mechanical procedures that are used to generate buy and sell signals.

- PPP trading rule

Filter rules

- An $x\%$ filter rule means that a currency is bought when it appreciates by $x\%$ from the most recent trough and is sold when it depreciates by $x\%$ from the most recent peak
  - x is any small number, i.e. 0.5%, 1%, 2%, 5%
- Choice of filter size
  - Catching the 'true' break-outs vs. catching the trend

Moving average rule

- A moving average rule depends on the behaviour of one or two moving averages in relation to the actual exchange rate and to each other.

$$M_t(q) = \frac{1}{q}\sum_{i=0}^{q} S_{t-1}$$

- A moving average of order (length) q at time (day) t is the simple average of the daily values over the last q days.

(cont.)

Example

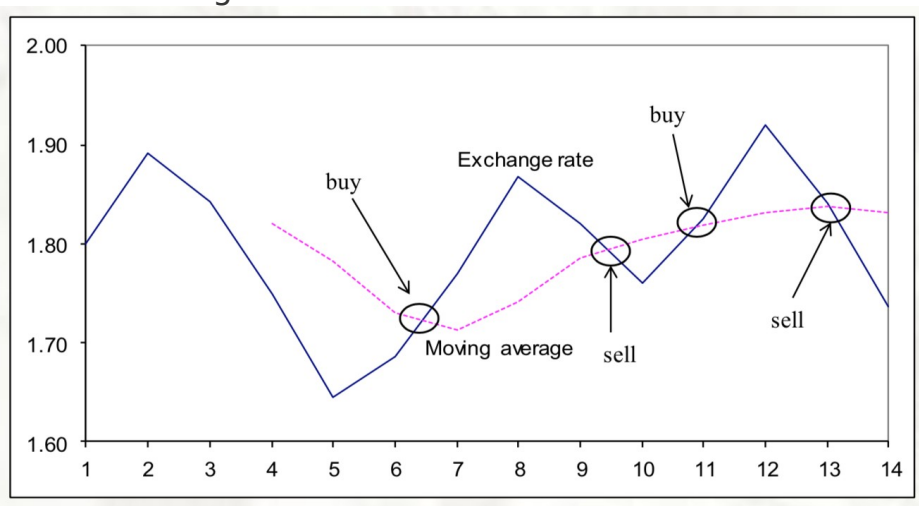
Day	Exchange Rate
1	1.8000
2	1.8907
3	1.8423
4	1.7495
5	1.6445

The 5-period moving average (at day 5) is:

1/5 X (1.8000 + 1.8907 + 1.8423 + 1.7495 + 1.6445) = 1.7854

A single moving average rule:

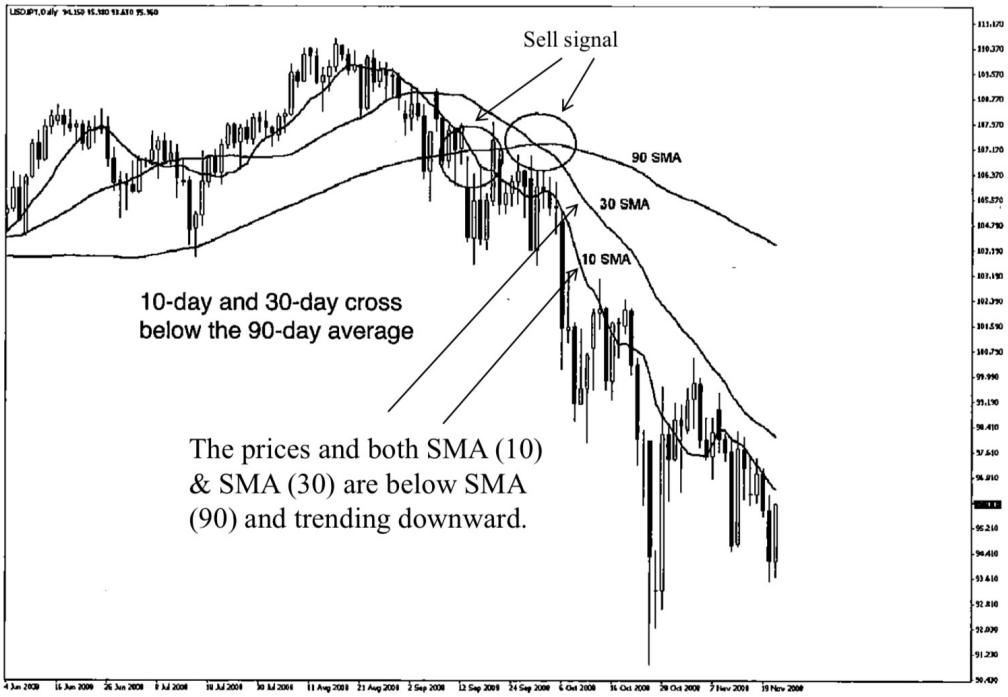
- A currency is bought when the moving average cuts the exchange rate series from above
- A currency is sold/sold short when the moving average cuts the exchange rate series from below



Double moving average rule

A double moving average rule involves using two moving averages of difference orders

- A buy signal is indicated when the long moving average crosses the short moving average from above
- A sell or short sell signal is indicated when the long moving average cuts the short moving average from below



(source MetaQuotes Software Corp)

Figure 4.5 USD/JPY daily chart with 10, 30 and 90-day simple moving averages crossing negative.

Source: Burgess (2009)

Topic 4 – The Balance of Payments and the Effective Exchange Rate

The **Balance of Payments records** financial flows that affect financial variables:

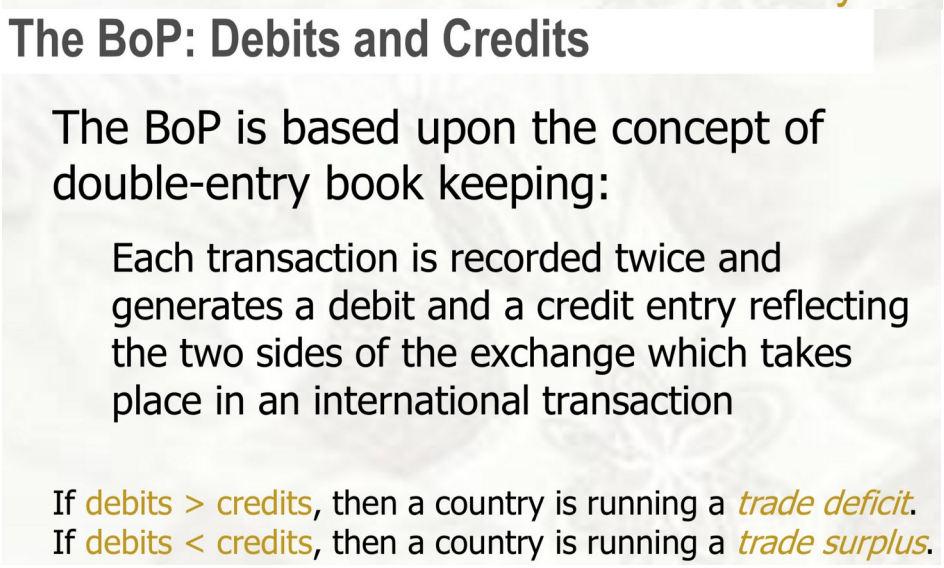
- Exchange rates
- Interest rates
- "Two-way causation"

Definition: balance of payments (BOP)

- The balance of payments (BOP) is a systematic record of all economic transactions between the residents of the reporting country and the rest of the world over a specified period of time.

Important elements in the definition

- Rest of the world
- Economic transactions
- Resident
- Flows versus stocks
- The BOP records changes in assets and liabilities
- Figures may or may not be seasonally adjusted



The BoP: Debits and Credits

Exchange is a **two-way transaction** – one is the acquisition or sale side, the other is the payment or purchase side

- First, anything that gives rise to a receipt from a foreign resident (sale/export) is counted as being positive and is recorded as a credit entry
- Second, anything that gives rise to a payment obligation to foreigner (purchase/import) is counted as being negative and is recorded as a debit entry

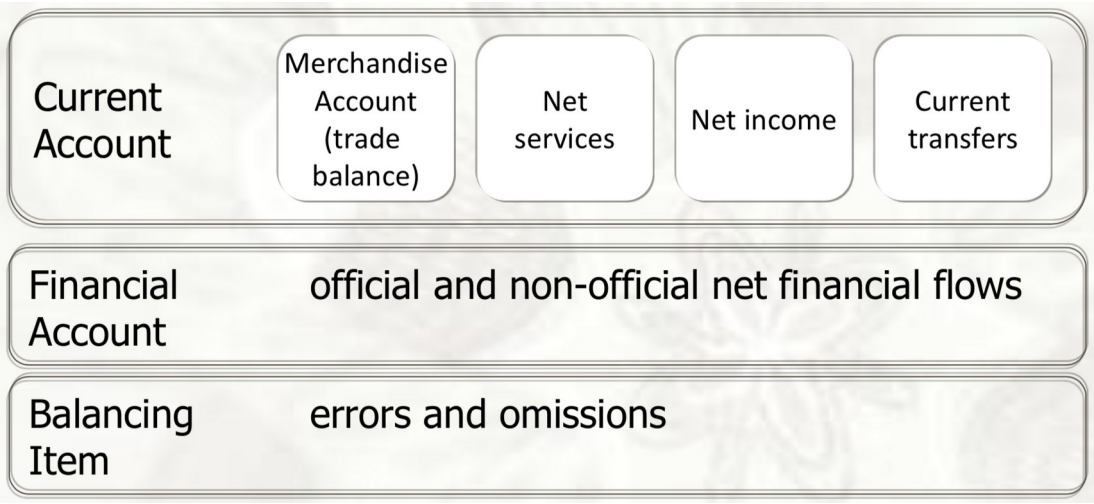
EXAMPLE:

1. An Australian merchant exchange AUD1000 with a Chinese merchant at S(CNY/AUD) = 6.4467
   a) Export currency AUD1000 – Credit in FA
   b) Import currency CNY6446.70 – Debit in FA
2. The Australian merchant uses CNY6446.70 to purchase a vase from a Chinese merchant.
   a) Export currency CNY6446.70 – Credit in FA
   b) Import vase valued at CNY6446.70 – Debit in CA
3. A Chinese merchant purchase opals valued at AUD1000 from an Australian merchant.
   a) Export opal – Credit in CA
   b) Import currency AUD1000 – Debit in FA

The BoP: Debits and Credits - Example

	AUS BoP	
	Credit (+)	Debit (-)
Current Account (CA)	(3) 1,000 (Opal)	(2) – 1,000 (Vase)
Financial Account (FA)	(1) 1,000 (AUD)	(1) – 1,000 (CNY)
	(2) 1,000 (CNY)	(3) – 1,000 (AUD)

The Australian Balance of Payments



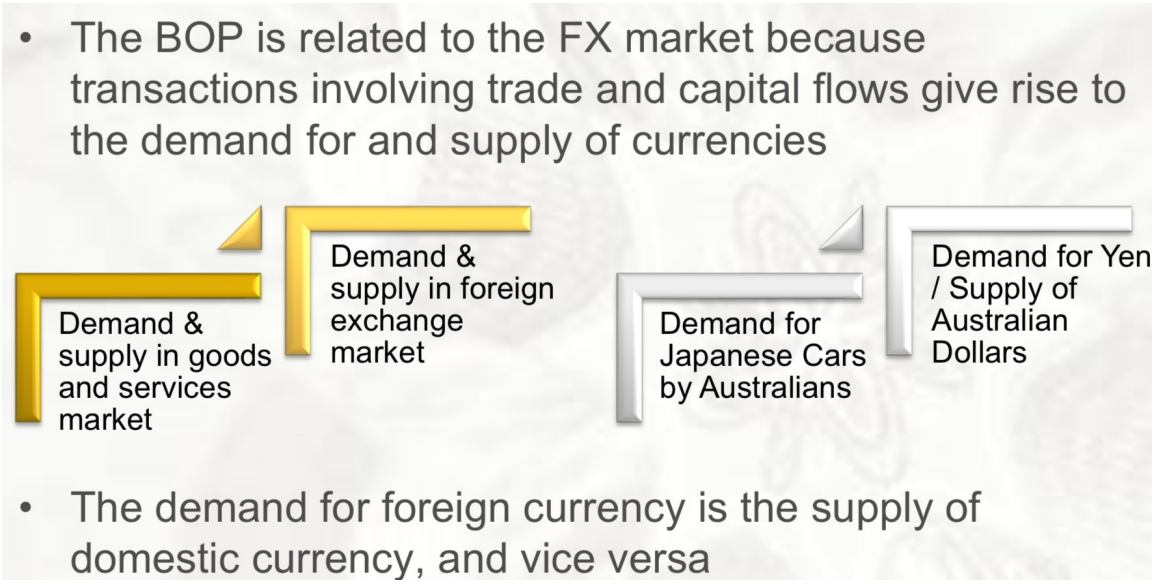
The Structure of the Balance of Payments

Table 1: The Structure of the Balance of Payments
1. Trade Account: Exports (+) and Imports (-)
2. Services Account: Receipts (+) and Payments (-)
3. Income Account: Receipts (+) and Payments (-)
4. Unrequited Transfers: Gifts Received (+) and Gifts Sent (-)
I. Balance on the Current Account (sum of 1 + 2 + 3 + 4)
5. Foreign Investment in Australia (Capital Inflow)
Inward Direct Investment (+)
Sale of Domestic Financial Assets (+)
6. Australian Investment Abroad (Capital Outflow)
Outward Direct Investment (-)
Purchase of Foreign Financial Assets (-)
7. Official Reserves Account
Increase in Reserves and Gold/Selling of Australian dollars (-)
Decrease in Reserves and Gold/Purchases of Australian dollars (+)
II. Balance on the Capital Account (sum of 5 + 6 + 7)
III. The Underlying Balance (sum of I + II)
8. Balancing Item (±)
IV. The Balance of Payments (sum of III ± 8)

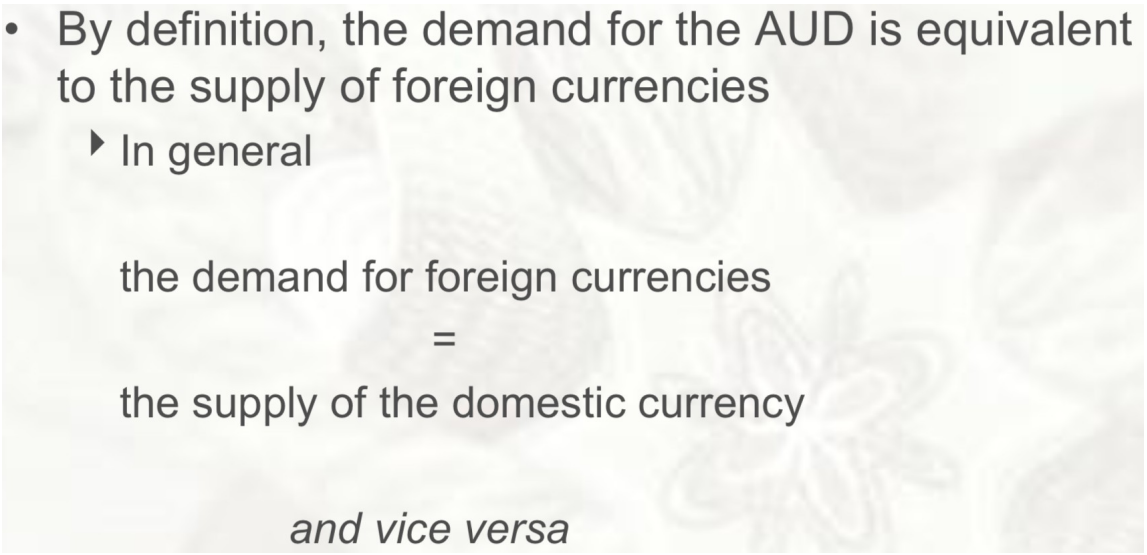
The Balancing Item

- The collection of such BoP statistics are invariably marred by ‘errors’ (incorrectly recorded transactions) and ‘omissions’ (transactions not recorded) such that a balancing item must be added to a country’s national ledger in order that the debits and credits are equal

The BOP and FX market

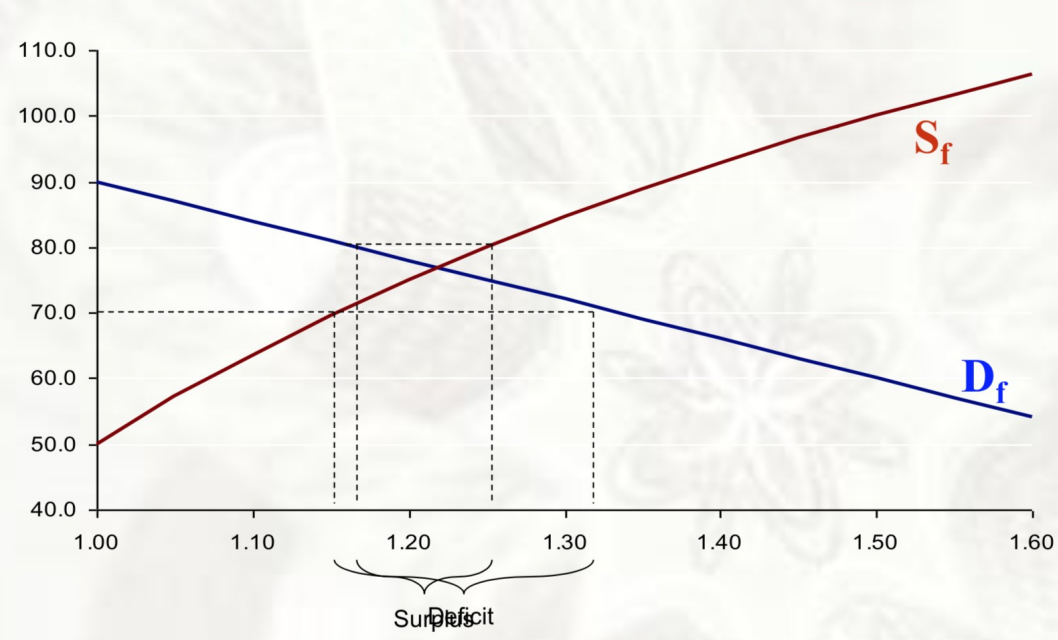


The BOP and FX market



- For simplicity, let’s suppose that exports and imports are the only sources of supply and demand for foreign exchange
  - We hold all other components of the BoP constant, so that only changes in exports and imports give rise to the supply and demand for foreign currencies

FX Demand and Supply Curves



FX Demand and Supply Curve

Symbols:

p_m^*	Foreign currency prices of imports
P_x^*	Foreign currency prices of exports
Q_m	Import quantity
Q_x	Export quantity

Since the demand for imports leads to demand for foreign exchange,

the demand for foreign exchange = import expenditure, $P_m^* Q_m$

the supply of foreign exchange = export revenue, $P_x^* Q_x$

Derivation of the demand for FX:

$$Df = P_m^* Q_m$$

$$Q_m = a - bP_m$$

$$P_m = SP_m^*$$

Derivation of the supply for FX:

$$Sf = P_x^* Q_x$$

$$Q_x = c - dP_x^*$$

$$P_x^* = \frac{P_x}{S}$$

Example

Deriving the demand for foreign exchange curve

Assume **Qm=15-0.6Pm** and foreign currency prices of imports is unchanged at 10.

What happens to the demand for imports and foreign exchange as the value of the exchange rate, S, changes?

S	P_m^*	P_m	Q_m	Df
		$P_m = SP_m^*$	$Q_m = a - bP_m$	$Df = P_m^* Q_m$
1.00	10.0	10.00	9.00	90.00
1.25	10.0	12.50	7.50	75.00
1.50	10.0	15.00	6.00	60.00

As S rises, imports become more expensive (rising Pm), leading to a decline in the demand for imports (lower Qm) and the demand for foreign exchange (Df)

Deriving the supply for foreign exchange curve

Assume **Qx=20-1.5Px*** and domestic currency prices of exports is unchanged at 10.

What happens to the demand for exports and foreign exchange as the value of the exchange rate, S, changes?

S	P_x	P_x^*	Q_x	Sf
		$P_x^* = \frac{P_x}{S}$	$Q_x = c - dP_x^*$	$Sf = P_x^* Q_x$
1.00	10.0	10.00	5.00	50.00
1.25	10.0	8.00	8.00	64.00
1.50	10.0	6.67	10.00	66.67

As S rises, exports become cheaper (falling Px*), leading to a rise in the demand for exports (higher Qx) and the supply of foreign exchange (Sf)

Factors Affecting the BoP

- The components of the BoP of a country can be in equilibrium, surplus or deficit, at any point in time
- They can also change from time to time – a surplus could change into a deficit, and a deficit into a surplus
- Changes in the current account are caused by a number of factors, including
  - Economic growth
  - Exchange rate

◊ The Marshall-Lerner condition ◊ The 'J-Curve' effect

  - Inflation
  - Trade restrictions

Factors affecting the current account

Economic growth: A country with a higher growth rate than its trading partners will experience deterioration in the current account.

The exchange rate: The effect of the exchange rate depends on the elasticities of demand for exports and imports.

$$B^* = P_x^* Q_x - P_m^* Q_m$$

$$\dot{Q}_m = e_m \dot{P}_m$$

$$\dot{Q}_x = e_x \dot{P}_x^*$$

Example

Let $Q_x = Q_m = 100$, $P_x = P_m^* = 15$, $S_0 = 1.50$, $S_1 = 1.80$

$$B^* = P_x^* Q_x - P_m^* Q_m$$

B^* = 10 X 100 – 15 X 100 = -500 (CA deficit)

What happens to the current account position if:

(i) Low elasticity, $e_x = -0.4$, $e_m = -0.2$

(ii) High elasticity, $e_x = -1.8$, $e_m = -1.5$

	Before the change	(i) After (Low)	(ii) After (High)
S	1.50	1.80	1.80
P_x =15	15	15	15
P_x^* ($P_x^* = \frac{P_x}{S}$)	15/1.5 = 10	15/1.8=8.3	8.3
P_m^* =15	15	15	15
P_m ($P_m = SP_m^*$)	1.5x15 = 22.5	1.8*15=27	27
e_x		-0.4	-1.8
e_m		-0.2	-1.5
Q_x ($\dot{Q}_x = e_x \dot{P}_x^*$)	100	$\dot{Q}_x = -0.4 \times (\frac{8.3}{10} - 1 \times 100) = 6.8\%$ Qx = 100x(1+0.068) = 106.8	130.6
Q_m ($\dot{Q}_m = e_m \dot{P}_m$)	100	$\dot{Q}_m = -0.2 \times (\frac{27}{22.5} - 1 \times 100) = -4\%$ Qm = 100*(1-0.04) = 96	70
$P_x^* Q_x$	10*100=1000	8.3*106.8=886.44	1084
$P_m^* Q_m$	15*100=1500	15*96=1440	1050
$B^* = P_x^* Q_x - P_m^* Q_m$	1000-1500=-500	886.44-1440=-553.56	34

Exchange Rates - Marshall-Lerner Condition

- The Marshall-Lerner condition states that the elasticities for demand of exports and imports to be greater than unity in absolute terms for the devaluation to improve the current account
  - If the Marshall-Lerner condition is satisfied, then the demand for imports falls, while the demand for exports rises, leading to an improvement in the current account
  - Price effect
  - Volume effect

Exchange Rates - Marshall-Lerner Condition

According to the Marshall-Lerner condition, a devaluation will lead to an improvement in the current account, if and only if

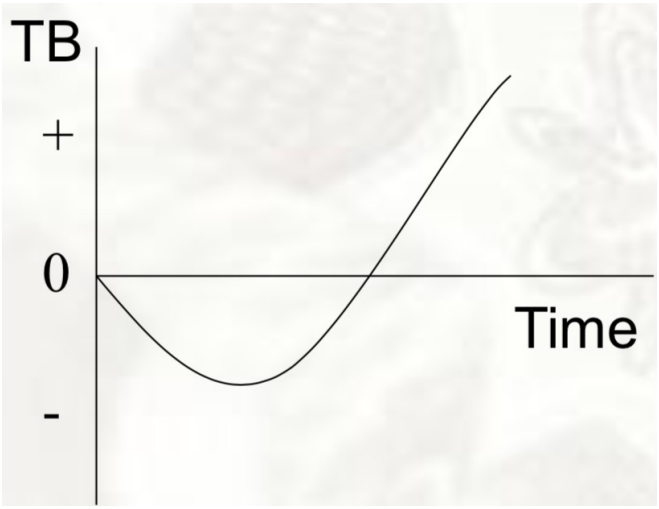
$$|e_{EX}^{fd} + e_{IM}^{dd}| > 1$$

Elasticity Estimates of Import and Export Demand

Country	ε_{EX}	ε_{IM}	$\varepsilon_{EX} + \varepsilon_{IM}$
Japan	1.40	0.95	2.35
UK	0.86	0.65	1.51
USA	1.19	1.24	2.43
India	0.50	2.20	2.70
Korea	2.50	0.80	3.30
Philippines	0.90	2.70	3.60

Exchange Rate - The 'J-curve' Effect

- If Marshall-Lerner Condition is satisfied in the LR but not in the SR, CA may deteriorate further before recovering in the LR
- If we map out this process on a diagram, the time path of the trade balance is shaped like a 'j', and hence, gives rise to the name of this effect.

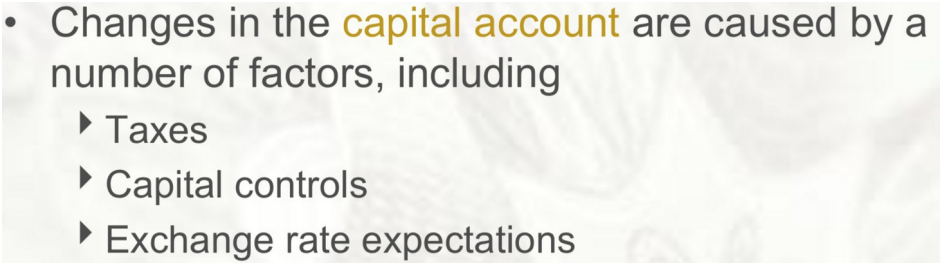


Factors affecting the current account (cont.)

Inflation: A country that has a higher inflation rate than its trading partners will experience deterioration in the current account.

Trade restrictions: One reason for imposing trade restrictions, such as tariffs and quotas, is the desire to protect the current account.

Factors Affecting the Capital Account



Factors affecting the financial account

Taxes: Taxes that are imposed on capital gains and/or income from dividends and interest payments may adversely affect the financial account. This is because foreign investors no longer find it attractive to invest in the underlying country's securities.

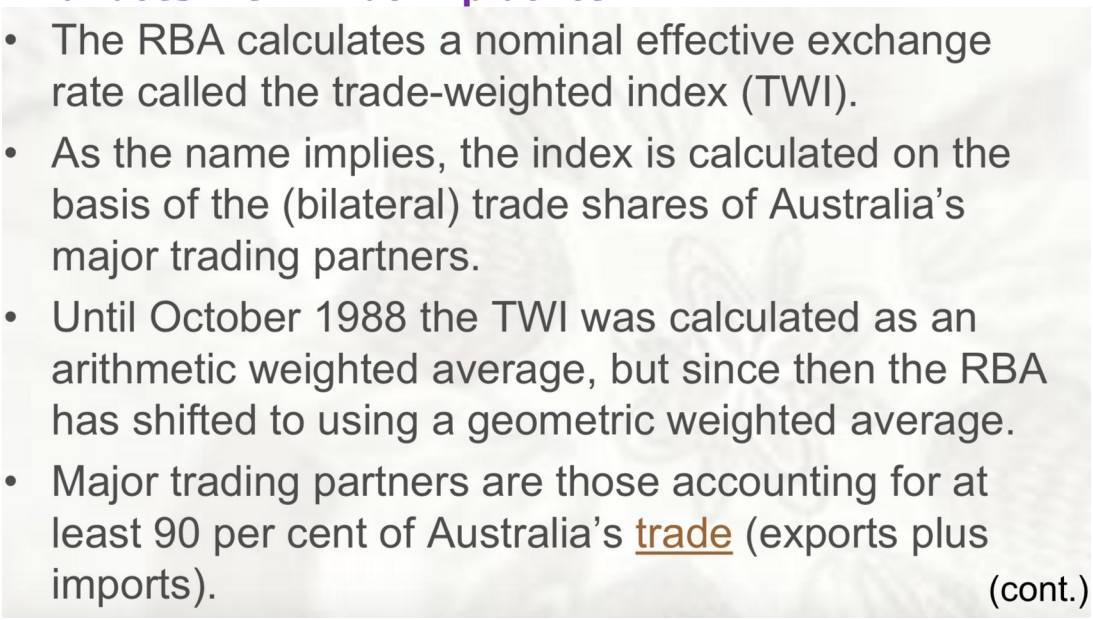
Capital controls: Capital controls are imposed typically to deal with a chronic weakness in the balance of payments.

The **expected change in the exchange rate**: If a currency is expected to appreciate, the expected rate of return on investment in securities denominated in that currency will be higher, attracting capital flows. Thus, a country's financial account will improve if that country's currency is expected to appreciate.

The effective exchange rates

- The effective exchange rate is an index of a weighted average of the nominal exchange rates against the currencies of major trading partners.

What does the RBA do in practice?



The EER equations

The following equations are used to calculate the EER:

$$E_t = \sum_{i=1}^{m} w_i V_{i,t}$$

$$E_t = \prod_{i=1}^{m} (V_{i,t})^{w_i}$$

$$V_{i,t} = \frac{S_{i,t}}{S_{i,0}}$$

The real exchange rate

The real exchange rate is the nominal exchange rate adjusted for differences in prices or inflation rates:

$$Q(x/y) = S(x/y)\left[\frac{P_y}{P_x}\right]$$

The real effective exchange rate

The real effective exchange rate can be calculated from the real bilateral exchange rates:

$$Q_t = \sum_{i=1}^{m} w_i \left[\frac{Q_{i,t}}{Q_{i,0}}\right]$$

$$Q_t = \prod_{i=1}^{m} \left[\frac{Q_{i,t}}{Q_{i,0}}\right]^{w_i}$$

The real exchange rate - Example

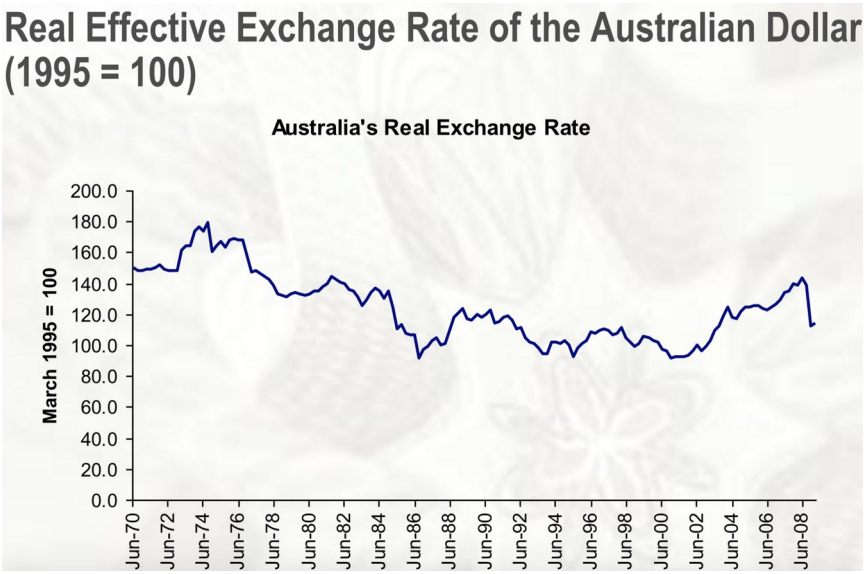
Country	Price Level Jan 2007 (Base)	Price Level Jan 2009	% Change	Price Ratio (Jan 2009)	Nominal/ Real Exchange Rate (Jan 2007)	Nominal Exchange Rate (Jan 2009)	Real Exchange Rate (Jan 2009)	Real Exchange Rate Relatives	Normalised Weights
Australia	100	109.80	9.80	-					
Japan / JPY/AUD	100	100.55	0.55	1.092	93.18	57.94			0.3954
US / USD/AUD	100	108.03	8.03	1.016	0.7720	0.6438			0.2886
Europe / EUR/AUD	100	107.32	7.32	1.023	0.5923	0.5031			0.3160

Real effective exchange rate (Arithmetic Weighted Average)

$(0.3954*67.9)+(0.2886*84.73)+(0.3160*86.9)=78.77$

Real effective exchange rate (Geometric Weighted Average)

$67.9^{0.3954} \times 84.73^{0.2886} \times 86.9^{0.3160} = 78.26$



Topic 5: Exchange Rate Determination & Purchasing Power Parity – Chapter 4

Some stylised facts

- Random walk
- The spot and forward rates
- There is no correspondence between exchange rates and prices.
- The relation between the exchange rate and the current account is not strong.
- Rapid monetary expansion leads to rapid currency depreciation.

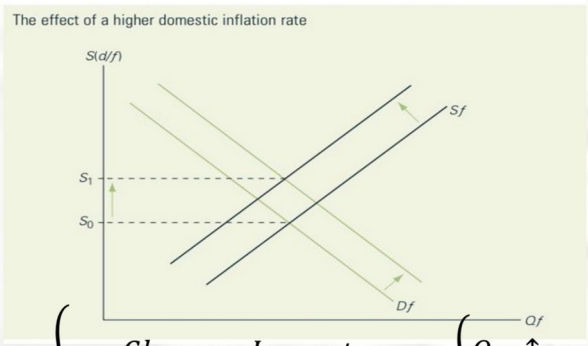
Factors Affecting the Supply of and Demand for FX

• In the real-world exchange rate determination is far more complex as many factors affect the demand and supply of foreign exchange
• These factors include:
    - Relative inflation rates
    - Relative interest rates
    - Relative growth rates
    - Relative trade balance
    - The role of the Government
    - Expectations

Relative inflation rates

Relative inflation rates: A country that has a higher inflation rate than its trading partners will experience a depreciating currency.

- Increase in demand for foreign currency
- Decrease in supply of foreign currency

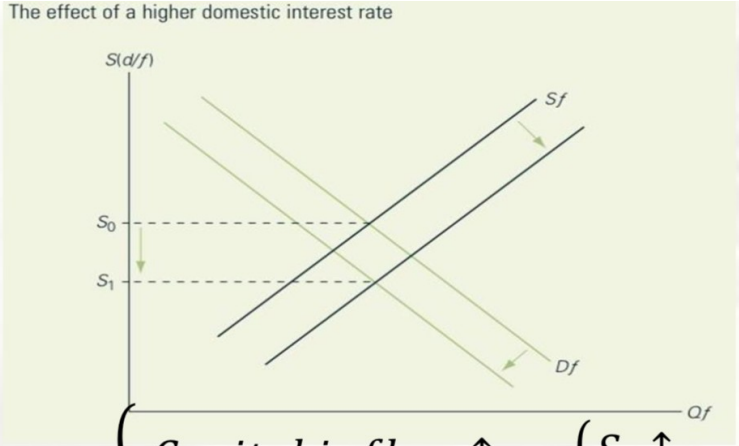


$$\dot{P}^d > \dot{P}^f \Rightarrow \begin{cases} Cheaper\ Import \\ More\ expensive\ export \end{cases} \Rightarrow \begin{cases} Q_m \uparrow \\ Q_x \downarrow \end{cases} \Rightarrow \begin{cases} D_f \uparrow \\ S_f \downarrow \end{cases} \Rightarrow \mathbf{S(d/f)} \uparrow$$

Relative interest rates

• Relative interest rates: Higher interest rates lead to currency appreciation.
  - Decrease in demand for foreign currency
  - Increase in the supply of foreign currency

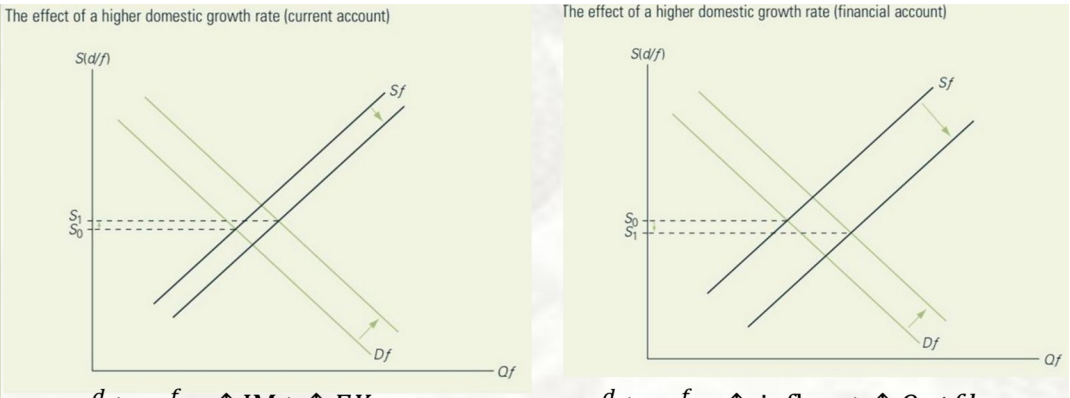
• Distinction must be made between nominal and real exchange rates



$$i^d > i^f \Rightarrow \begin{cases} Capital\ inflow \uparrow \\ Capital\ outflow \downarrow \end{cases} \Rightarrow \begin{cases} S_f \uparrow \\ D_f \downarrow \end{cases} \Rightarrow \mathbf{S(d/f)} \downarrow$$

Relative growth rates

Relative growth rates of income: The effect of growth is ambiguous since it affects the current account and financial account in different directions.



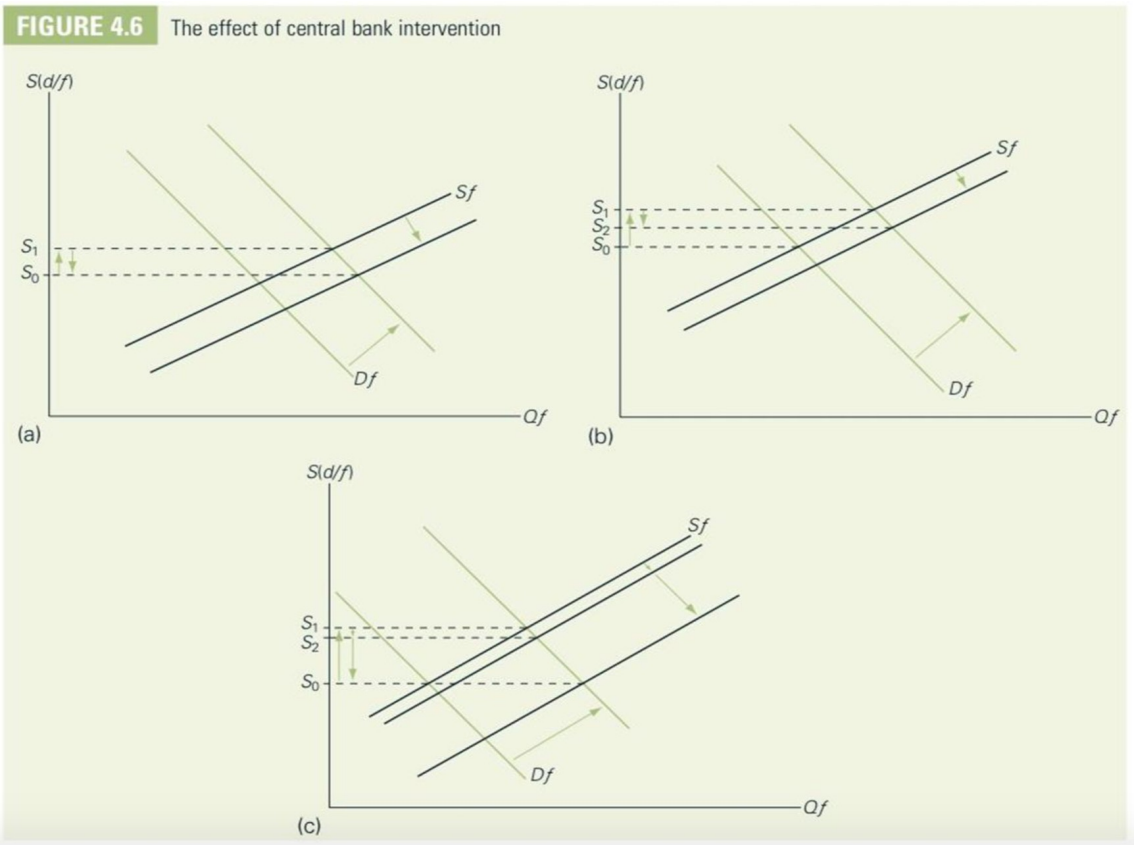
$g^d > g^f \Rightarrow\uparrow$ IM $>\uparrow EX$
$\Rightarrow\uparrow D_f > \uparrow S_f \Rightarrow$ **S(d/f)** $\uparrow$

$g^d > g^f \Rightarrow\uparrow$ inflow $>\uparrow Outflow$
$\Rightarrow\uparrow S_f > \uparrow D_f \Rightarrow$ **S(d/f)** $\downarrow$

The role of the government

The role of the government: The government affects exchange rates by:

- determining the exchange rate regime;
- controlling the supply of the currency;
- through central bank intervention in the foreign exchange market;
- imposing and removing trade barriers; and
- affecting the variables that determine exchange rates.



The role of expectations

The role of expectations: Speculators buy and sell currencies on the basis of expectations.

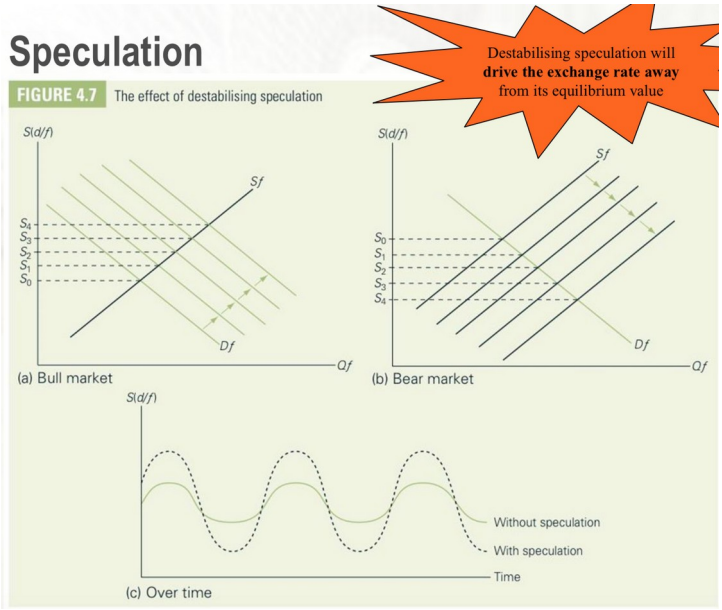
- If there is an expectation of the foreign currency to appreciate

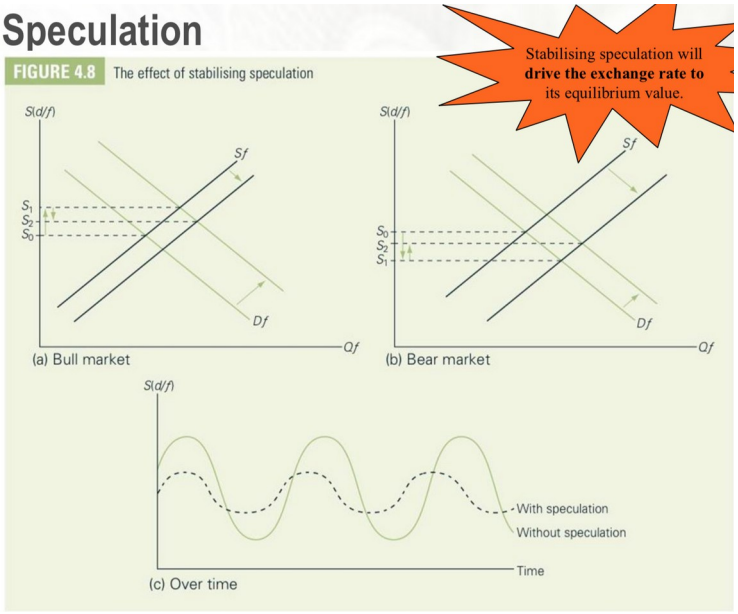
- ◊ Increase in the demand for foreign currency
- ◊ Increase in the supply of domestic currency

Speculation

Speculators participate in the foreign exchange market, buying and selling currencies by anticipating future movements of exchange rates.

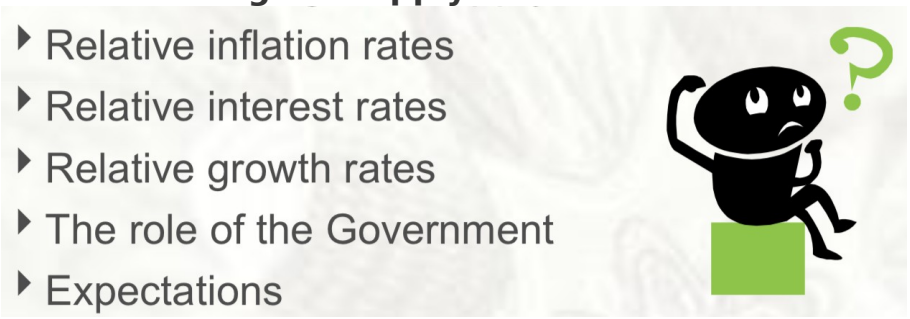
- By their actions, speculators affect the supply of and demand for currencies and therefore exchange rates.
- Stabilising speculation vs destabilizing speculation





The story so far...

- **Factors Affecting** the **Supply of** and **Demand for FX**



- It's important to look at the supply and demand for FX from the perspective of the quotation you use.
- The quotation determines which is the domestic and foreign currency

Purchasing power parity

- The theory of purchasing power parity (PPP) describes the relation between prices and exchange rates.

- The exchange rate between currencies of two countries should be equal to the ratio of the countries' price levels of a commodity basket.

The Law of One Price

According to the Law of One Price (LOP), identical commodities should have the *same price* in all markets

- The LOP should hold for internationally traded commodities in the absence of frictions
  - ◊ No barriers to trade
  - ◊ No transportation costs
  - ◊ No transaction costs
- Arbitrage opportunity arises if otherwise
  - ◊ Commodity arbitrage

According to LOP, in the absence of frictions, the price of a commodity i, must be the same in every country, linked by the exchange rate, S. This is given by:

$$P_i = SP_i^*$$

Where p_i = domestic price of commodity i
p_i^* = foreign price of commodity i
S = exchange rate between two currencies

Derivation of PPP

- The spot exchange rate, S, reflects the relative costs of the commodities between two markets:

$$S(x/y) = \frac{P_x}{P_y}$$

- If the prices of individual commodities, p_i and p_i^* are replaced by the general price levels, PPP is derived as:

$$P = SP^*$$

The accurate form of PPP

$$(1+\dot{P}_X)=(1+\dot{S}(x/y))*(1+\dot{P}_Y)$$

Inflation x

Inflation y

Or

$$\underbrace{\dot{S}(x/y)}_{\%\text{ change in S(x/y)}}=\frac{\dot{P}_X-\dot{P}_Y}{1+\dot{P}_Y}$$

The relative form of PPP

$$\dot{S}=\dot{P}-\dot{P}^*$$

- This equation states that rate of change in the spot exchange rate is equal to the difference in the rate of change in the domestic price level and the foreign price level

Example:

- Using the previous equations, compare the following scenarios:
  - What is the rate of change in AUD/USD if the inflation rate in the US and Australia are 5% and 10% respectively?

    $\dot{S}(\text{AUD/USD})=\dot{P}_{AU}-\dot{P}_{US}=10\%-5\%=5\%$

    => USD appreciates against USD by 5%
  - What will happen to AUD if the inflation rate in the US and Australia are now 5% and 15% respectively?

    $\dot{S}(\text{AUD/USD})=\dot{P}_{AU}-\dot{P}_{US}=15\%-5\%=10\%$

    $\dot{S}(\text{USD/AUD})=\frac{1}{1+\dot{S}(\text{AUD/USD})}-1=\frac{1}{1+10\%}-1=-9.1\%$

    => AUD depreciates against USD by 9.1%

The relative form of PPP (cont'd)

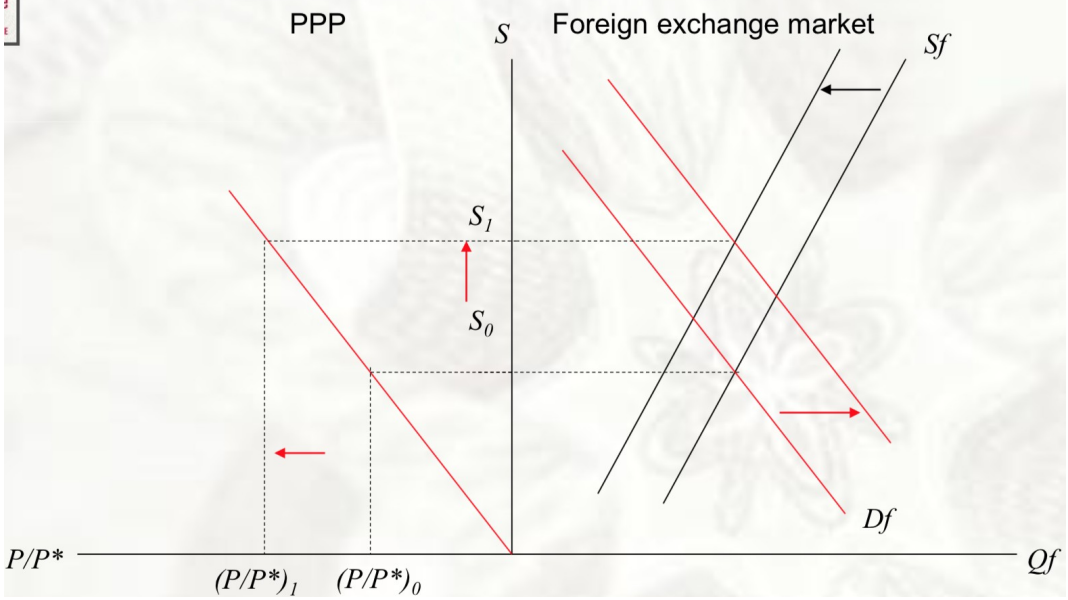
- In particular, if
  - The domestic rate of inflation is higher than the foreign rate, $\dot{P} > \dot{P}^*$, then $\dot{S} > 0$
  - If, however, the foreign rate of inflation is higher than the domestic level, then $\dot{P}^* > \dot{P}$ so that $\dot{S} < 0$

Relative PPP states that the rate of change in the exchange rate is equal to the differences in the rates of inflation:

% exchange rate change	=	% change in home prices	-	% change in foreign prices

Eg - if U.S. inflation rate is 5% and U.K. inflation rate is 8%, the pound should depreciate by around 3%.

Deriving PPP from the S-D model



The PPP Exchange Rate

- We can calculate an exchange rate that is consistent with PPP, or what might be called the PPP exchange rate

$$S_1 = S_0\left(\frac{1+\dot{P}}{1+\dot{P}^*}\right)$$

- Alternatively,

$$\bar{S}_t = S_0\left[\frac{P_t / P_0}{P_t^* / P_0^*}\right]$$

- *Example*

Deviation from PPP

The percentage deviation of the actual exchange rate from the PPP rate, D, is calculated as

$$D = 100\left[\frac{S - \bar{S}}{\bar{S}}\right]$$

Real Exchange Rate

- The real exchange rate is the nominal exchange rate adjusted for differences in prices or inflation and therefore is a measure of the purchasing power of currencies in foreign markets.
- The real exchange rate, Q, is equal to the nominal exchange rate, S, adjusted for foreign and domestic price differences

$$Q = S\left(\frac{P^*}{P}\right)$$

PPP and the Real Exchange Rate

$$Q = S\left(\frac{P^*}{P}\right)$$

- So, a rise (↑) in the real exchange rate (Q) may source from either a nominal exchange rate (S) rise (↑) or an increase in foreign prices (P*) relative to domestic prices.
- Either way the competitiveness of domestic exports is enhanced.

PPP and the Real Exchange Rate

Example:

Example: between 1980 and 1995, the ¥/$ exchange rate moved from ¥226.63/$ to ¥93.96. During this period, the CPI in Japan rose from 91.0 to 119.2 and the U.S. CPI rose from 82.4 to 152.4.

- If PPP had held over this period, what would the ¥/$ exchange rate have been in 1995?
- What happened to the real value of the yen in terms of dollars during this period?

	1980	1995
S(JPY/USD)	226.63	93.96
P (Japan)	91	119.2
P*(US)	82.4	152.4

- According to the PPP:

$$\bar{S}_t = S_0 \left[\frac{P_t/P_0}{P_t^*/P_0^*}\right] = 226.63 \left[\frac{119.2/91}{152.4/82.4}\right] = 160.507$$

- Real exchange rate:

$$Q = S\frac{P^*}{P}$$

$$Q(\text{JPY/USD})_{1980} = 226.63\frac{82.4}{91} = 205.212$$

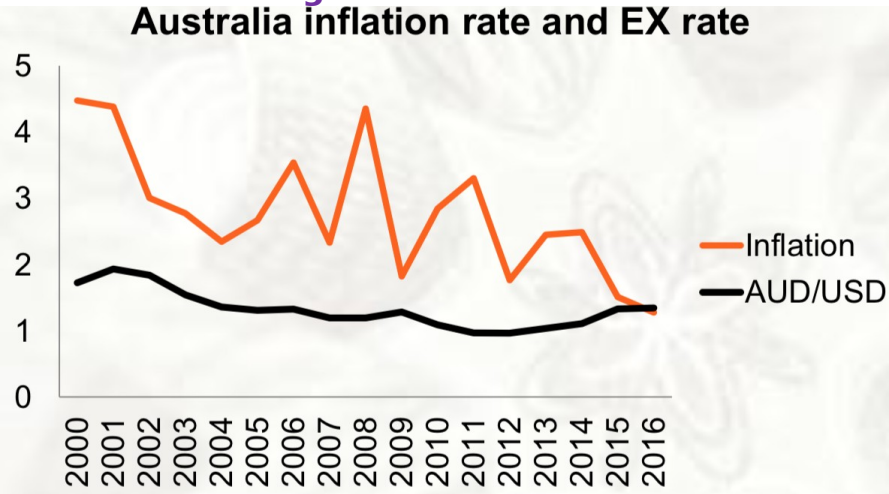
$$Q(\text{JPY/USD})_{1995} = 93.96\frac{152.4}{119.2} = 120.130$$

$$\%\ \text{Change in JPY(real)} = \frac{Q(\text{USD}/JPY)_{1995}}{Q(\text{USD}/JPY)_{1980}} - 1 = \frac{205.212}{120.130} - 1 = 70.825\%$$

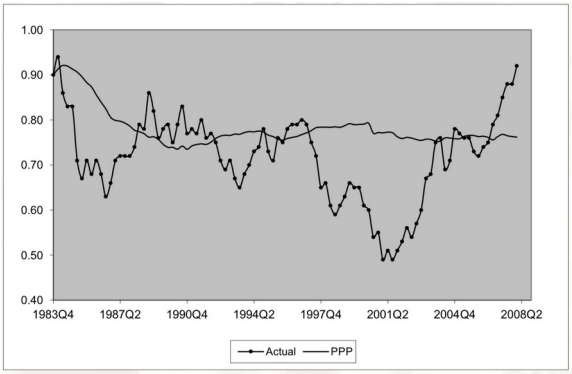
The empirical validity of PPP

- There is little empirical evidence to support the validity of PPP, particularly in the short run.
- There is some evidence for PPP under hyperinflation and over long periods of time.
- The PPP relationship tends to hold far more for traded goods than for non-traded goods
  - Price indices, such as the CPI, the PPI, and the WPI, measure the price of an average basket of goods and services that the typical consumer or producer buys
  - Once these indices are separated into traded and non-traded goods, the hypothesis generally holds for traded goods

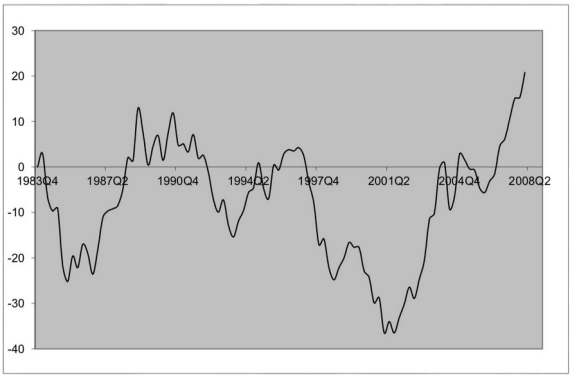
Australia exchange rate and inflation



Actual and PPP exchange rates (USD/AUD)



Percentage deviation of the actual rate from the PPP rate (USD/AUD)



PPP as a trading rule

$$\bar{S} = f\left(\frac{P}{P^*}\right)$$

$$S = F(\bar{S}, X_1, X_2, \ldots X_n)$$

Buy foreign currency when $S < \bar{S}$ (under-valued)

Sell foreign currency when $S > \bar{S}$ (over-valued)

The Big Mac Index

2014

Country	Big Mac Price Local Currency	Big Mac Price In Dollars	Implied PPP of the Dollar	Actual exchange rate - January
United States	$4.62	$4.62	-	-
China	Yuan 16.6	$2.74	3.59	6.05

The price of a Big Mac in China in US$ terms:

$$\frac{Price\_of\_Big\_Mac\_in\_China(RMB)}{RMB/\$} = \frac{RMB16.6}{RMB6.05/\$} = \$2.74$$

The Implied PPP of the Dollar:

$$\frac{Price\_of\_Big\_Mac\_in\_China(RMB)}{Price\_of\_Big\_Mac\_in\_the\_U.S.(\$)} = \frac{RMB16.6}{\$4.62} = RMB3.59/\$$$

Therefore, the RMB is undervalued by:

$$\frac{Implied\_Rate - Actual\_Rate}{Actual\_Rate} = \frac{3.59 - 6.05}{6.05} = -0.4068 = -40.68\%$$

The monetary model of exchange rates

$M_d = kPY$

$P = \frac{M}{kY}$

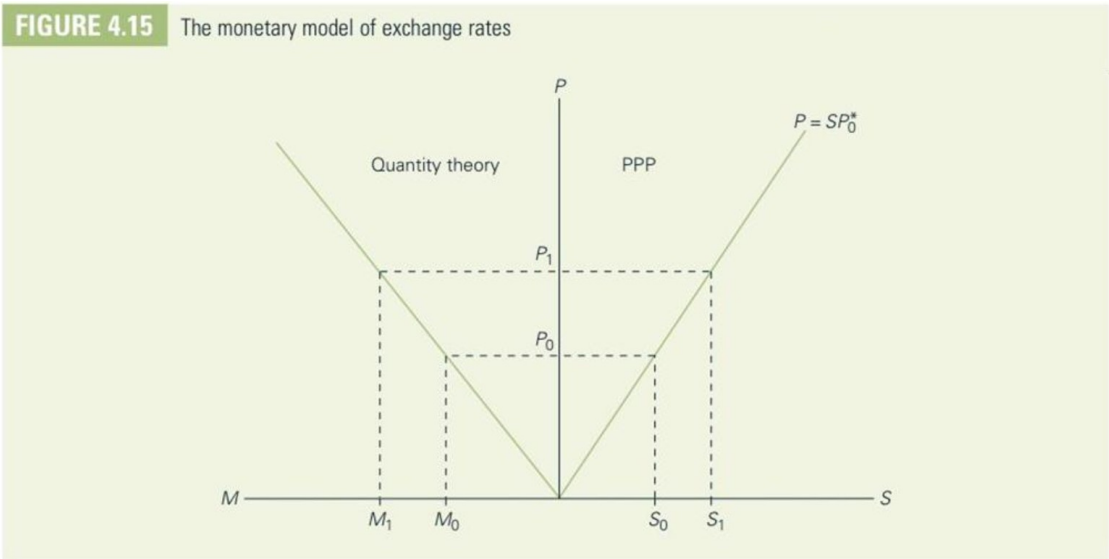
if $S = P/P^*$,

$S = \frac{M}{kP^*Y}$

Assume M_d is stable

PPP holds at any point in time

M_d = quantity of money demanded
P = price level
Y = real income
k = positive constant
M = money supply



Determination of the bid-offer spread

- Since the bid rate is the rate at which the dealer (price maker) buys and the customer sells unit/commodity currency, it is determined by the intersection of the dealer's demand curve and the customer's supply curve.
- Conversely, the offer rate is determined by the intersection of the customer's demand curve and the dealer's supply curve.

	Market maker (dealer)	**Market taker (customer)**
Bid Rate	Buy at	Sell at
	Demand	Supply
Ask Rate	Sell at	Buy at
	Supply	Demand

Determination of the forward spread

- The simplest model assumes that there are independent demand and supply forces in the spot and forward markets.
- It also assumes that there is a separate market with independent supply and demand forces for forward contracts with different maturities.

- The equilibrium spot exchange rate is determined in the spot market, whereas the equilibrium forward rate (for a particular maturity) is determined in the forward market.

- The forward spread is the difference between the forward and spot rates.

Factors affecting the AUD exchange rates

- Interest rates
- Commodity prices and the terms of trade
- Inflation
- The external account
- The role of the RBA

Canada	1.75%
UK	0.75%
EU	-0.40%
US	2.375%
Japan	-0.1%
Australia	1.5%

Example

Given S(AUD/USD) = 1.80

$$\dot{S}_t = 0.52 + 0.92(\dot{P} - \dot{P}^*)_t$$

Scenario	$\dot{P}$	$\dot{P}^*$	Probability
(1) High inflation in both countries	10	8	0.10
(2) High inflation in Australia	10	2	0.20
(3) High inflation in US	3	8	0.15
(4) Low inflation in both countries	3	2	0.55

What is the forecast exchange rate one year from now?

Given S(AUD/USD) = 1.80

$$\dot{S}_t = 0.52 + 0.92(\dot{P} - \dot{P}^*)_t$$

Scenario	$\dot{P}$	$\dot{P}^*$	Probability	$\dot{S}_{t+1}$	S_{t+1}
(1)	10	8	0.10	0.52+0.92(10-8)=2.36	1.0236 X 1.80 = 1.8425
(2)	10	2	0.20	0.52+0.92(10-2)=7.88	1.0788 x 1.8=1.9418
(3)	3	8	0.15	0.52+0.92(3-8)=-4.08	0.9592 x 1.8=1.7266
(4)	3	2	0.55	0.52+0.92(3-2)=1.44	1.0144 x 1.8=1.8259

S_{t+1} = 0.1x1.8425+0.2x1.9418+0.15x1.7266+0.55x1.8259=1.8358

Factor	Cause	Effect
Inflation	$\dot{P}^d > \dot{P}^f$	**S(d/f) ↑**
Interest rate	$i^d > i^f$	**S(d/f) ↓**
Growth rate	$g^d > g^f$	**CA: S(d/f) ↑** **FA: S(d/f) ↓**
Government	Sell f Buy f	S^f **↑ => S(d/f) ↓** D^f **↑ => S(d/f) ↑**
Expectation	Destabilising Stabilising	Away from Equilibrium Back to Equilibrium

Summary

- PPP accurate and relative forms
- PPP and S-D diagrams
- PPP ($\bar{S}$) vs Real exchange rate (Q)
- Monetary model of EX
- Bid-ask determination

Topic 6 & Topic 7: Arbitrage and CIP Chapter 11

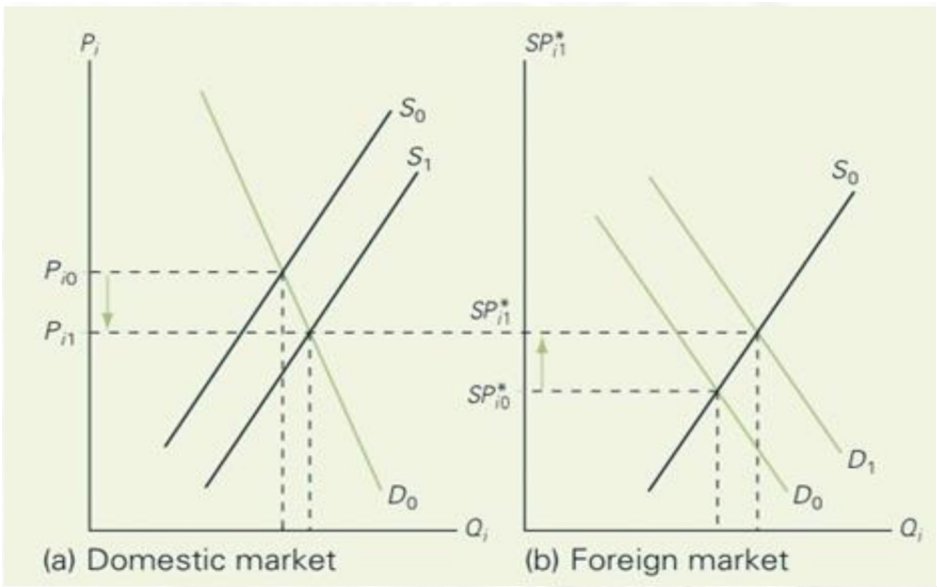
Commodity arbitrage

• Recall LOP, in the absence of frictions, the price of a commodity i, must be the same in every country, linked by the exchange rate, S.

$$P_i = SP_i^*$$

• In the case of commodity arbitrage, this is known as the no-arbitrage condition

Commodity arbitrage



$$P_{i,0} > SP^*_{i,0} \Rightarrow \begin{cases} buy\ in\ Foreign \\ Sell\ in\ Domestic \end{cases} \Rightarrow \begin{cases} Foreign: D \uparrow \\ Domsetic: S \uparrow \end{cases} \Rightarrow \begin{cases} P^* \uparrow \\ P \downarrow \end{cases}$$

(cont.)

Definition of arbitrage

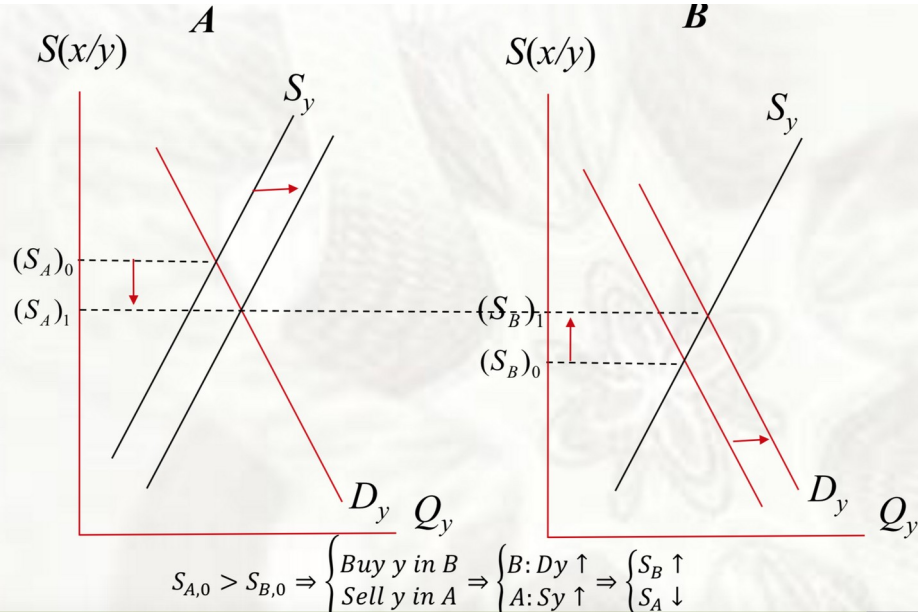
- Capitalising on a discrepancy in quoted prices as a result of the violation of an equilibrium (no-arbitrage) condition
- The arbitrage process restores equilibrium via changes in the supply of and demand for the underlying commodity, asset or currency
- The importance of arbitrage

Two-point arbitrage

- Also known as spatial or locational arbitrage, it arises when the following condition is violated

$$S_A(x/y) = S_B(x/y)$$

The effect of two-point arbitrage



Example: Two-Point Arbitrage

Suppose that

- Sydney – 3.5780 (AUD/GBP)
- London – 0.5120 (GBP/AUD)

- Invert the exchange rate in London, which gives (AUD/GBP) = 1/0.5120 = AUD1.9531
  - The equilibrium condition is violated because the GBP is more expensive in Sydney than in London
  - Arbitragers buy the GBP in London at 1.9531 and sell it in Sydney at 3.5780, making a profit of

    π=3.5780-1.9531=1.6249 AUD
  - The effect of arbitrage is to raise the price of the GBP in London and to lower it in Sydney, until they are equalised somewhere between 1.9531 and 3.5780

Two-point arbitrage with bid-offer spreads

With bid-offer spreads the no-arbitrage condition becomes:

$$S_{b,A}(x/y) = S_{a,B}(x/y)$$

$$S_{a,A}(x/y) = S_{b,B}(x/y)$$

Two-Point Arbitrage: Example

Suppose for GBP/AUD

- Sydney: 0.3750 – 0.3790
- London: 0.3700 – 0.3740

- The equilibrium condition is violated
- Arbitragers buy the AUD in London at 0.3740 and sell it in Sydney at 0.3750, making a profit of

  π=0.3750-0.3740=0.0010 GBP or 10 points
- The effect of arbitrage is to raise the price of the AUD in London and to lower it in Sydney, until they are equalised somewhere between 0.3740 and 0.3750

  OR

  •Arbitragers buy the GBP in Sydney at 2.6667 (1/0.3750) and sell it in London at 2.6738 (1/0.3740), making a profit of

  π=2.6738-2.6667=0.00713 AUD or 71.3 points

Three-point (triangular) arbitrage

It is triggered when cross exchange rates are inconsistent, that is, when the following condition is violated:

$$S(x/y) = \frac{S(x/z)}{S(y/z)}$$

or

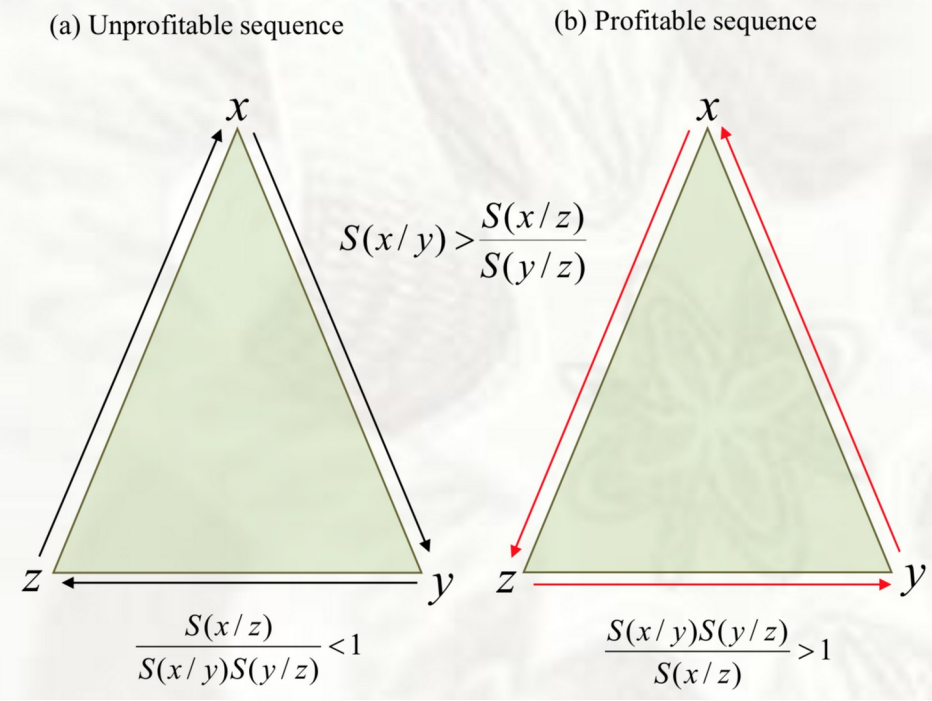
$$S(x/y)S(y/z)S(z/x) = 1$$

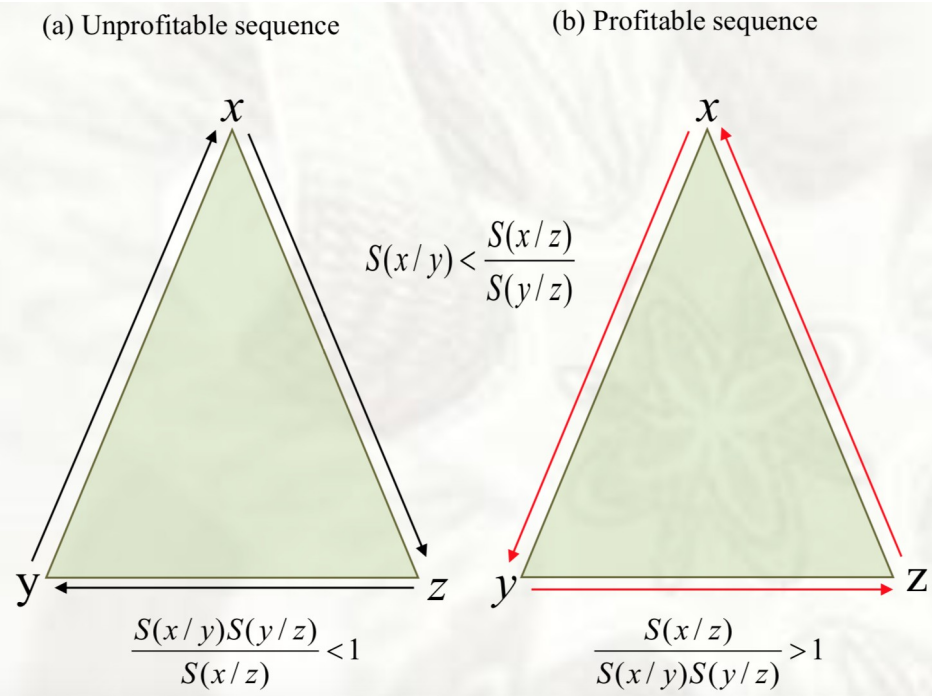
- No-arbitrage condition if $S(x/y) = \frac{S(x/z)}{S(y/z)}$
- If $S(x/y) > \frac{S(x/z)}{S(y/z)}$,

  possibility of arbitrage profit arises by following the sequence x → z → y → x.
- If $S(x/y) < \frac{S(x/z)}{S(y/z)}$,

  possibility of arbitrage profit arises by following the sequence x → y → z → x.

Profitable/unprofitable sequences





Three-Point Arbitrage: Example

- Suppose that the following exchange rates are given:

  S(CAD/AUD) = 3.5619
  S(NZD/AUD) = 1.2052
  S(CAD/NZD) = 2.5825
  The cross rate is given by

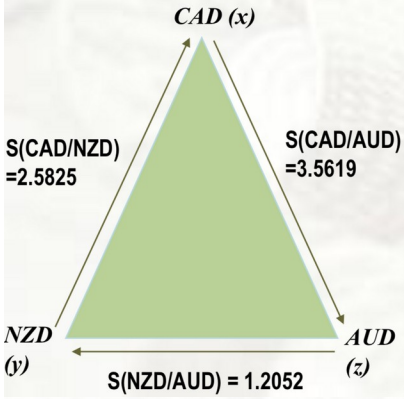
$$S_{CR}(\overset{x}{CAD}/\overset{y}{NZD}) = \frac{S(CAD/AUD)}{S(NZD/AUD)} = \frac{3.5619}{1.2052} = 2.9554$$

  Actual **S(CAD/NZD)=2.5825 <S_{CR}(CAD/NZD) =2.9554**: there is a possibility in three-point arbitrage

  Profitable sequence: x (CAD)->y (NZD)->z (AUD)
  Unprofitable sequence: x (CAD)-> z (AUD)->y (NZD)

Three-Point Arbitrage: The Unprofitable Sequence

(a) Unprofitable sequence

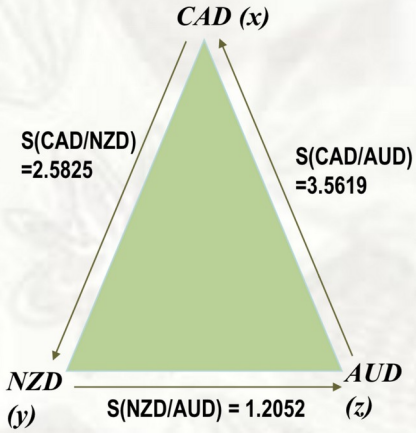


- Start with one currency and move clockwise
- Sell 1 unit of CAD and obtain 0.2807=1/3.5619 units of AUD
- Sell 0.2807 units of AUD and obtain 0.3384=0.2807*1.2052 units of NZD
- Sell 0.3384 units of NZD and obtain 0.8738=0.3384*2.5825 units of CAD.
- Loss=0.8738-1=-0.1262 CAD

Three-Point Arbitrage: The Profitable Sequence

- Start with one currency and move anti-clockwise
- Sell 1 unit of CAD and obtain 0.3872=1/2.5825 units of NZD
- Sell 0.3872 units of NZD and obtain 0.3213=0.3872/1.2052 units of AUD
- Sell 0.3213 units of AUD and obtain 1.1444=0.3213*3.5619 units of CAD.
- Profit=1.1444-1=0.1444 CAD

(b) Profitable sequence



Multipoint arbitrage

- Arbitrage involving 4, 5, 6 or more currencies can take place
- The condition precluding multipoint arbitrage is:

$$S(x_1 / x_2)S(x_2 / x_3)\cdots S(x_n / x_1) = 1$$

Topic 8 & 9: Foreign Exchange Risk Exposure and Risk Management

Definitions of risk

- The possibility of loss, injury, disadvantage or destruction (*Webster's Dictionary*)
- The chance of bad consequence, loss, etc. (The Concise Oxford Dictionary)

> "the possibility of something happening that impacts on your objectives. It is the chance to either make a gain or a loss. It is measured in terms of likelihood and consequence."

Definitions of risk (cont.)

- In finance, a distinction is made between risk and uncertainty
- In finance, risk is measured by the dispersion around the mean value of the rate of return, the cost of borrowing, the value of assets and liabilities, etc.
- Risk also implies both favourable and unfavourable outcomes with some probability distribution.

FX risk

- FX risk arises because of uncertainty about the future spot exchange rate
- It refers to the variability of the domestic currency value of certain items resulting from the variability of the exchange rate

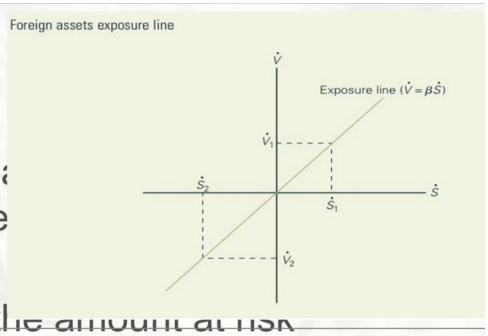
Risk vs. Exposure

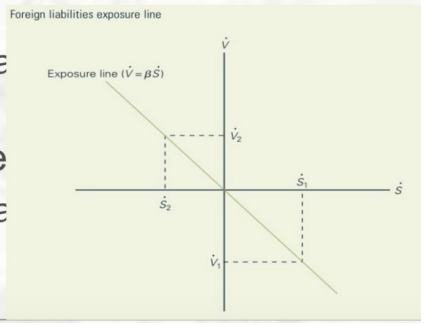
Risk measures the probability and magnitude of deviation from some expected outcome

Exposure is a measure of the sensitivity of what is at risk to the source of risk

FX exposure

- Exposure to FX risk is a mea
  the domestic currency value
  in the exchange rate
- Sometimes it is defined as the amount at risk
- Long exposure ⇒ assets
  - If S(d/f) ↑, domestic currency va
    (gain), and vice versa
- Short exposure ⇒ liabilitie
  - If S(d/f) ↑, domestic currency va
    ↑ (loss), and vice versa





Combined exposure

• A combined arises when a firm holds both foreign assets and foreign liabilities

Types of FX Exposure

- Transaction exposure
- Economic / Operating exposure
- Translation exposure

Transaction exposure

- Transaction exposure arises if payables and receivables are denominated in foreign currencies. It is a cash flow exposure associated with trade and capital flows
- Foreign assets or liabilities that are already recorded on the balance sheet
- A contract or an agreement involving a future foreign currency cash flow

Transaction exposure (cont'd)

- Net cash flows
  - Collate all receivables and payables in each currency to determine net exposure

Currency	Receivables	Payables	Net Exposure
USD	200,000	150,000	+50,000
JPY	15,000,000	21,000,000	-6,000,000
Euro	350,000	250,000	+100,000
GBP	250,000	460,000	-210,000

Volatility and correlation

Risk associated with transaction exposure:

4Currency variability - Exposure to a currency that fluctuates sharply is more of a source of concern

4Currency correlations - Exchange rate correlations are important

	USD/AUD	JPY/AUD	EUR/AUD	GBP/AUD
USD/AUD	1.00	0.85	0.47	0.64
JPY/AUD		1.00	0.72	0.29
EUR/AUD			1.00	-0.02
GBP/AUD				1.00

Economic exposure

- Changes in exchange rates affect the firm's non- ***contractual or unplanned*** cash flows
- It refers to future changes in earning power as a result of changes in exchange rates
- Cannot, in general, be known accurately in advance

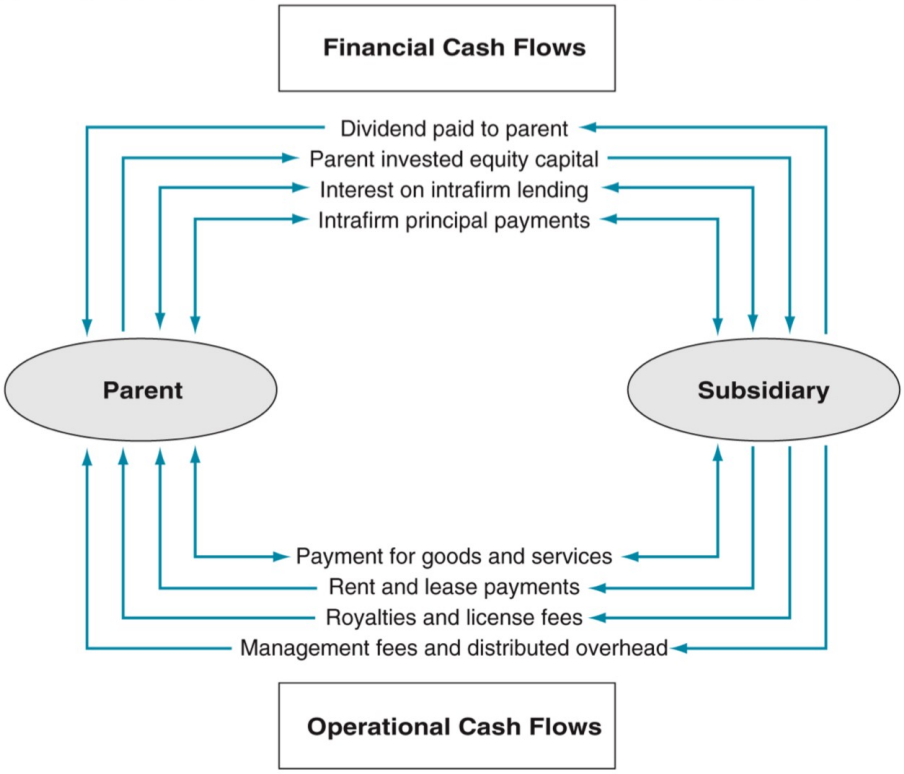
Transaction exposure	Economic/Operation exposure
Planned transactions In-progress/Completed transactions	Future transactions
Recorded in balance sheet	Not recorded yet
Nominal exchange rates	Real exchange rates
Currency conversion	Not involve any currency conversion

Economic exposure (cont'd)

- ***Operating cash flows arise*** from intercompany (between unrelated companies) and intra-company (between units of the same company) receivables and payables, rent and lease payments, royalty and license fees and assorted management fees.

- ***Financing cash flows*** are payments for loans (principal and interest), equity injections and dividends of an inter and intra-company nature.

Example of Economic Cash Flows – intracompany



Economic Exposure (cont'd)

- An ***expected change*** in foreign exchange rates is not included in the definition of operating exposure, because both management and investors should have factored this information into their evaluation of anticipated operating results and market value.
- Only ***unexpected changes*** in exchange rates, or an inefficient foreign exchange market, should cause market value to change.

Translation (accounting) exposure

- Translation exposure arises from the consolidation of foreign currency assets, liabilities, net income and other items
- For example, IBM wants to prepare a final consolidated financial statement at the end of the financial year, which exchange rate should be used, historical or current?
- Conversion may produce gain or loss

Three rates for conversion

4Closing rate (current rate)
4Average rate
4Historical rate

Example:

Australian MNE with assets in USA

	US$	Rate (USD/AUD)	AUD
Time 1			
Asset Value:	520,000	0.6500	800,000
Time 2			
Asset Value:	520,000	0.7500	693,333
Change in net worth			(106,667)

Translation Exposure

Potential impacts of translation exposure

- Consolidated Balance Sheet
  - Change in value of, assets, liabilities & ownership
  - Implications for **gearing, capital structure** etc.,
- Consolidated Income Statement
  - Change in value of reported earnings
  - Implications for **profitability, taxation, dividends** etc.,
- Other impacts
  - Share price/market value of firm
  - Ratings, risk & cost of borrowing
  - Performance evaluation issues

Translation Exposure

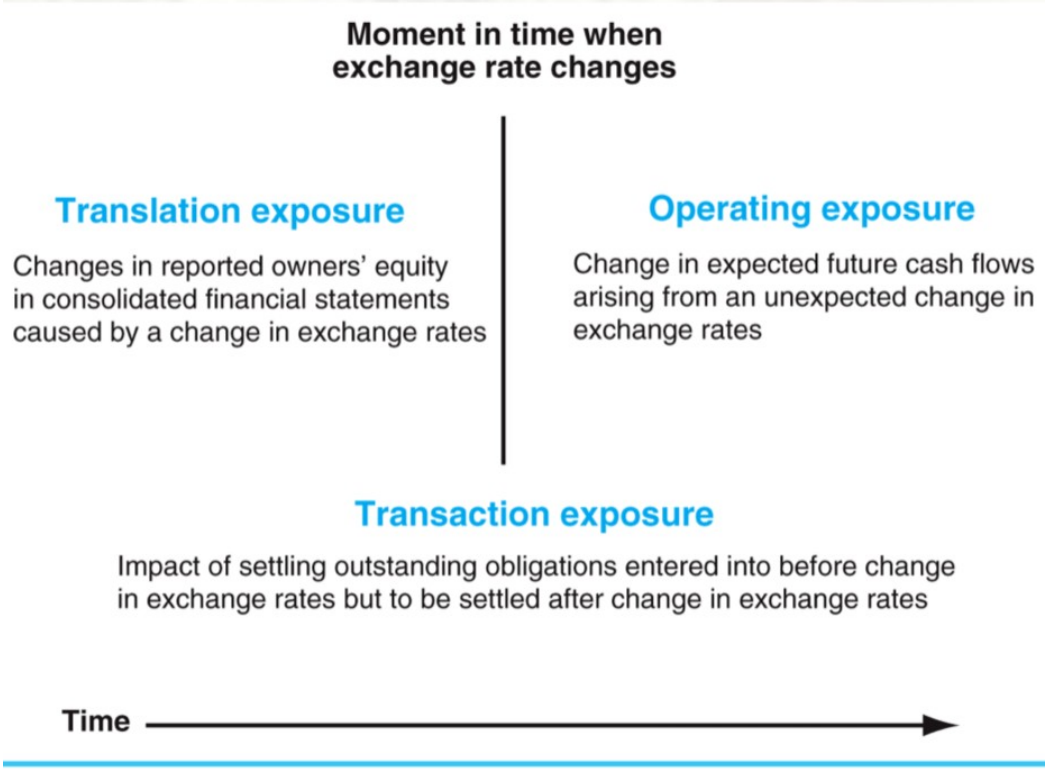
A firm's degree of translation exposure is dependent on:

❶ the proportion of its business conducted by its foreign subsidiaries,

❷ the level of integration between parent company and its foreign subsidiaries, and

❸ the accounting method that it uses.

Foreign Exchange Exposure



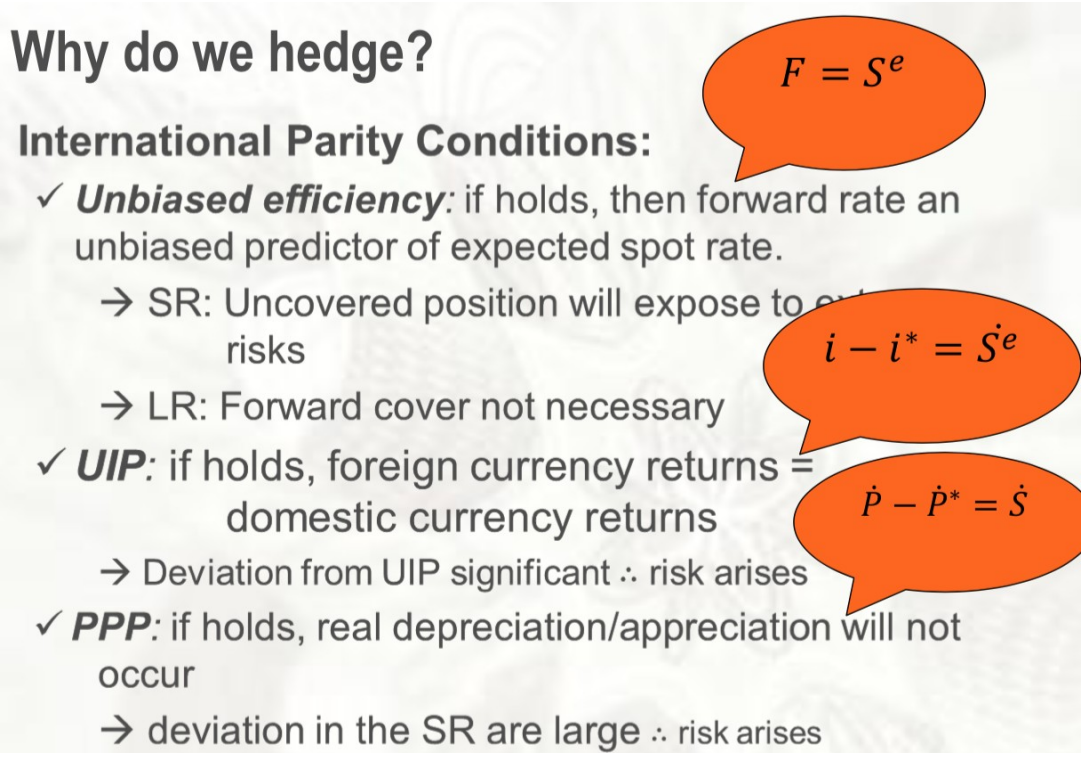
Hedging

- Hedging, which is the core risk management operation, is a process whereby a firm can protect itself from unanticipated changes in exchange rates and other sources of risk
- The decision to hedge depends on the expected exchange rate or the movement of the exchange rate between the point in time when the decision is taken and when its effect materialises.

Why is there no need to worry about FX risk?

- If international parity conditions hold, FX risk will not arise
- FX risk can be controlled
- Shareholders are naturally hedged through diversification

→ **Then why do we hedge?**



Why do we hedge?

Exchange rate forecasting:

✓Accuracy of forecasts questionable

✓ Foreign exchange risks cannot be controlled if we forecast future spot rates using forward rates / interest rate differentials

Natural hedging through diversification:

✓ Due to the nature of diversification, the amount of exposure may be difficult to measure

Benefits of hedging

- Hedging has a positive effect on the value of the firm
- It produces a more stable corporate income stream

Managing short-term transaction exposure (financial hedging)

- Forward hedging
- Money market hedging
- Futures hedging
- Option hedging

Forward hedging

Forward hedging entails locking in the exchange rate at which **payables** and **receivables** are converted from the domestic currency into a foreign currency, and vice versa

Forward hedging of payables - Example

- Suppose that an Australian company owes an amount of GBP300,000, due in one month.
- Current spot rate = 2.70
- 1-month forward rates =2.75
- Should the company hedge its position for the payables due in one month?

The following future spot rates and probability is given:

S_1	Probability	S_1	Probability
2.50	0.05	2.80	0.10
2.60	0.05	2.85	0.15
2.65	0.05	2.90	0.15
2.70	0.10	2.95	0.25
2.75	0.10		

To decide whether to take up a hedge or no-hedge position, evaluate the expected value of payables under the two options - hedge or no-hedge.

K= GBP 300,000
S(AUD/GBP)=2.7
F(AUD/GBP)=2.75

- If hedged, the domestic currency expected value of payables = K*F=300,000 * 2.75 = AUD 825,000

- If un-hedged, the domestic currency expected value of payables is

S_1	Probability	V	E(Payables)
2.50	0.05	750 000	37 500
2.60	0.05	780 000	39 000
2.65	0.05	795 000	39 750
2.70	0.10	810 000	81 000
2.75	0.10	825 000	82 500
2.80	0.10	840 000	84 000
2.85	0.15	855 000	128 250
2.90	0.15	870 000	130 500
2.95	0.25	885 000	221 250
		Total	843 750

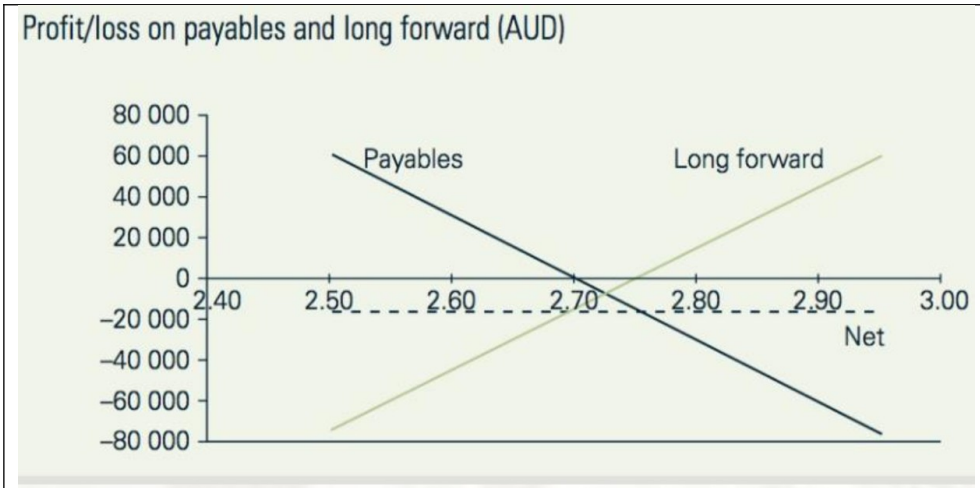
Hedged=825000<Un-hedged=843750

Choose to hedge

- Therefore, the profit/loss on the spot and forward positions:

S_1	$K(S_0-S_1)$ Profit/Loss (Payables, spot, No-hedge)	$K(S_1-F_0)$ Profit/Loss (Payables, forward, Hedge)	$K(S_0-F_0) = K(S_0-S_1) + K(S_1-F_0)$ NET
2.50	60,000	-75,000	-15,000
2.60	30,000	-45,000	-15,000
2.65	15,000	-30,000	-15,000
2.70	0	-15,000	-15,000
2.75	-15,000	0	-15,000
2.80	-30,000	15,000	-15,000
2.85	-45,000	30,000	-15,000
2.90	-60,000	45,000	-15,000
2.95	-75,000	60,000	-15,000

Note: $S_0 = 2.70$, $F_0 = 2.75$, K=GBP300,000



Note: $S_0 = 2.70$, $F_0 = 2.75$, K=GBP300,000

Forward Hedging - payables (cont'd)

- Profit/loss in the spot market (no-hedge)

$$K(S_0 - S_1)$$

- Profit/loss in the forward market (hedge)

$$K(S_1 - F_0)$$

- Net position

$$K(S_0 - F_0) = K(S_0 - S_1) + K(S_1 - F_0)$$

Forward hedging of receivables

The same decision-making applies to forward hedging of receivables

Choose to hedge if expected value of receivables under hedge > expected value of receivables under no hedge

Forward hedging of receivables - Example

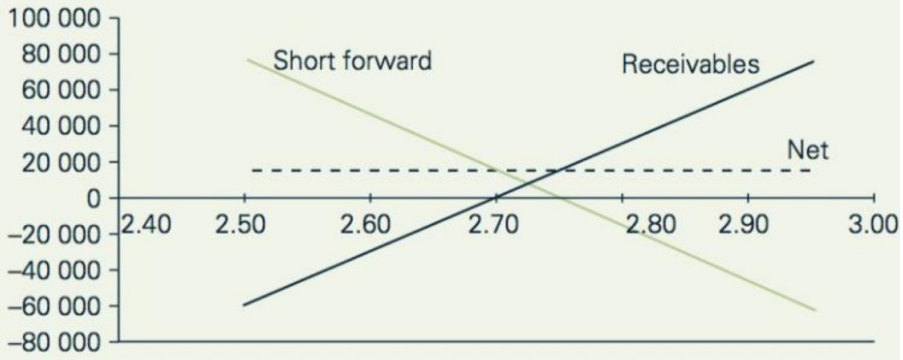
- The profit/loss on the spot and forward positions:

S_1	$K(S_1-S_0)$ Profit/Loss (Receivables, spot)	$K(F_0-S_1)$ Profit/Loss (Receivables, forward)	$K(F_0-S_0)$ $=K(S_1-S_0)+K(F_0-S_1)$ NET
2.50	-60,000	75,000	15,000
2.60	-30,000	45,000	15,000
2.65	-15,000	30,000	15,000
2.70	0	15,000	15,000
2.75	15,000	0	15,000
2.80	30,000	-15,000	15,000
2.85	45,000	-30,000	15,000
2.90	60,000	-45,000	15,000
2.95	75,000	-60,000	15,000

Note: $S_0 = 2.70$, $F_0 = 2.75$, K=GBP300,000

- The profit/loss on the spot and forward positions:

Profit/loss on receivables and short forward (AUD)



Note: $S_0 = 2.70$, $F_0 = 2.75$, K=GBP300,000

Forward Hedging - receivables

- Profit/loss in the spot market (no-hedge)

$$K(S_1 - S_0)$$

- Profit/loss in the forward market (hedge)

$$K(F_0 - S_1)$$

- Net position

$$K(F_0 - S_0) = K(S_1 - S_0) + K(F_0 - S_1)$$

Future hedging definition

- Currency futures contracts represent an obligation of the seller to deliver a certain amount of a specified currency in the future at an exchange rate determined now

Futures hedging

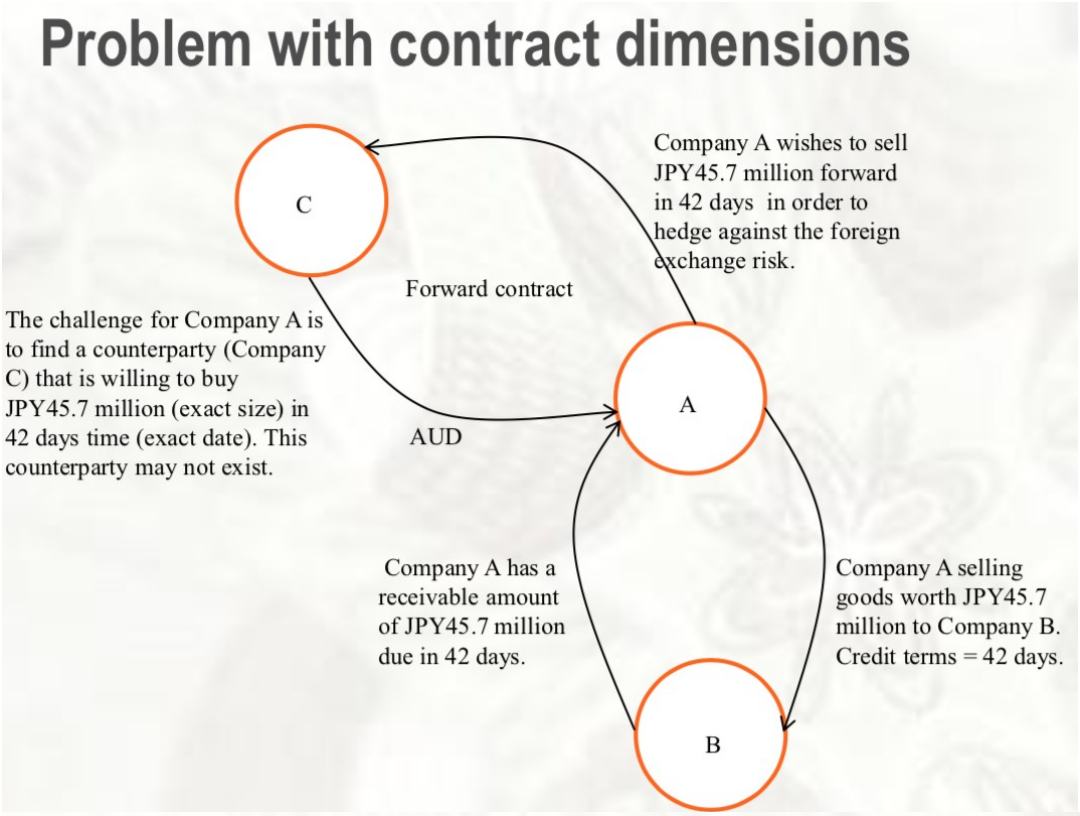
- Futures hedging results may differ quantitatively from those of forward hedging
- Because of the standardisation of contracts, it may not be possible to hedge the exact amount
- The due date may not coincide with the settlement date
- Marking-to-market introduces some variation

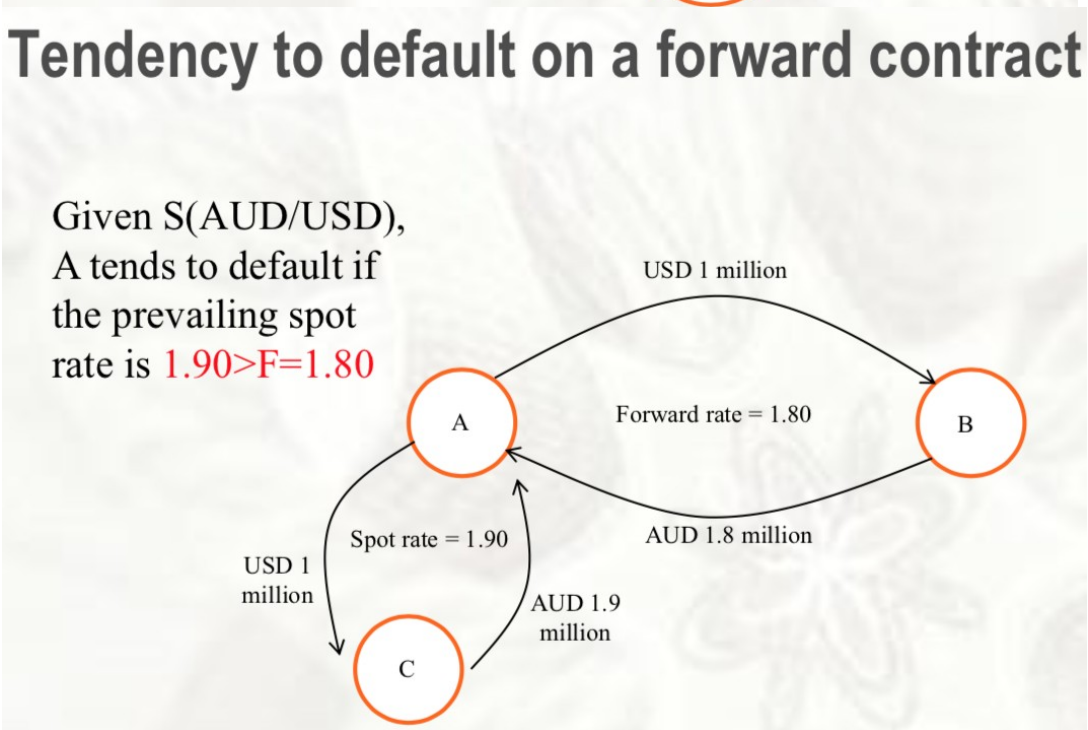
Problems of Forward Contracts

Non-standard contract dimensions

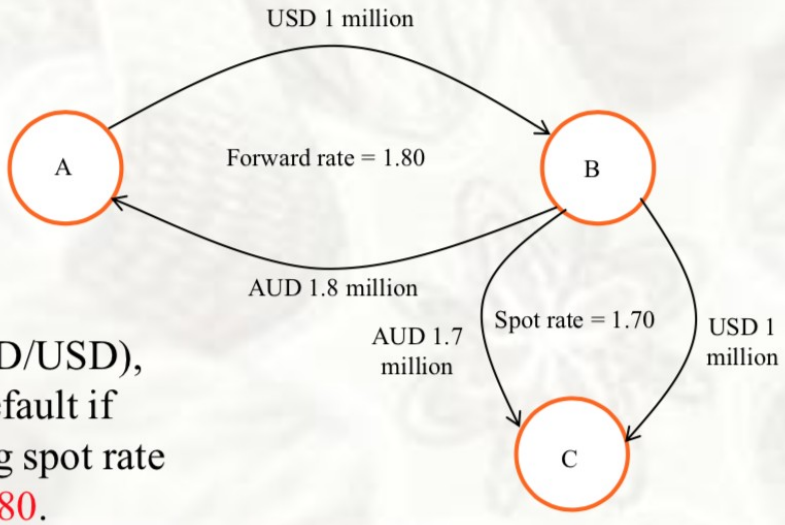
- Size
- Settlement date
- ‘double coincidence of wants’

- **Default risk**
- **Lack of liquidity**





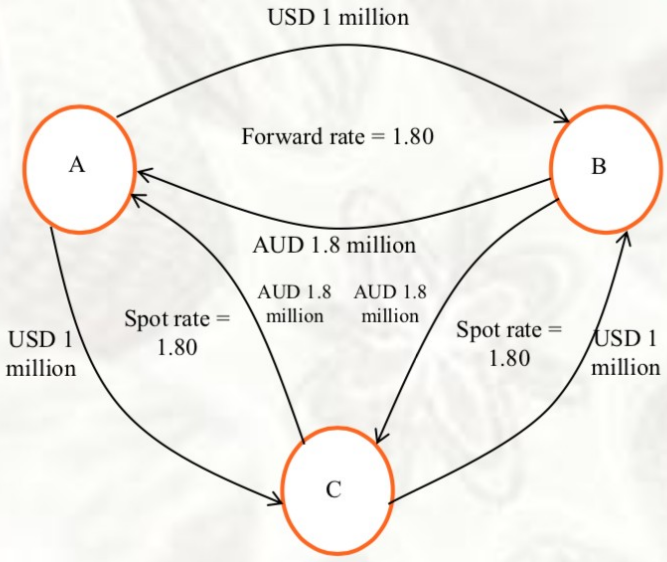
Tendency to default on a forward contract (cont.)



Given S(AUD/USD), B tends to default if the prevailing spot rate is $1.70<F=1.80$.

Tendency to default on a forward contract (cont.)

Given S(AUD/USD), neither tends to default if the prevailing spot rate is 1.80.



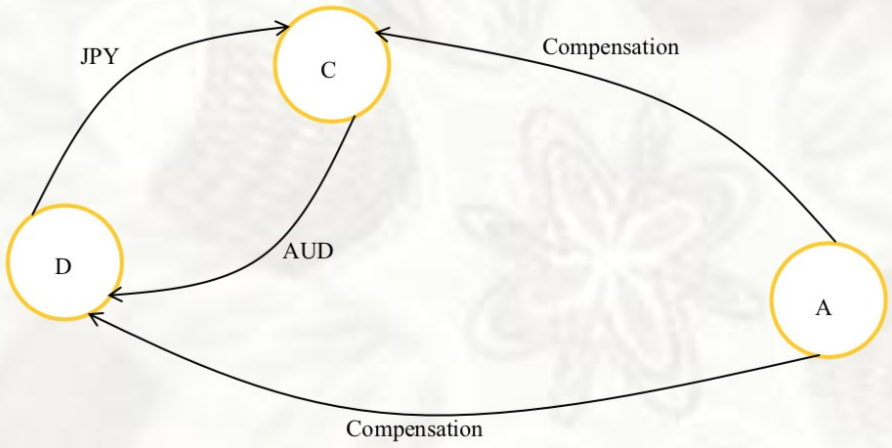
Unwinding a forward contract

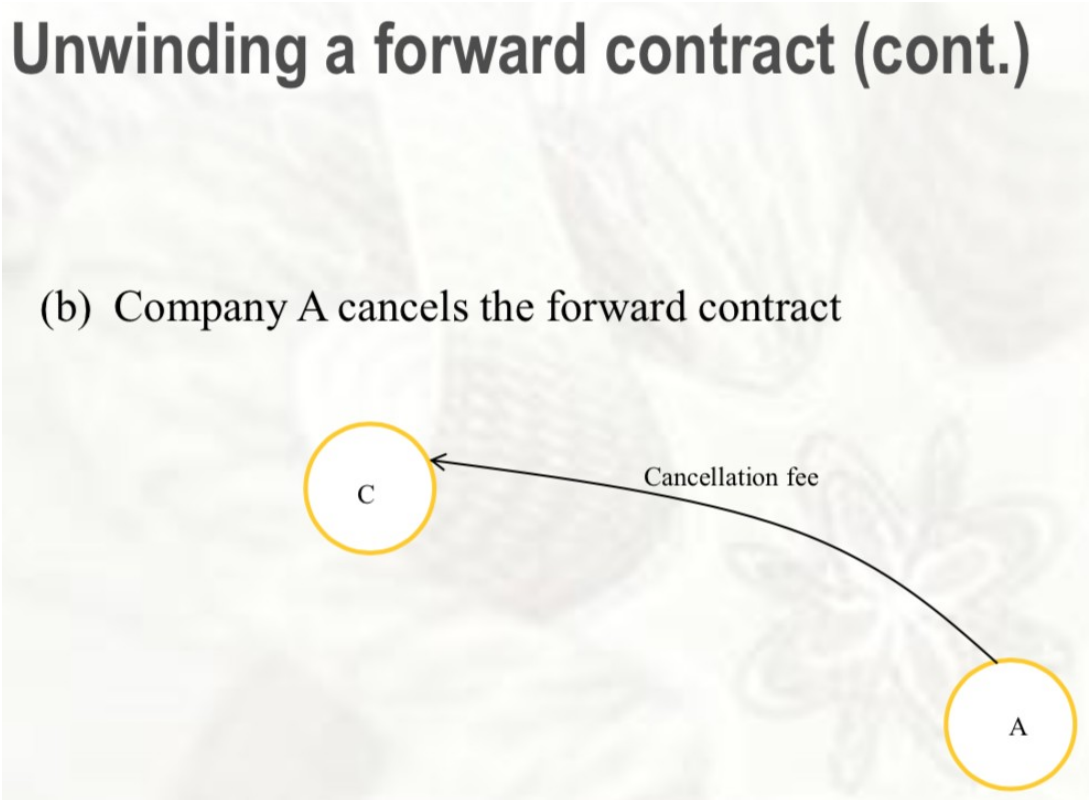
Example

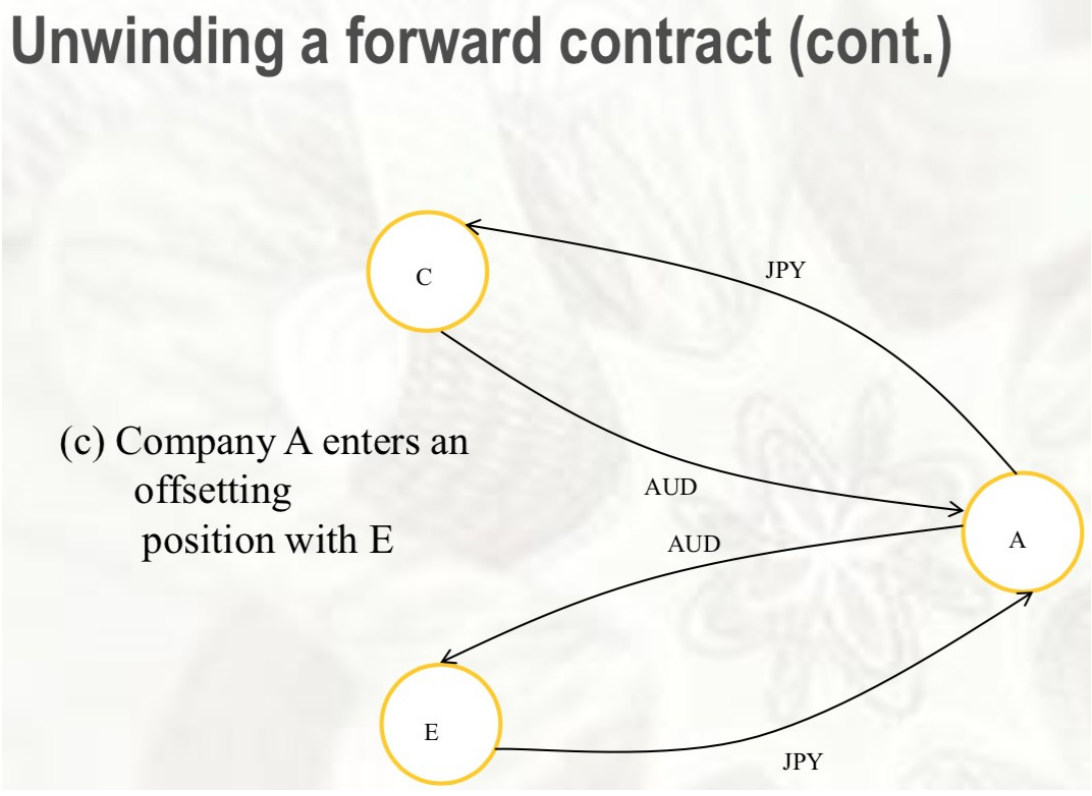
- A is an Australian exporter
- Receivables in JPY (shipment of goods to Japan for B)
- Forward contract to sell JPY to a counterparty C
- But exports deal with B is cancelled
- How to unwind the forward contract with C?
- 3 courses of action is available

Unwinding a forward contract

(a) Company A assigns the obligation to another counterparty (D)







How futures contracts solve these problems

- Standardised contract dimension
- Size
- Settlement date

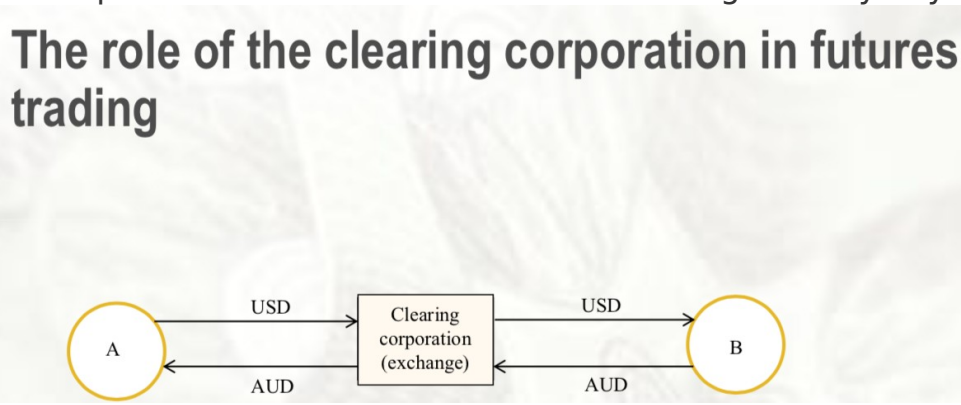
Default risk is controlled by the clearing corporation and some regulations

4 Manage default risk by margin accounts and marking to market on a daily basis

4 Initial margin, maintenance margin

4 Price limit, position limit

- Marking-to-market – a contract is cancelled and a new one purchased as the settlement rate changes every day



Example – Margin Account

A US-dollar based trader buys one Australian dollar futures contracts worth AUD100,000 on 1 February at S(USD/AUD) = 0.5600.

The US dollar value of this contract
= 100,000 X 0.5600 = USD56,000

The settlement exchange rate changes on successive days as the following:

Date	Settlement Rate
2 Feb	0.5800
3 Feb	0.5950
4 Feb	0.6010
5 Feb	0.5775

Initial margin = USD3500

Maintenance margin = USD2500

Date	Beginning Balance	Rate	Value of Contract	Price change	Gain/ Loss	Ending Balance
1 Feb	3500	0.5600	56,000			
2 Feb	3500	0.5800	58,000	0.0200	+2000	5500
3 Feb	5500	0.5950	59,500	0.0150	+1500	7000
4 Feb	7000	0.6010	60,100	0.0060	+600	7600
5 Feb	7600	0.5775	57,750	0.0235	-2350	5250

Note that the trader takes a long position in AUD (buys AUD). Hence an increase in the settlement rate leads to a gain for the trader (buys AUD for less USD).

The settlement rate is moving in favour of the trader. As the ending balance has not fallen below the maintenance margin (2500), hence no margin call is made.

If the ending balance falls below the maintenance margin, a margin call will be made to request the trader to bring it up to the initial margin level.

Disparity of rate between the forward and futures market

- If the exchange rates implicit in forward and futures contracts are different, profit-seeking arbitrage will be triggered.
- However, due to marking-to-market, arbitrage ensures that the offer forward rate is not significantly below the bid futures rate, and vice versa.

Example

	Forward	Futures
USD/AUD bid rate	0.5800	
USD/AUD offer rate		0.5675
Value of contract	Sell AUD 100,000 X 0.5800 = USD58,000	Buy AUD 100,000 X 0.5675 = USD56,750
Gain on settlement date	58,000 – 56,750 = USD1250	

As a result, there will be
an increase in the demand for AUD futures contract
an increase in the supply for AUD forward contract
until the rates converge on each other (profit =0)

A comparison of forward and futures markets

	Forward	Future
Market Size	Larger	Smaller
Structure	OTC	Organised exchange
Contract size, maturity date, length, etc	Non-standardised	Standardised
Trade currencies	Any	Major
EX fluctuations	No limits	Daily limits
Credit risk	Higher default risk	Lower default risk (Clearing corporation)
Cash flows	None until the maturity	Interim flows
Liquidity	Low (Hard to be cancelled)	High (Easy to be cancelled)
Major users	Hedger	Speculators

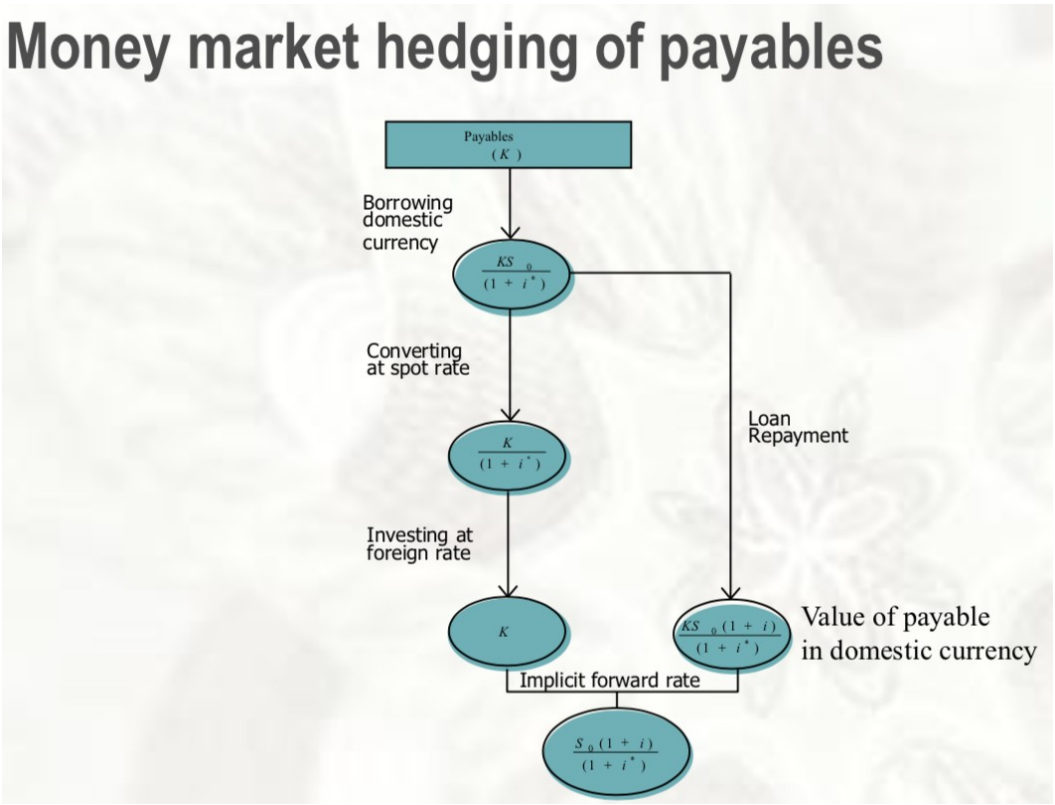
Specifications of currency futures contracts

Contract	Base Currency	Underlying Currency	Size (in UC terms)	Price for delivery
AUD/USD	USD	AUD	AUD100,000	0.6330
AUD/JPY	JPY	AUD	AUD200,000	61.25
CAD/USD	USD	CAD	CAD100,000	0.7808
CAD/JPY	JPY	CAD	CAD200,000	75.79

- Contract name is in terms of 2 currencies
- Base currency is used to buy the underlying currency (profit/loss)
- Underlying currency is the 'commodity' that is bought and sold (contract size)
- Price is expressed as the base currency price of one unit of underlying currenc
- Take CAD/JPY contract, this is called the "CAD" contract.
- Given the delivery price of 75.79, the JPY value of the contract is 15,158,000.

Money market hedging

- A money market hedge amounts to taking a money market position to cover expected payables or receivables
- By borrowing and lending, a synthetic forward contract is created



Money market hedging of payables - Example

- Suppose that an Australian company owes an amount of GBP300,000=K, due in one month.
- Current spot rate = 2.70=S_0(AUD/GBP)
- 1-month forward rates = 2.75=F(AUD/GBP)
- 1-month interest rate (AUD) = 8% p.a.=i
- 1-month interest rate (GBP) = 4% p.a.=i*
- What is the process of money market hedge of GBP payables?

Money market hedging of payables - Example (cont'd)

1. Find out how much to borrow in AUD in order to meet payables in 1 month:

$$\frac{KS_0}{(1+i^*)} = \frac{300{,}000\times 2.7}{(1+\frac{0.04}{12})} = AUD\ 807{,}309$$

2. Convert this amount at present spot rate
   807 309 / 2.7 = GBP 299 003
3. Invest for 1-month at 4% and obtain
   299 003 X [1 + (0.04/12)] = GBP 300,000
4. Repay loan in AUD
   807 309 X [1 + (0.08/12)] = AUD812,691

$$\frac{KS_0(1+i)}{(1+i^*)} = \frac{300{,}000 \times 2.7 \times (1+\frac{0.08}{12})}{(1+\frac{0.04}{12})} = AUD\ 812{,}691$$

Money market hedging of payables - Example (cont'd)

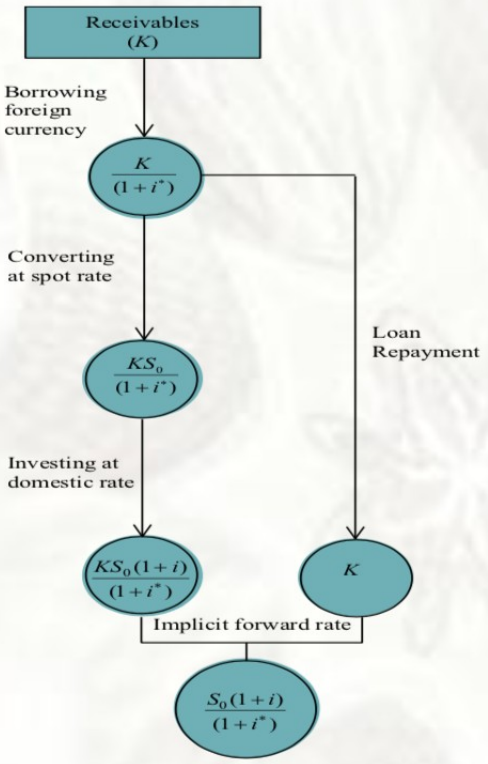
The implicit forward rate is calculated as

$$\frac{812691}{300000} = 2.7090$$

Which can also be calculated as

$$\overline{F}_0 = \frac{S_0(1+i)}{(1+i^*)} = 2.70 \times \frac{1+\frac{0.08}{12}}{1+\frac{0.04}{12}} = 2.7090$$

Money market hedging of receivables



Money market hedging (cont'd)

- If $\overline{F}_0 < F_0$, money market hedging of payables will be preferred to forward hedging.
  - $\overline{F}_0(d/f) < F_0(d/f)$, foreign currency at the implicit rate is worth less in terms of domestic currency
- If $\overline{F}_0 > F_0$, money market hedging of receivables will be preferred to forward hedging.
  - $\overline{F}_0(d/f) > F_0(d/f)$, foreign currency at the implicit rate is worth more in terms of domestic currency

Option hedging

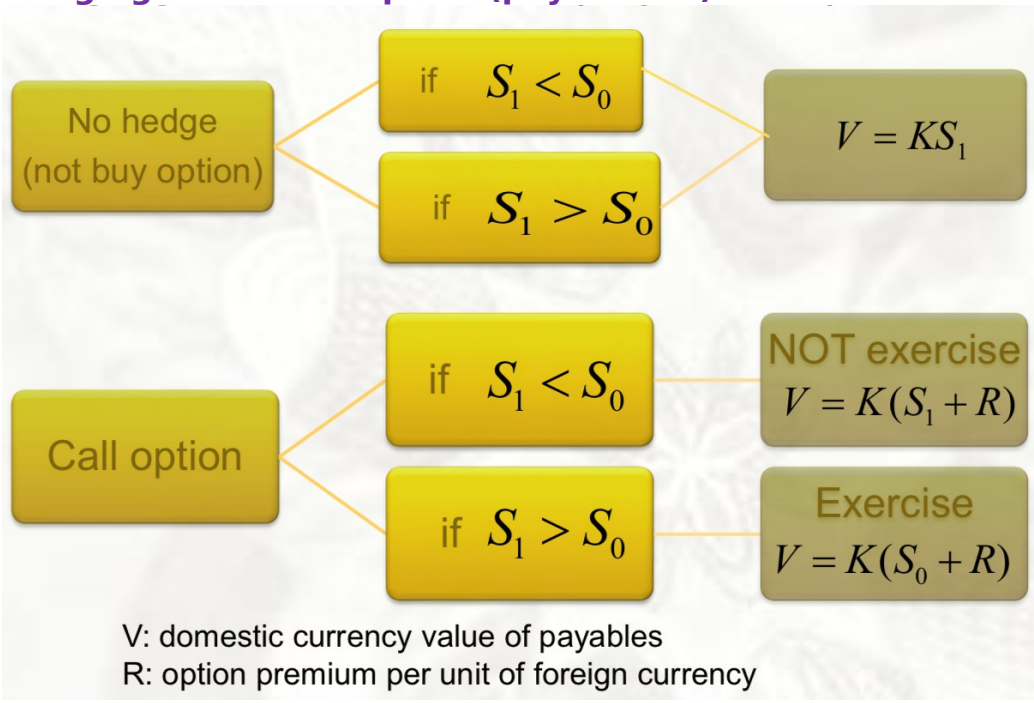
- The holder of an option contract **has the right, but not the obligations**, to buy or sell a currency at a pre-determined exchange rate.
- The outcome of option hedging is *not known* with certainty, since it depends on whether or not the option is exercised

Options

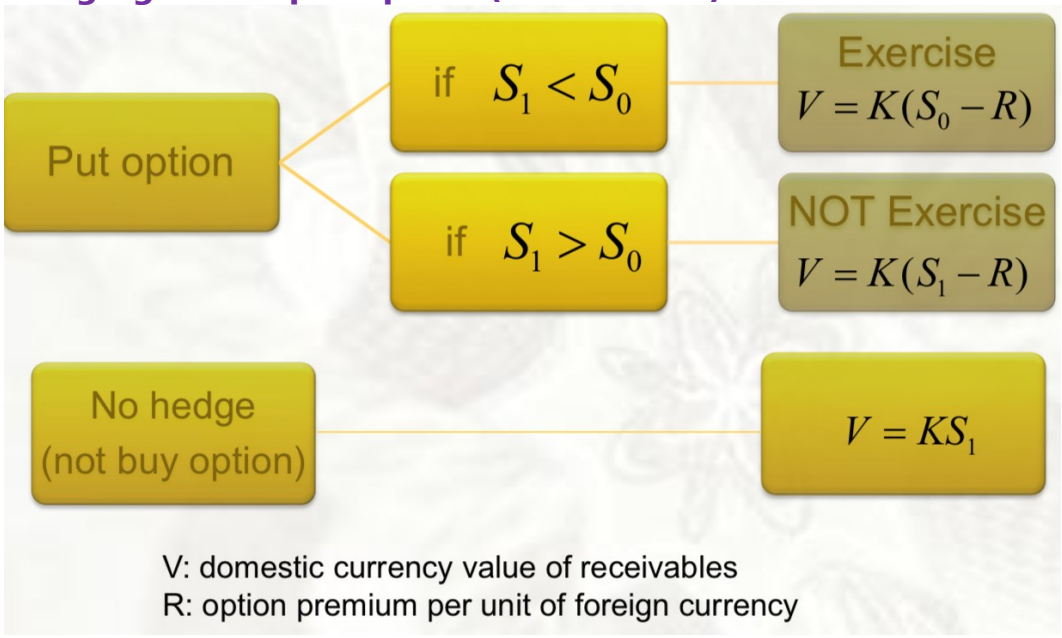
Two types of options

- **Call**: gives the buyer the right to buy the commodity at the exercise price
  - The buyer of the **call** option: has the **right to buy** a currency
- **Put**: gives the buyer the right to sell the commodity at the exercise price
  - The buyer of the **put** option: has the **right to sell** a currency

Hedging with a call option (payables K)



Hedging with a put option (receivables)



Option Hedging (Receivables) - Example

A French importer of Australian kangaroo meat owes the Australian exporting company EUR150 000=K, due in three months.

S_0 (AUD/EUR)	1.60
S^e (AUD/EUR)	1.55 (0.4) and 1.65 (0.6)
Premium on EUR put option	R = AUD0.01
Exercise exchange rate	S_0 = 1.60
Time to expiry	3 months

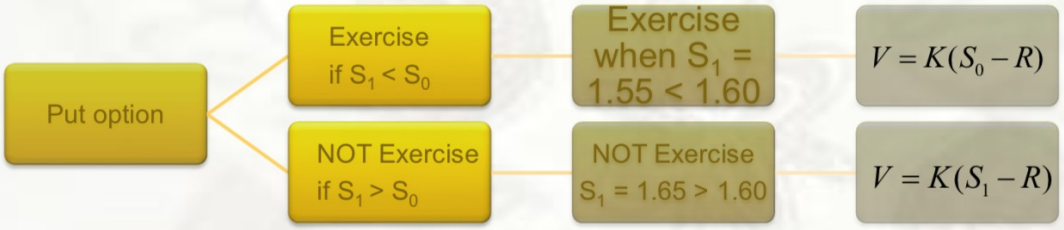
•What is the expected value of receivables in AUD under an option hedge.

•Will the decision to hedge be taken?

Option Hedging (Receivables) - Example

Exercise rate, S_0 1.60

S_1 (AUD/EUR) 1.55 (0.4) and 1.65 (0.6)



Option Hedging (Receivables) - Example

The expected domestic currency value of receivables under a put option hedge is:

$K(S_0 - R)$ $K(S_1 - R)$

150,000 x (1.60 - 0.01) x 0.4 + 150,000 x (1.65 – 0.01) x 0.6 = 243,000.

(Exercise option) (NOT Exercise option)

If the position is left unhedged the expected value of receivables is

150,000 x 1.55 x 0.4 + 150,000 x 1.65 x 0.6 = 241,500.

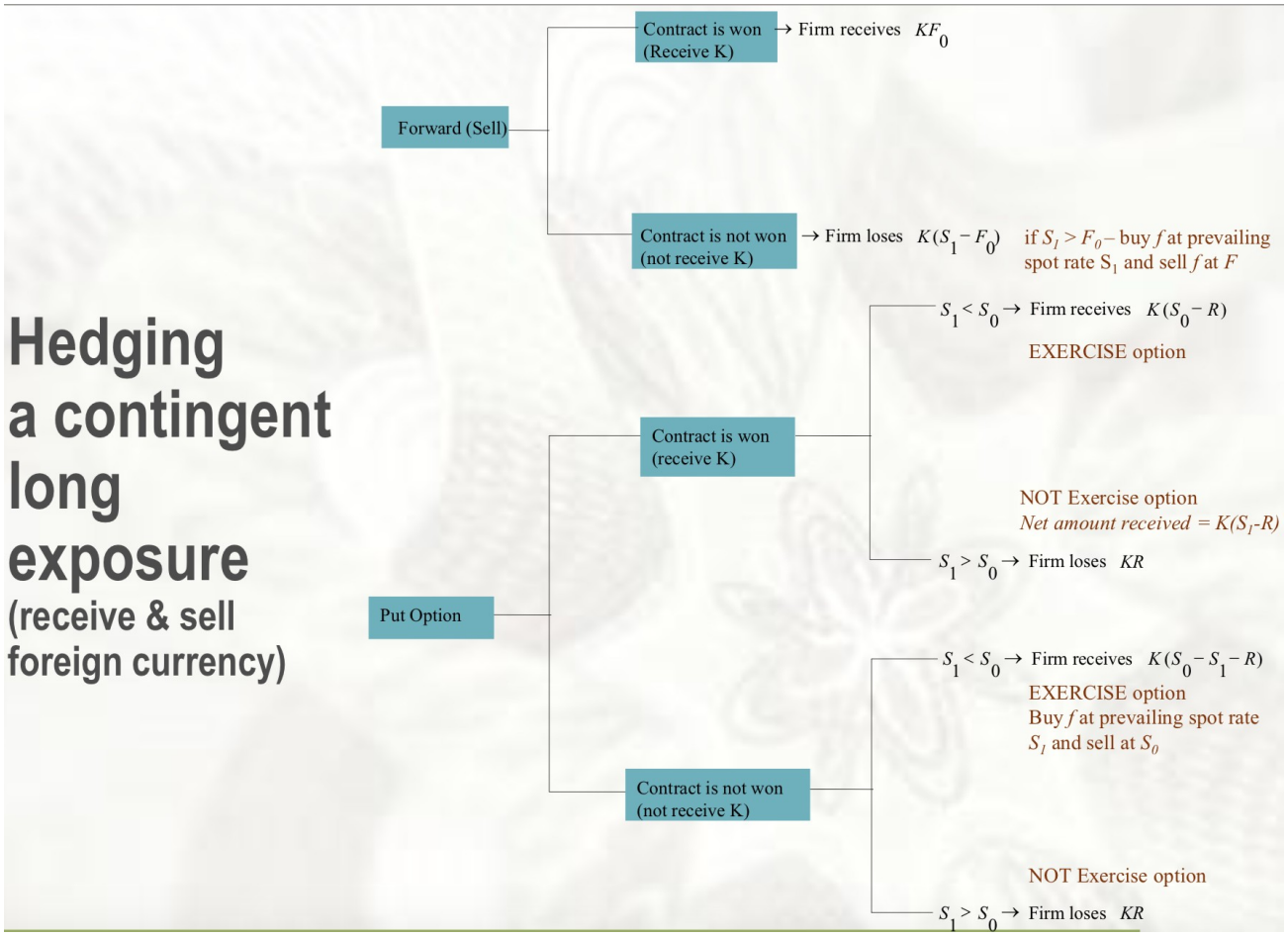
KS_1 KS_1

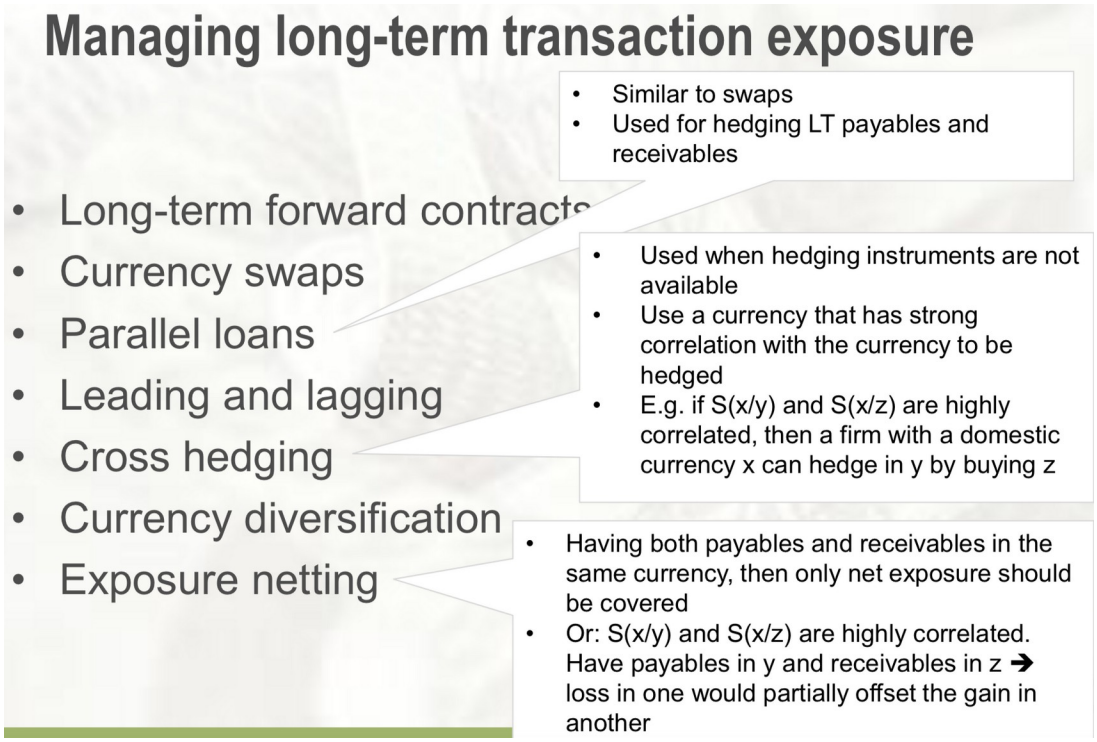
Since the expected value of the receivables under the hedge decision is higher than otherwise, a hedge decision will be taken.

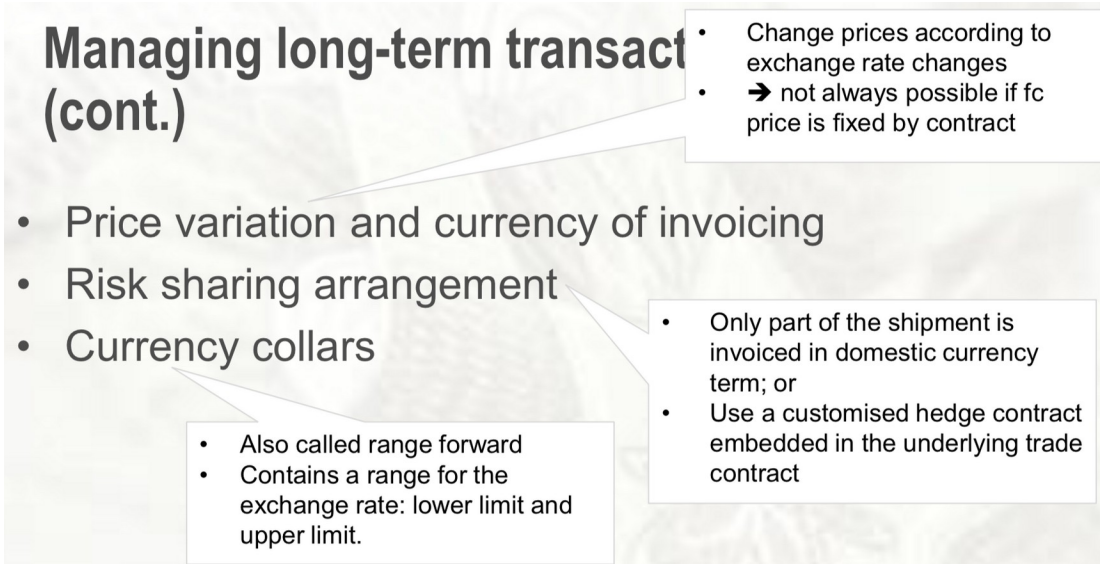
Contingent exposure

A contingent exposure arises only if a certain outcome materialises, such as winning a contract

Compare between a forward contract and a put option - Figure 13.17







Option hedging

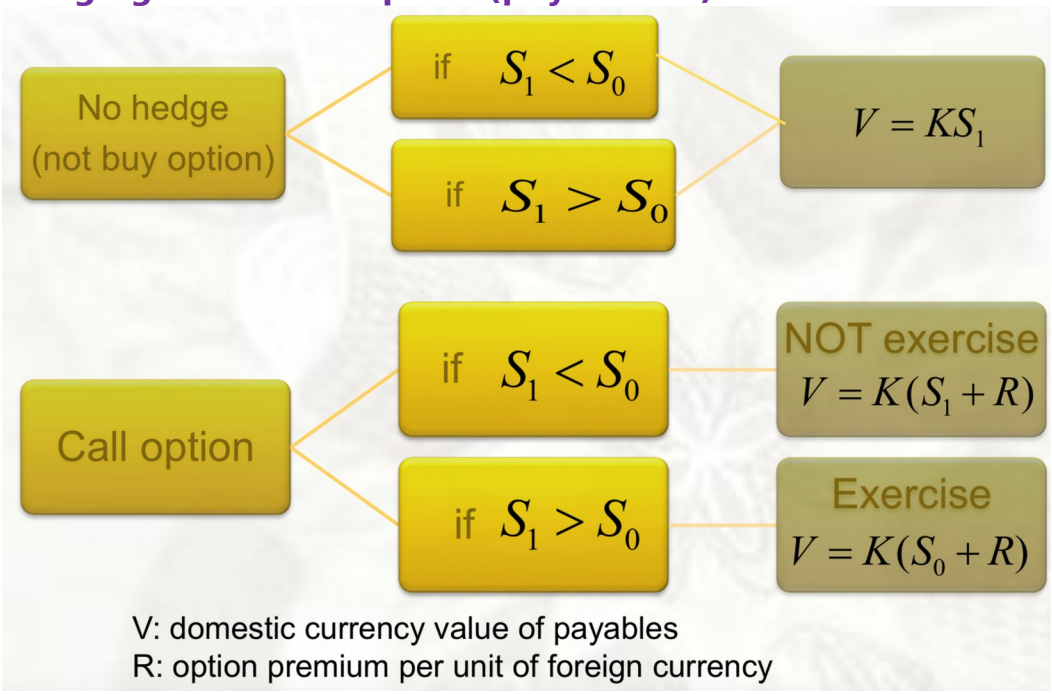
- The holder of an option contract has the right, but not the obligations, to buy or sell a currency at a pre-determined exchange rate.
- The outcome of option hedging is not known with certainty, since it depends on whether or not the option is exercised

Options

Two types of options

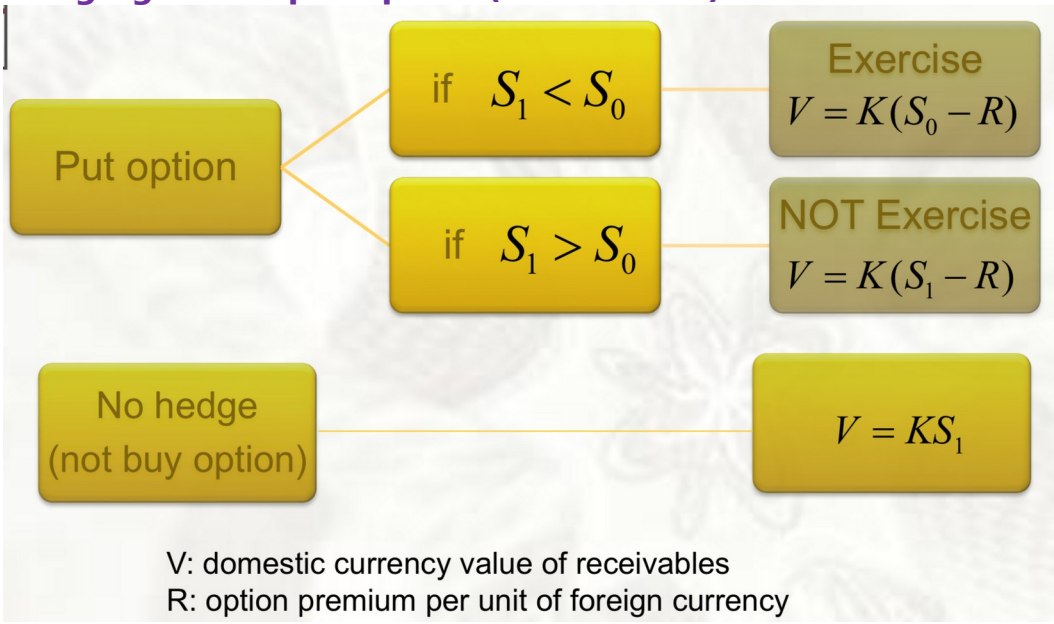
- **Call**: gives the buyer the right to buy the commodity at the exercise price
  - The buyer of the **call** option: has the **right to buy** a currency
- **Put**: gives the buyer the right to sell the commodity at the exercise price
  - The buyer of the **put** option: has the **right to sell** a currency

Hedging with a call option (payables K)



V: domestic currency value of payables
R: option premium per unit of foreign currency

Hedging with a put option (receivables)



V: domestic currency value of receivables
R: option premium per unit of foreign currency

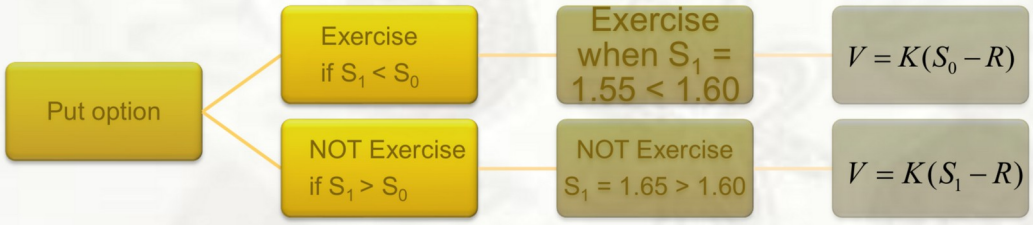
Option Hedging (Receivables) - Example

A French importer of Australian kangaroo meat owes the Australian exporting company EUR150 000=K, due in three months.

S_0 (AUD/EUR)	1.60
S^e (AUD/EUR)	1.55 (0.4) and 1.65 (0.6)
Premium on EUR put option	R = AUD0.01
Exercise exchange rate	S_0 = 1.60
Time to expiry	3 months

- What is the expected value of receivables in AUD under an option hedge.
- Will the decision to hedge be taken?

Exercise rate, S_0	1.60
S_1 (AUD/EUR)	1.55 (0.4) and 1.65 (0.6)



The expected domestic currency value of receivables under a put option hedge is:

$K(S_0 - R)$ $\qquad$ $K(S_1 - R)$

150,000 x (1.60 - 0.01) x 0.4 + 150,000 x (1.65 – 0.01) x 0.6 = 243,000.

(Exercise option) (NOT Exercise option)

If the position is left unhedged the expected value of receivables is

150,000 x 1.55 x 0.4 + 150,000 x 1.65 x 0.6 = 241,500.

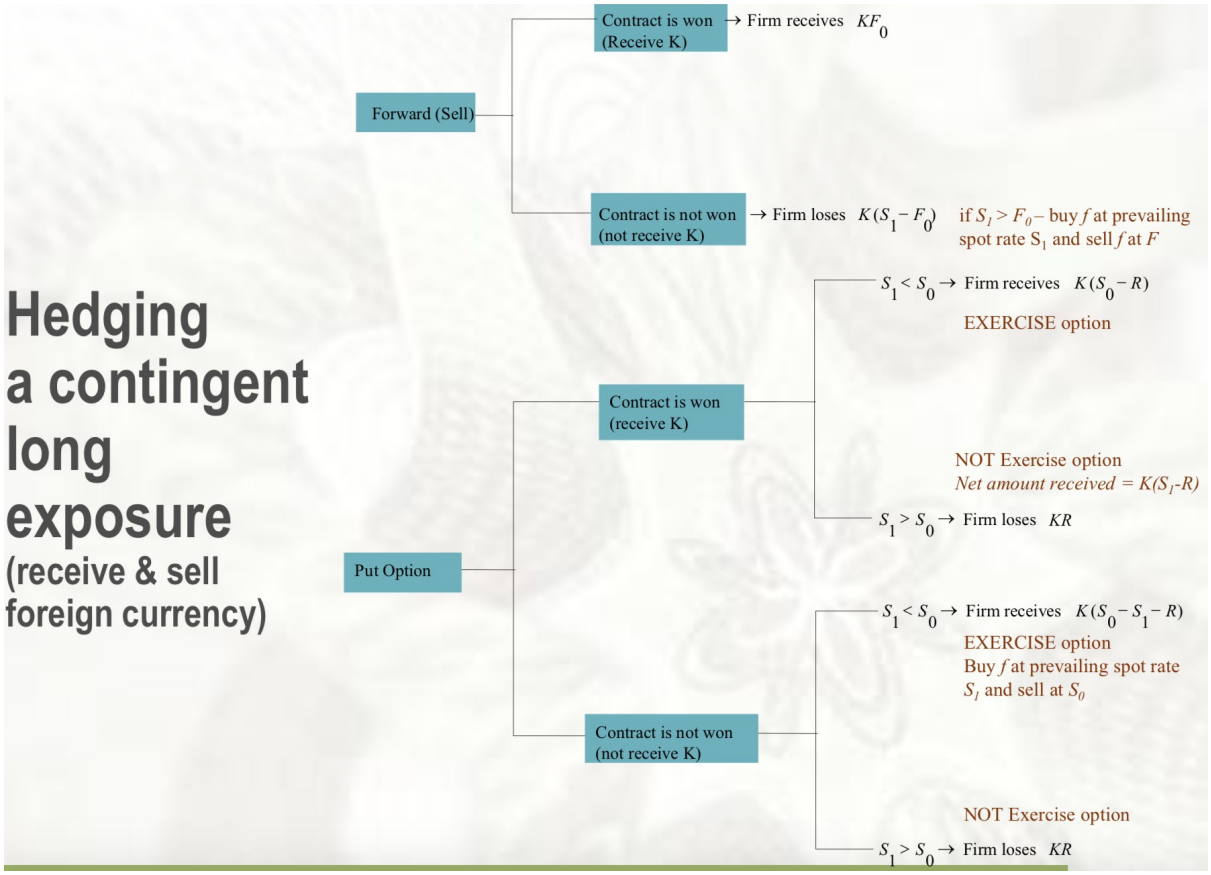
KS_1 $\qquad$ KS_1

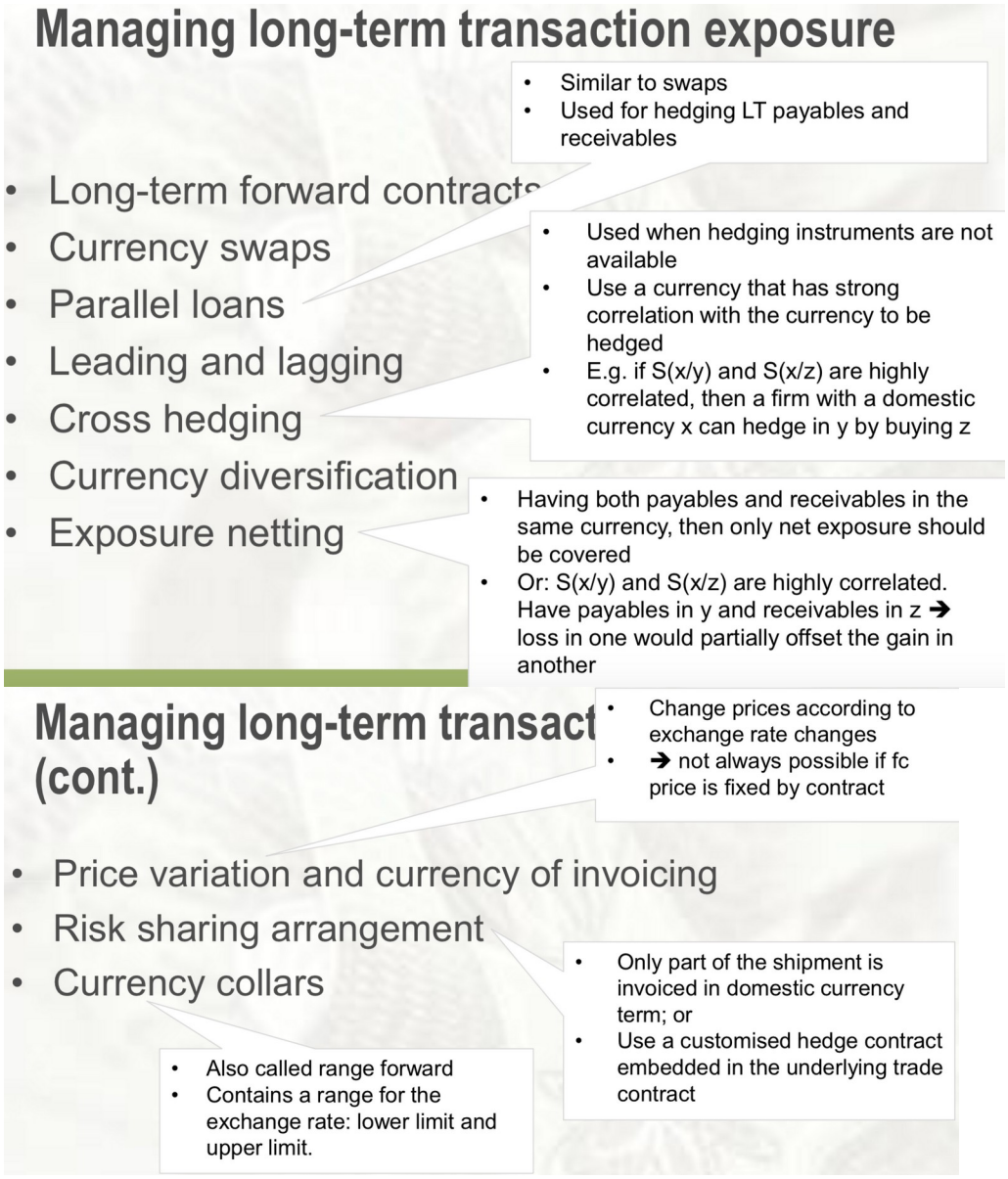
Since the expected value of the receivables under the hedge decision is higher than otherwise, a hedge decision will be taken.

Contingent exposure

A contingent exposure arises only if a certain outcome materialises, such as winning a contract

- Compare between a forward contract and a put option - Figure 13.17





Risk Sharing Example

Ford agrees with Mazda that all purchases will be in ¥ at the spot exchange rate.

- Ford will bear all forex risk at S= ¥115/$ - ¥125/$
- Risk sharing if the spot rate falls outside this range.
- If Ford's A/P = ¥25,000,000 for the month of March
  S(JPY/USD) = ¥110/$
- Ford's payment: $\left[\frac{Y25{,}000{,}000}{120-\left(\frac{115-110}{2}\right)}\right]=\frac{Y25{,}000{,}000}{Y117.50/\$}=\$212{,}765.96$
- Savings of $227,272.73-$212,765.96 = $14,506.77

Risk Sharing Arrangements

- If S < lower limit, then payables are converted at a rate calculated as

$$V=K\left[\bar{S}-\frac{Lower\_limit-S_1}{2}\right]$$

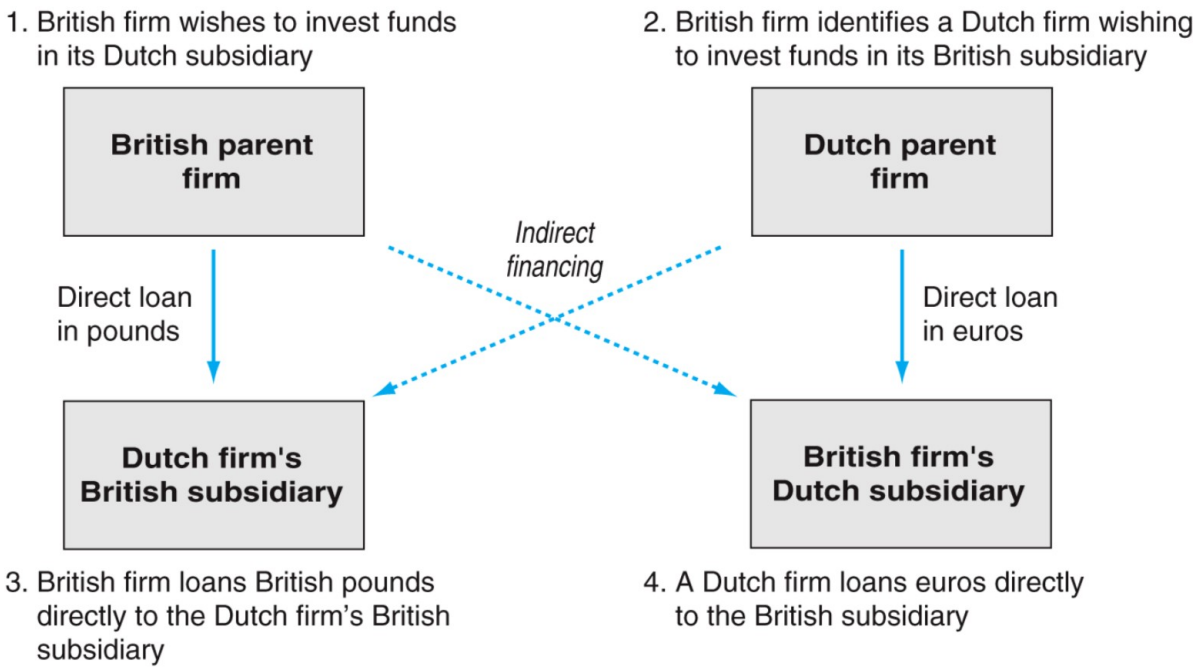
- $\bar{S}$ = base rate, S_1 = prevailing spot rate

- If S > upper limit, then payables are converted at a rate calculated as

$$V=K\left[\bar{S}+\frac{S_1-Upper\,limit}{2}\right]$$

- $\bar{S}$ = base rate, S_1 = prevailing spot rate

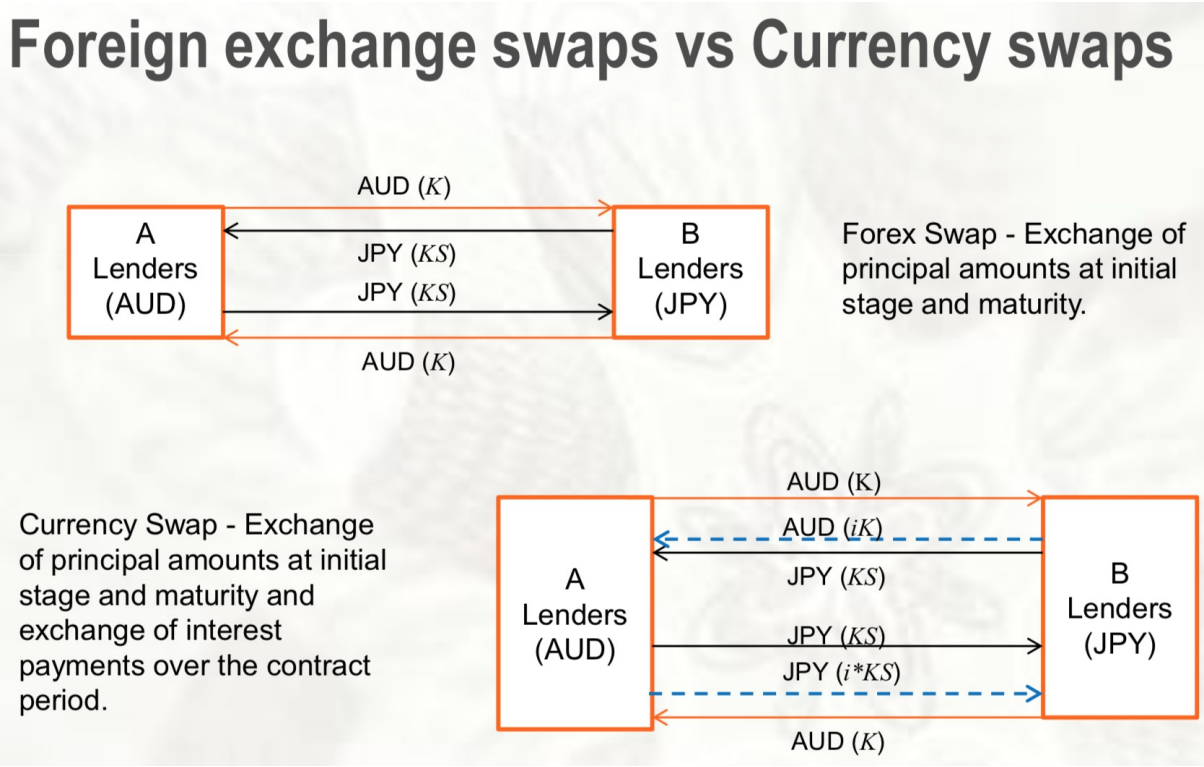
Back-to-back loan Example



The back-to-back loan provides a method for parent-subsidiary cross-border financing without incurring direct currency exposure.

Definition of currency swaps

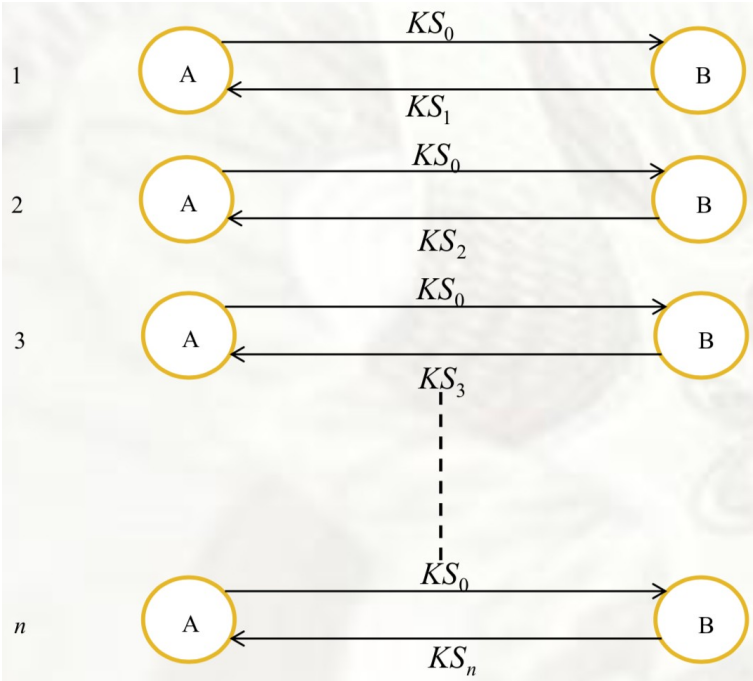
- Foreign exchange swaps
  - Only principal amount is exchanged at initiation and maturity of the contract
  - No exchange of interest payments in between these two dates
- Currency swaps
  - transactions in which two counterparties exchange specific amounts of two different currencies at the outset and repay over time according to a predetermined rule
  - Successor to back-to-back loans / parallel loans



Currency swaps with notional principals

- A notional principal is not exchanged. Only compensatory payments are made by one
  counterparty to the other
- In this case, a currency swap resembles a portfolio of forward contracts
  - Exchange two cash flows denominated in two different currencies at a predetermined exchange rate on a sequence of dates in the future

A swap without exchanging principals (Notional Principal)



Given $S(x/y)$,

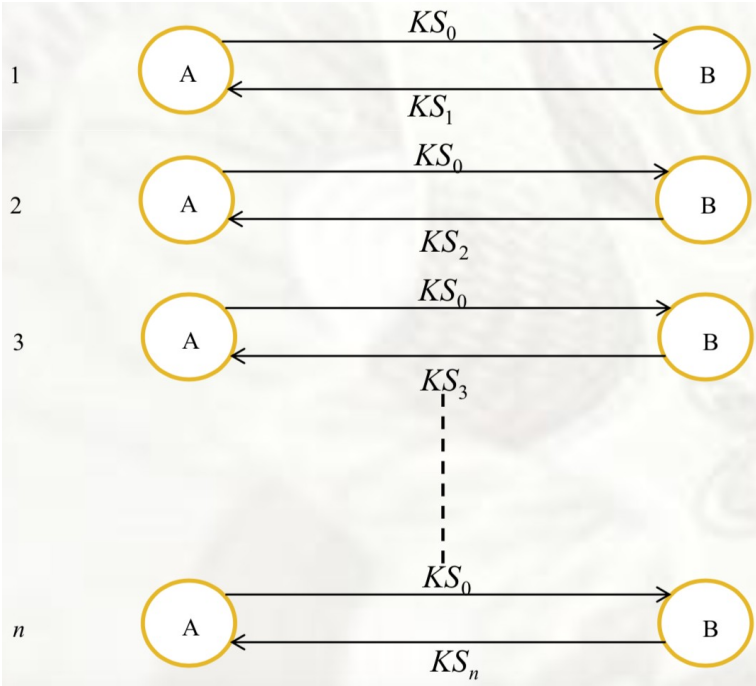
Principal is expressed in terms of currency y

Gross and net amounts exchanged are expressed in terms of currency x

A: receive a fixed amount of currency y, K, pay B the equivalent amount of x valued at the contract exchange rate $S_0(x/y)$

Principal is not exchanged, only the interest payments as a result of the difference between the fixed and the prevailing exchange rates will be delivered

A swap without exchanging principals (Notional Principal) (cont'd)



For example,

if in period 1, $S_1 > S_0$
currency y appreciates
receiver of y (party A) will benefit
party A receives $K(S_1 - S_0)$

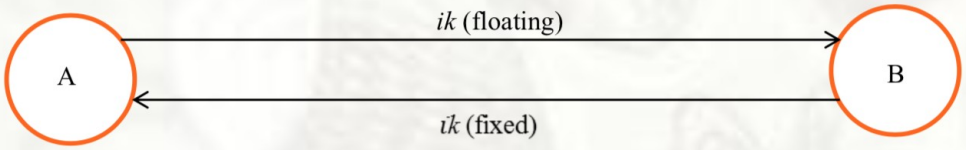
if in period 2, $S_2 < S_0$
currency x appreciates
receiver of x (party B) will benefit
party B receives $K(S_0 - S_2)$

Interest rate swaps

- A fixed-for-floating swap involves the exchange of cash flows by applying fixed and floating interest rates to a notional principal in a specific currency.

Fixed-for-floating interest rate swap

Both interest payments are calculated based on the notional principal k which will never be exchanged.



A receives payments based on a fixed rate

B receives payments based on a floating rate

Only compensatory payments are made by one party to the other, depending on whether the floating rate turns out to be higher or lower than the fixed rate.\

If floating interest rate > fixed rate, B receive payment $K(i\text{-}\bar{\imath})$ [floating – fixed] from A

If floating interest rate < fixed rate, A receive payment $K(\bar{\imath}\text{-}i)$[floating – fixed] from B

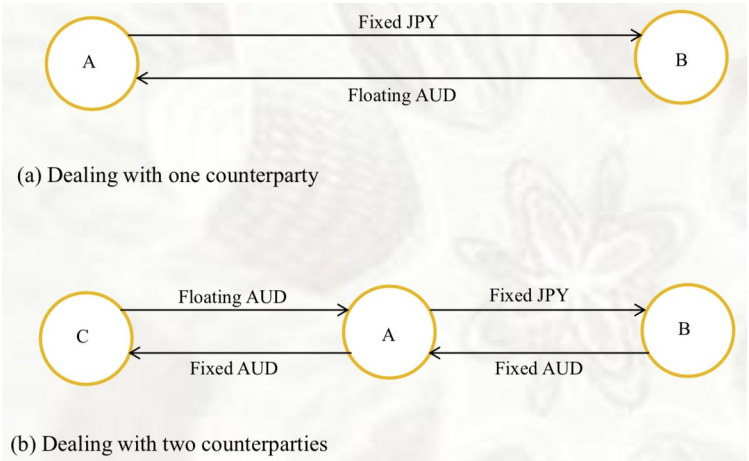
Other kinds of interest rate swaps

- A basis swap involves two floating interest rates
  e.g. deposit rate and Treasury bill rate
- A zero-coupon swap involves a zero fixed rate
  streams of payments made as one lump sum payment at maturity

Cross-currency interest rate swaps

Involve the exchange of payments in different currencies, one of which is calculated on the basis of a fixed interest rate and the other on the basis of a floating rate

Cross-currency interest rate swaps



Swap terminology

- A money market swap has a maturity of three years or less. This is unlike a term swap, which has a maturity of more than three years

Swap terminology (cont.)

- A spot-start swap starts (that is, it becomes operational) two days after the contract has been agreed upon verbally
- A swap that starts after more than two days but within one year is a delayed-start swap
- If the starting date is more than one year after the start of the verbal agreement, it is a forward swap
- An option on a swap is a contract allowing the holder to exercise, or otherwise, the right to engage in a specified swap
- A swaption allows one party to the contract (the holder of the swaption) to alter the swap

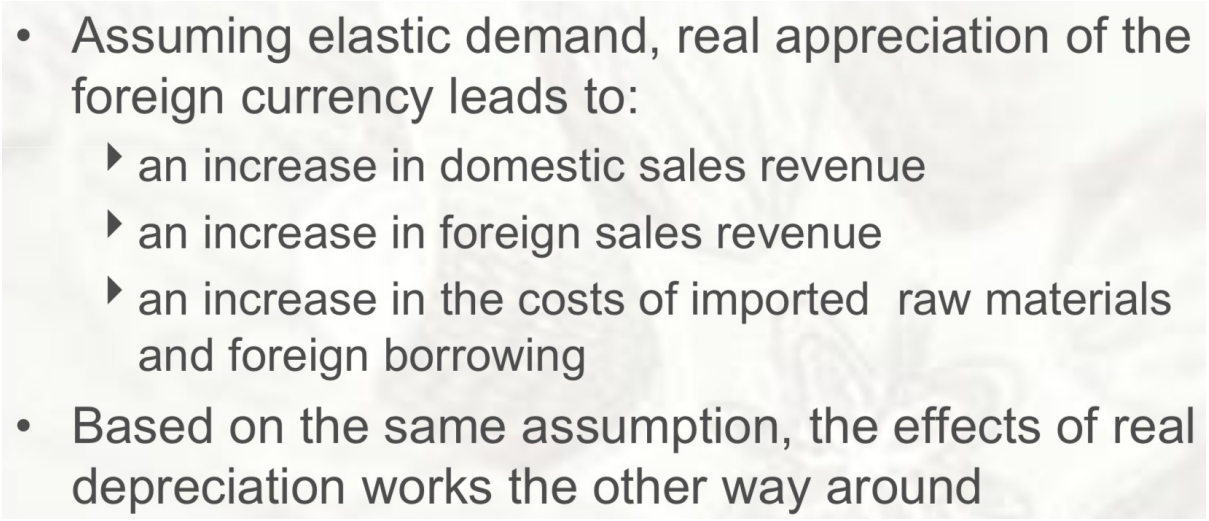
- If a counterparty wishes to terminate the swap without holding a swaption, then he or she would indulge in a swap buyout (that is, the swap is closed and settled at current prices)

- Normally, the notional principal on which a swap is based is constant throughout the life of the swap
- In the case of an amortising swap, the principal declines with time
- Another alteration is when the principal takes an irregular pattern

Economic exposure

- Economic exposure arises because revenues and costs vary with changes in the real exchange rate

The effects of real appreciation & depreciation



Hedging economic exposure

Reducing economic exposure requires:

- changing sales in new or existing foreign markets

- changing dependence on foreign supply of raw materials
- establishing or eliminating production facilities abroad 4changing the level of foreign debt

Measuring the impact of economic exposure

An unexpected change in exchange rates impacts a firm's expected cash flows at four levels, depending on the time horizon used:

- **Short run:** cash flows in the 1-year operating budget;
- **Medium run:** 2-5 years budget, firms can adjust prices and costs strategies to maintain competitive advantages;
- **Medium run:** 2-5 years budget, firms cannot adjust prices and costs strategies to maintain competitive advantages;
- **Long run:** expected cash flows beyond 5 years.

Why worry about translation exposure?

Translation exposure does not affect the economic value of the firm: why worry?

- Different translation methods affect reported earnings per share and other financial indicators

Hedging translation exposure

- Fund adjustment
- Forward contracts
- Exposure netting and balance sheet hedging