

AFIN329 Derivative Instruments

Introduction to Derivatives

The Nature of Derivatives

A derivative is an instrument whose price depends on, or is derived from, the price of another asset. Examples of derivatives:

- Futures contracts
- Forward contracts
- Swaps
- Options

The Theory of the Futures Market

(i) The Development and functions of Futures Market “Specialization in the function by Speculators”

(ii) The relation between spot and futures prices-(discount or premium)

(iii) The use of the futures by various investors and companies

(iv) The effect of futures markets on Economic Efficiency

(a) Social Value Issue (+)

(b) Firm-level Issue

What are the Recognized Benefits Attributed to Derivative Instruments

Price Discovery:

- Futures market prices depend on a continuous flow of information from around the world and require a high degree of transparency.
- The price of all future contracts serve as prices that can be accepted by those who trade the contracts in lieu of facing the risk of uncertain future prices.
- Options also aid in price discovery, not in absolute price terms, but in the way the market participants view the volatility of the markets.

Risk Management

This is because options are a different form of hedging in that they protect investors against losses while allowing them to participate in the asset's gains.

Risk Management

Risk management is the process of identifying the desired level of risk, identifying the actual level of risk and altering the latter to equal the former. This process can fall into the categories of hedging and speculation.

They Improve Market Efficiency for the Underlying Asset Investors who want exposure to the S&P 500 can buy an S&P 500 stock index fund or replicate the fund by buying S&P 500 futures and investing in risk-free bonds. Either of these methods will give them exposure to the index without the expense of purchasing all the underlying assets in the S&P 500.

Derivatives Also Help Reduce Market Transaction Costs Because derivatives are a form of insurance or risk management, the cost of trading in them has to be low or investors will not find it economically sound to purchase such "insurance" for their positions

Derivatives are used to:

- Hedge risks
- Speculate
- Lock in an arbitrage profit
- Change the nature of a liability
- Change the nature of an investment without incurring the costs of selling one portfolio and buying another

Futures Contracts Terminology

- A **long futures** position is an agreement to buy the asset at a certain time in the future for a certain price
- A **short futures** position is an agreement to sell the asset at a certain time in the future for a certain price

Futures price:

The futures price is the price at which you agree to buy or sell. It is determined by supply and demand in the same way as a spot price

Examples of Futures Contracts:

Agreement to:

- Buy 100 oz of gold @ US\$1,050/oz in December
- Sell £62,500 @ 1.5500 US\$/£ in March
- Sell 1,000 bbl of oil @ US\$75/bbl in April
- Buy 100 90-day bank bill futures contracts expiring in June

- March: Trader takes a long position in a June futures contract on 90-day bank accepted bills at 95.00. This implies a yield of 5% per annum is to be used to value the futures contract
- June: Trader must buy 90-day bank accepted bills with total face value of \$1,000,000 at a yield of 5% per annum

- The futures price that would be paid for the bills is:

$$\text{Futures price} = \frac{\$1,000,000}{1 + \frac{5}{100} \times \frac{90}{365}} = \$987,821.38$$

Electronic Trading:

- Traditionally, futures contracts have been traded using the open-outcry system where traders physically meet on the floor of the exchange
- Increasingly this is being replaced by electronic trading where a computer matches buyers and sellers
- The Australian Securities Exchange relies entirely on electronic trading

The Over-The-Counter Market:

The over-the-counter (OTC) market is an important alternative to exchanges. It is a telephone and computer-linked network of dealers who do not physically meet.

Trades are usually between financial institutions, corporate treasurers and fund managers.

Forward Contracts

Forward contracts are similar to futures except that they trade in the over-the-counter market.

“Price formation is carried out by forward buyers and sellers in association with their other activities”

Forward contracts are popular on currencies and interest rates.

Options

- A **call option** gives the holder the right to buy an asset by a certain date for a certain price (the strike price)
- A **put option** gives the holder the right to sell an asset by a certain date for a certain price (the strike price)

American vs. European Options:

- An American option can be exercised at any time during its life
- A European option can be exercised only at maturity

Options vs. futures/forwards

- In a **futures/forward** contract the holder has an **obligation** to buy or sell the asset at a certain price
- An **option** gives the holder the **right** to buy or sell the asset at a certain price

Exchanges Trading Options:

- Chicago Board Options Exchange
- NYSE Euronext
- Eurex (Europe)
- ASX

The Over-The-Counter Market for Options

Currently larger than the exchange-traded market. **Advantage:** contracts can be tailored to meet the particular needs of a corporate treasurer or fund manager

Types of Trader:

Three broad categories of trader can be identified:

1. Hedgers
2. Speculators
3. Arbitrageurs

Hedge Funds-Major uses of derivatives

Hedge funds are not subject to the same rules as mutual funds and cannot offer their securities publicly.

Mutual funds must:

- Disclose investment policies
- Make shares redeemable at any time
- Limit use of leverage
- Take no short positions

Three Reasons for Trading Derivatives:

Hedge funds trade derivatives for all three reasons: hedging, speculation and arbitrage. When a trader has a mandate to use derivatives for hedging or arbitrage, but then switches to speculation, large losses can result.

Hedgers

Hedging using forward contracts:

It is 10 January 2011. Import Co, a company based in Australia, must pay USD 10 million on 10 April 2011, for goods purchased from a US supplier.

Import Co buys USD 10 million in the three-month forward market to lock in an exchange rate of 0.98257 (3 months offer rate, see table 1.1) for the USD it will pay the US exporter AUD 10177392.

Hedging using options:

- It is February. An investor who owns 5,000 CBA shares wants protection against a possible decline in the share price over the next five months
- Current CBA share price is 51.21 and CBA July 50.00 put price is \$2.735
- The investor buys five put option contracts for a total cost of \$13,675. This gives the investor the right to sell 5,000 shares for \$50.00 per share during the next five months

Speculators

Speculation using futures:

An Australian speculator, who in February thinks that the Australian share market will strengthen over the next two months, is prepared to back that hunch to the tune of \$250,000

The speculator can purchase \$250,000 worth of units in an index fund in the hope that the units can be sold later at a higher price

Or, take a long position in ASX SPI 200TM futures contracts

Speculation using options:

- It is October and a speculator considers that a stock is likely to increase in value over the next two months and will invest \$2,000
- The stock price is currently \$20 and a two-month call option with a \$22.50 strike price is currently selling for \$1 per share (Price of the stock is \$27)

What are the alternative strategies?

Buying the stock: $100 \times (\$27 - \$20) = \$700$

Buying the call option: $2000 \times \$4.50 = \9000

Net profit: $\$9000 - \$2000 = \$7000$

Arbitrageurs

Arbitrage involves locking in a riskless profit by simultaneously entering into transactions in two or more markets.

Suppose that a stock price is \$162 in Australia and £100 in London at a time when the exchange rate is \$1.6500 per pound. What is the arbitrage opportunity?

1. Buy 100 shares in Australia
2. Sells the shares in London
3. Converts the sale proceeds from pounds to dollars $100 \times [(\$1.65 \times 100) - \$162] = \$300$

1. Gold: An arbitrage opportunity?

Suppose that:

- The spot price of gold is US\$1,000
- The quoted 1-year futures price of gold is US\$1,100
- The 1-year US\$ interest rate is 5% per annum
- No income or storage costs for gold

Is there an arbitrage opportunity?

2. Gold: Another arbitrage opportunity?

Suppose that:

- The spot price of gold is US\$1,000
- The quoted 1-year futures price of gold is US\$990
- The 1-year US\$ interest rate is 5% per annum
- No income or storage costs for gold

Is there an arbitrage opportunity?

The Futures Price Of Gold

If the spot price of gold is S and the futures price for a contract deliverable in T years is F , then:

$$F = S (1+r)^T$$

where r is the 1-year (domestic currency) risk-free rate of interest

In our examples, $S=1,000$, $T=1$, and $r=0.05$ so that:

$$F = 1,000 (1+0.05)^1 = 1,050$$

1. Oil: An arbitrage opportunity?

Suppose that:

- The spot price of oil is US\$70
- The quoted 1-year futures price of oil is US\$80
- The 1-year US\$ interest rate is 5% per annum
- The storage costs of oil are 2% per annum

Is there an arbitrage opportunity?

$$F_0 = S_0(1 + (r + u))^T = 70(1 + 0.07)^1 = 74.90$$

1. Consider a 1-year futures contract on an investment asset that provides no income. It cost \$2 per unit to store the asset, with the payment being made at the end of the year. Assume that the spot price is \$450 per unit and the risk-free rate is 7% p.a. for all maturities. What should be the actual futures price?

2. Consider a 4-month forward contract to buy a zero-coupon bond that will mature 1 year from today (this means that the bond will have 8 months to go when the forward contract matures). The current price of the bond is \$930. We assume that the 4-month risk-free rate of interest (continuously compounded) is 6% p.a. Because zero-coupon bonds provide no income. Calculate the futures price?

$$1. \quad U = \frac{2}{(1 + 0.07)^1} = 1.869$$
$$F_0 = (450 + 1.869)(1.07) = 483.50$$

$$2. \quad F_0 = 930e^{0.06 \times \frac{4}{12}} = \$948.79$$

2. Oil: Another arbitrage opportunity?

Suppose that:

- The spot price of oil is US\$70
- The quoted 1-year futures price of oil is US\$65
- The 1-year US\$ interest rate is 5% per annum
- The storage costs of oil are 2% per annum

Is there an arbitrage opportunity?

$$F_0 = S_0(1 + (r + u))^T = 70(1 + 0.07)^1 = 74.90$$

The Wall Street Journal gives the following futures prices for gold on September 6, 2006:

Maturity	Oct 06	Dec 06	Jun 07	Dec 07
Futures price (\$/oz)	635.60	641.80	660.60	678.70

and the spot price of gold is \$633.50/oz.

Compute the (effective annualize) interest rate implied by the futures prices for the corresponding maturities.

The forward price is given by:

$$H_T = S_0 (1 + r_T)^T \Rightarrow r_T = \left(\frac{H_T}{S_0} \right)^{\frac{1}{T}} - 1$$

Then the effective annualized interest rates are:

$$\text{October 2006: } r_{Oct} = \left(\frac{635.60}{633.50} \right)^{12} - 1 = 0.0405$$

$$\text{December 2006: } r_{Dec} = \left(\frac{641.80}{633.50} \right)^4 - 1 = 0.0534$$

$$\text{June 2007: } r_{June} = \left(\frac{660.60}{633.50} \right)^{12/9} - 1 = 0.0574$$

$$\text{December 2007: } r_{Dec} = \left(\frac{678.70}{633.50} \right)^{12/15} - 1 = 0.0567$$

Mechanics of Futures Markets

Opening and Closing Futures Positions

A futures contract is an agreement to buy or sell an asset for a certain price at a certain time in the future. Closing a position involves entering into an opposite trade to the original one that opened the position.

For example, an investor who buys five July corn futures contracts on 6 May can close out the position on 20 June by selling five July corn futures contracts.

Specification of a Futures Contract

- What can be delivered (the asset)
- The contract size (how much of the asset)
- Where it can be delivered
- When it can be delivered

Cash Settlement:

Some financial futures are settled in cash because it is inconvenient or impossible to deliver the underlying asset.

Final settlement price is equal to the spot price of the underlying asset at either the opening or close of trading on that day.

Price Quotes:

- The exchange defines how prices will be quoted
- The ASX quotes the short-term interest rate and bond futures in yield per cent per annum
- For quotation purposes, the yield is deducted from an index of 100

Price Limits and Position Limits:

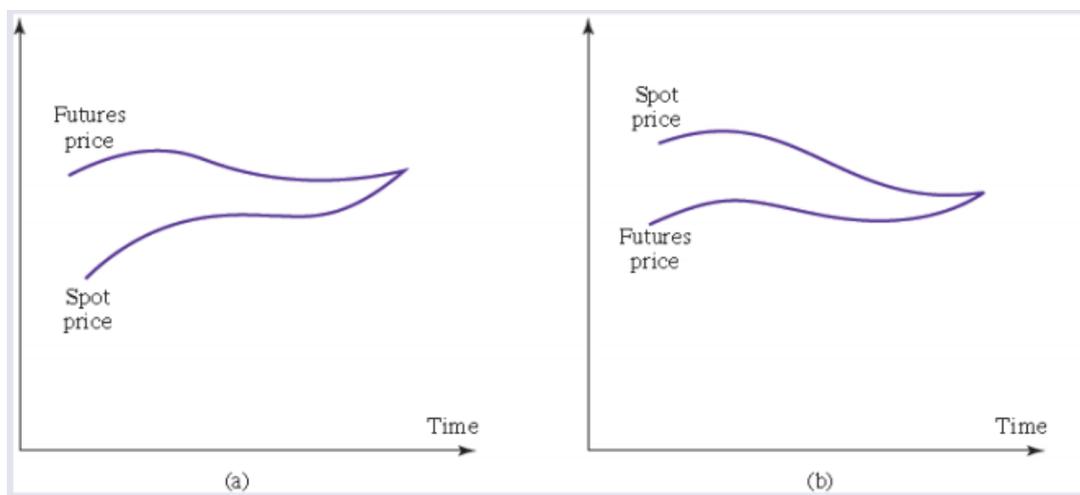
- For most contracts, daily price movement limits are specified
- A limit move is a move in either direction equal to the daily price limit
- Position limits are the maximum number of contracts that a speculator may hold
- Under the ASX trading rules, the position limits are imposed through the Capital Based Position Limits (CBPL), which restricts the initial margin liabilities

Convergence of Futures Price to Spot Price:

- When the delivery period is reached, the futures price equals, or is very close to, the spot price
- If the futures price is above the spot price, traders then have an arbitrage opportunity
- As they exploit this arbitrage opportunity, the futures price will fall
- If the futures price is below the spot price companies will find it attractive to buy a futures contract and then wait for delivery to be made
- As they do so, the futures price will tend to rise

Relationship between futures price and spot price

(a) futures price above spot price (b) futures price below spot price



The Operation of Margins:

A margin is cash or marketable securities deposited by an investor with his or her broker. The balance in the margin account is adjusted to reflect daily settlement.

Margins minimise the possibility of a loss through a default on a contract

Daily Settlement:

An investor takes a long position in one December 2010 ASX SPI 200 futures contract on October 20

- Contract size is AUD 115,900
- Futures price is 4,636.0 index points
- Margin requirement is AUD 3,250/contract
- Maintenance margin is equal to the initial margin (AUD 3,250)

Further Details

- The balance in a margin account may earn interest
- Futures contracts are settled daily
- Closing out a futures position involves entering into an offsetting trade
- Most contracts are closed out before maturity

The Clearinghouse and Clearing Margins:

The clearinghouse keeps track of all the transactions that take place so that it can calculate the daily net position of each of its members.

Brokers are required to maintain margin accounts with clearinghouse members and clearinghouse members are required to maintain a margin account with the clearinghouse.

Collateralisation in OTC Markets:

- It is becoming increasingly common for contracts to be collateralised in OTC markets
- Counterparties then post margins with each other to reflect changes in the value of the contract
- Regulators are now insisting that clearinghouses be used for some OTC contracts

Regulation

4. Regulation is designed to protect the public interest
5. Regulators try to prevent questionable trading practices by either individuals on the floor of the exchange or outside groups
6. In the US: Commodity Futures Trading Commission (CFTC) and the National Futures Association (NFA)
7. In Australia: Australian Securities and Investments Commission (ASIC) and the ASX Compliance

Accounting and Tax:

- It is logical to recognise hedging profits (losses) at the same time as the losses (profits) on the item being hedged
- It is logical to recognise profits and losses from speculation as they are incurred
- Roughly speaking, this is what the accounting and tax treatment of futures in the US and many other countries attempts to achieve

Forward Contracts

A forward contract is an OTC agreement to buy or sell an asset at a certain time in the future for a certain price. There is no daily settlement.

At the end of the life of the contract one party buys the asset for the agreed price from the other party.

Forward Contracts vs. Futures Contracts:

Forward

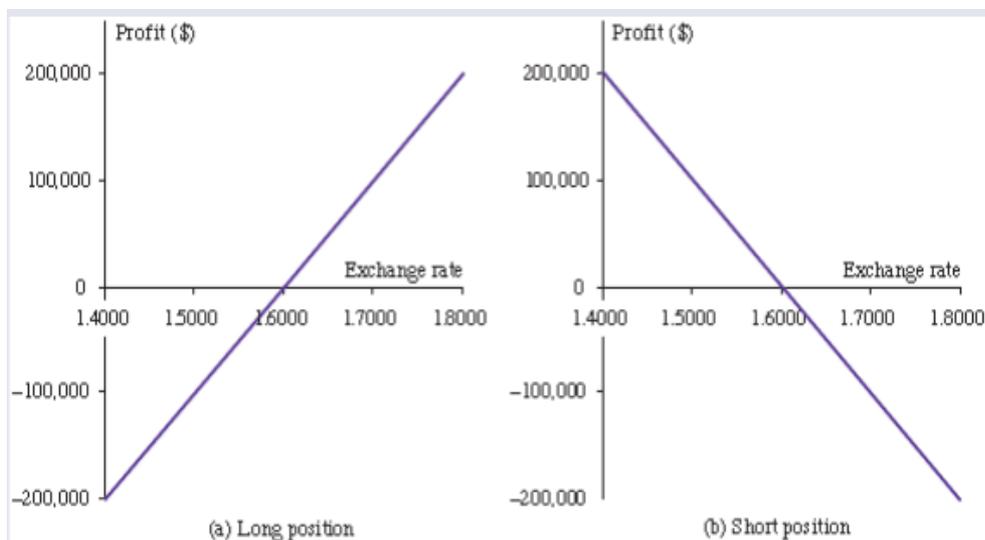
- Private contract between two parties
- Not standardised
- Usually one specified delivery date
- Settled at end of contract
- Delivery or final cash settlement usually take place
- Some credit risk

Futures

- Traded on an exchange
- Standardised
- Range of delivery dates
- Settled daily
- Contract is usually closed out prior to maturity
- Virtually no credit risk

Daily Settlement:

Profit from: (a) long and (b) short forward or futures position on £1 million



Extra Examples

1) The price of gold is currently \$800 per ounce. Forward contracts are available to buy or sell gold at \$1,000 for delivery in one year. An arbitrageur can borrow money at 10% per annum. What should the arbitrageur do? Assume that the cost of storing gold is zero and that gold provides no income.

The arbitrageur should borrow money to buy a certain number of ounces of gold today and short forward contracts on the same number of ounces of gold for delivery in one year. This means that gold is purchased for \$800 per ounce and sold for \$1,000 per ounce. Assuming the cost of borrowed funds is less than 25% per annum this generates a riskless profit.

2) In March, a US investor instructs a broker to sell one July put option contract on a stock. The stock price is \$42 and the strike price is \$40. The option price is \$3. Explain what the investor has agreed to. Under what circumstances will the trade prove to be profitable? What are the risks?

The investor has agreed to buy 100 shares of the stock for \$40 in July (or earlier) if the party on the other side of the transaction chooses to sell. The trade will prove profitable if the option is not exercised or if the stock price is above \$37 at the time of exercise. The risk to the investor is that the stock price plunges to a low level. For example, if the stock price drops to \$1 by July (unlikely but possible), the investor loses \$3,600. This is because the put options are exercised and \$40 is paid for 100 shares when the value per share is \$1. This leads to a loss of \$3,900, which is offset by the premium of \$300 received for the options.