SAIFM

South African Institute of Financial Markets

The Derivatives Market

Learner Guidance: Assessment methodology

Self-test questions (formative assessments) are designed to help you master the outcomes specified in the beginning of each chapter. The summative assessment (exam) will take the form of a multiple-choice set of questions that have been designed to assess whether you have mastered the required outcomes. The format of the self-test questions therefore differs from the format of multiple-choice questions and this should be kept in mind when reading the material.

Each multiple-choice question contains a key (correct answer or statement/s) and certain distracters (incorrect answers or statements). The drafter of multiple-choice questions strives to make the distracters appear plausible - meaning they seem correct to a person who did not read the material properly, but they are actually incorrect. You will find a short set of exam-style multiple-choice questions at the end of the material.

The average learner should go through the material at least 3 times and complete the self-test questions before attempting the summative assessment (exam).

Activities are meant to enrich the learning process and to make it more meaningful. They are entirely voluntary and can be skipped if a learner so wishes. However, activities are recommended, as they familiarise you with certain websites that serve as sources of information, so that you learn how to research information on your own once you become a securities market practitioner.

THE DERIVATIVES MARKET

CHAPTER 1

THE DERIVATIVES MARKET IN CONTEXT

1.1 CHAPTER ORIENTATION

CHAPTERS OF “THE DERIVATIVES MARKET”	
Chapter 1	The derivatives market in context
Chapter 2	Forwards
Chapter 3	Futures
Chapter 4	Swaps
Chapter 5	Options
Chapter 6	Other derivative instruments

1.2 LEARNING OUTCOMES OF THIS CHAPTER

After studying this chapter, the learner should:

- Understand the context and basics of the derivatives market.

1.3 INTRODUCTION

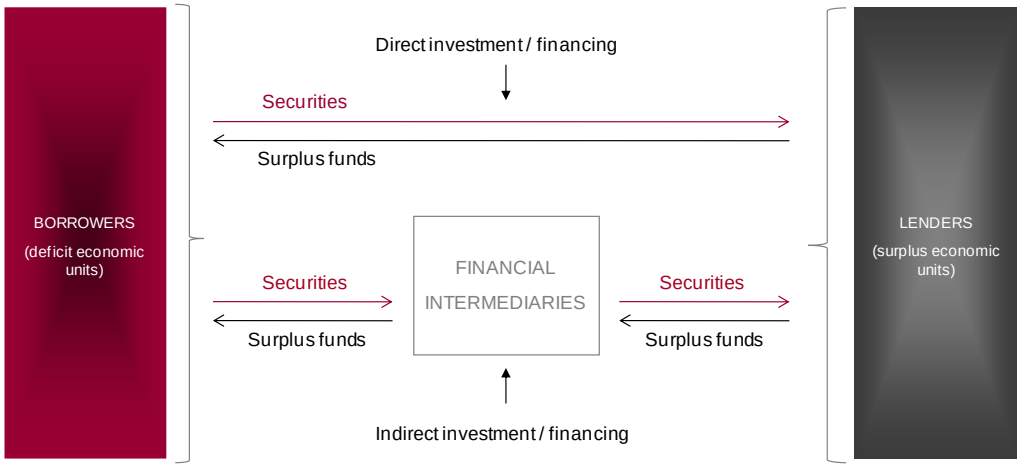
The purpose of this chapter is to provide the context of the derivatives market. The context of the derivatives markets in the financial system and its financial markets, and the commodities markets. This brief chapter has the following sections:

- The financial system in brief.
- Ultimate lenders and borrowers.
- Financial intermediaries.
- Financial instruments.
- Spot financial markets.
- Interest rates.
- The derivatives market.

1.4 THE FINANCIAL SYSTEM IN BRIEF

The financial system is essentially concerned with borrowing and lending and may be depicted simply as in Figure 1.1.

Figure 1.1: financial system (simplified)



The financial system has six essential elements:

- First: *ultimate lenders* (surplus economic units) and *borrowers* (deficit economic units), i.e. the non-financial economic units that undertake the lending and borrowing process.
- Second: *financial intermediaries* which intermediate the lending and borrowing process; they interpose themselves between the lenders and borrowers.
- Third: *financial instruments*, which are created to satisfy the financial requirements of the various participants; these instruments may be marketable (e.g. treasury bills) or non-marketable (retirement annuity).
- Fourth: the *creation of money (= deposits)* when credit is demanded; banks have the unique ability to create money by extending credit / loans.
- Fifth: *financial markets*, i.e. the institutional arrangements and conventions that exist for the issue and trading (dealing) of the financial instruments;

- Sixth: *price discovery*, i.e. the price of equity and the price of money / debt (the *rate of interest*) are “discovered” (made and determined) in the financial markets. Prices have an allocation of funds function.

We touch upon five of the elements of the financial system below (i.e. excluding the creation of money), because they serve as a useful introduction to the derivatives market.

1.5 ULTIMATE LENDERS AND BORROWERS

The ultimate lenders can be split into the four broad categories of the economy: the *household sector*, *the corporate (or business) sector*, the *government sector* and the *foreign sector*. The same non-financial economic units also appear on the other side of the financial system as *ultimate borrowers*.

This is because the members of the four categories may be either surplus or deficit units or both at the same time. An example of the latter is government: the governments of most countries are permanent borrowers (usually long-term), while at the same time having short-term funds in their accounts at the central bank and the private banks, pending spending.

1.6 FINANCIAL INTERMEDIARIES

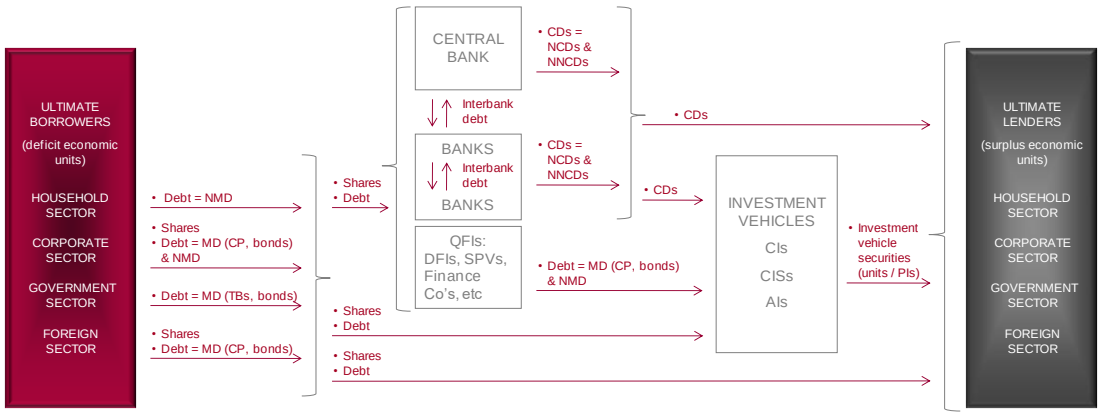
Financial intermediaries exist because there is a conflict between lenders and borrowers in terms of their financial requirements (term, risk, volume, etc.). They solve this divergence of requirements and perform many other functions such as lessening risk, creating a payments system, monetary policy, etc.

Financial intermediaries may be classified in many ways. A list of financial intermediaries in South Africa, according to our categorisation preference, is as shown in Table 1.1.

TABLE 1.1: FINANCIAL INTERMEDIARIES IN SOUTH AFRICA
DEPOSIT INTERMEDIARIES
South African Reserve Bank (SARB)
Corporation for Public Deposits (CPD)
Private sector banks
Postbank
NON-DEPOSIT INTERMEDIARIES
Contractual intermediaries (CIs)
Short-term insurers
Long-term insurers
Retirement funds
Collective investment schemes (CISs)
Securities unit trusts (SUTs)
Real Estate Investment Trusts (REITs)
Exchange traded funds (ETFs)
Alternative investments (AIs)
Hedge funds (HFs)
Private equity funds (PEFs)
QUASI-FINANCIAL INTERMEDIARIES
Development Finance Institutions (DFIs) (Land Bank, DBSA, IDC, etc.)
Investment trusts / companies
Finance companies
Securitisation vehicles (SPVs*)
Savings and credit cooperatives (SACCOs)
Friendly societies
Micro lenders
Buying associations
Stokvels
* Aka special purpose vehicles.

The main financial intermediaries (or categories) and their relationship to one another (as well as the securities – marketable and non-marketable - issued by them and the ultimate borrowers) may be depicted as in Figure 1.2.

Figure 1.2: financial intermediaries & instruments (securities)



MD = marketable debt; NMD = non-marketable debt; CP = commercial paper; CDs = certificates of deposit (= deposits); NCDs = negotiable certificates of deposit; NNCDs = non-negotiable certificates of deposit; foreign sector issues foreign shares and foreign MD (foreign CP & foreign bonds); PI = participation interests.

1.7 FINANCIAL INSTRUMENTS

As a result of the process of financial intermediation, and to satisfy the investment requirements of the ultimate lenders and the financial intermediaries (in their capacity as borrowers and lenders), a wide array of financial instruments exist. The instruments are either non-marketable [e.g. retirement annuities, insurance policies, utilised overdraft faculties (which are IOUs issued by borrowers to the banks)], which means that their markets are only primary markets (see next section), or marketable, which means that they are issued in their primary markets and traded in their secondary markets (see next section). The *marketable* financial instruments (also called securities) that exist in the South African financial markets (defined in the next section) are revealed in Table 1.2[1].

[1] All the financial intermediaries are repeated in this table to indicate that many financial intermediaries do not issue securities that are marketable.

TABLE 1.2: MARKETABLE SECURITIES IN SOUTH AFRICA	
Ultimate borrowers / financial intermediaries	Instrument
ULTIMATE BORROWERS	
HOUSEHOLD SECTOR	-
CORPORATE SECTOR	Shares*, corporate bonds & CP**
GOVERNMENT SECTOR	
Central government	RSA Treasury bills (TBs) & bonds
Provincial governments	(Do not issue at this stage)
Local governments	Local government bonds
State owned enterprises (SOEs)	SOE (aka parastatal) bonds & CP
FOREIGN SECTOR	Foreign shares, bonds & CP
FINANCIAL INTERMEDIARIES	
DEPOSIT INTERMEDIARIES	
South African Reserve Bank (SARB)	SARB debentures
Corporation for Public Deposits (CPD)	-
Private sector banks	Negotiable certificates of deposit (NCDs)
Postbank	-
NON-DEPOSIT INTERMEDIARIES	
Contractual intermediaries (CIs)	
Short-term insurers	-
Long-term insurers	-
Retirement funds	-
Collective investment schemes (CISs)	
Securities unit trusts (SUTs)	SUT units (marketable to issuer)
Property unit trusts (PUTs)	PUT units (JSE Listed)
Exchange traded funds (ETFs)	ETF units*** (marketable to issuer)
Alternative investments	

Hedge funds (HFs)	HF units*** (marketable to issuer)
Private equity funds (PEFs)	PEF units*** (marketable to issuer)
QUASI-FINANCIAL INTERMEDIARIES	
Development Finance Institutions (DFIs)	Bonds & CP
Investment trusts / companies	-
Finance companies	Bonds & CP
Securitisation vehicles (SPVs****)	Bonds & CP
Savings and credit cooperatives	-
Friendly societies	-
Micro lenders	-
Buying associations	-
Stokvels	-
* Aka equity: ordinary and preference shares. ** Commercial paper (bankers' acceptances and promissory notes also exist in some countries). ** * Aka participation interests (PIs). **** Special purpose vehicles.	

It is to be noted that non-marketable securities far outnumber marketable securities. The latter are highlighted here because derivative instruments are largely piggybacked on marketable securities.

1.8 SPOT FINANCIAL MARKETS

1.8.1 Introduction

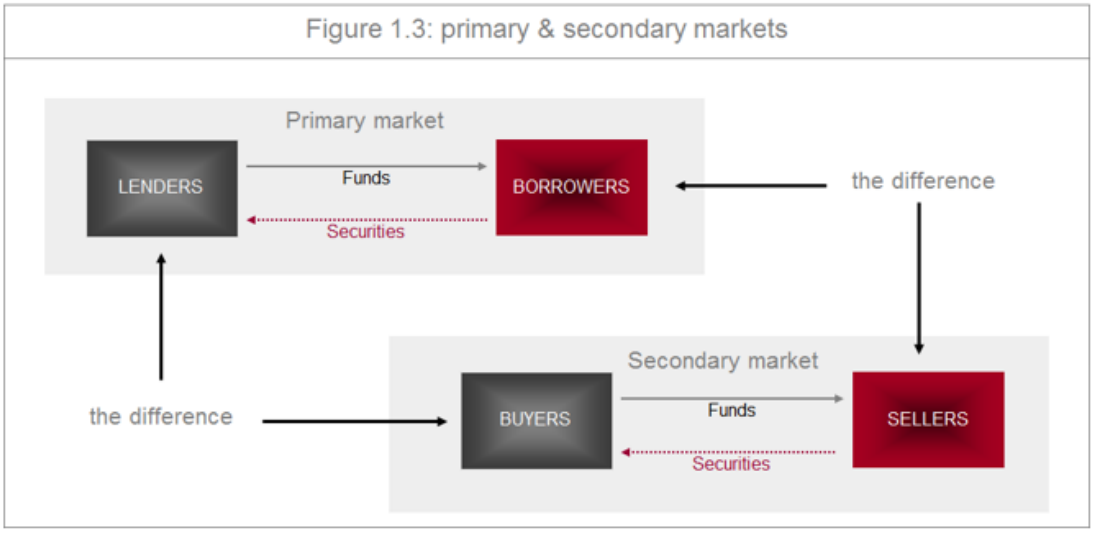
Spot, also known as *cash*, financial markets are the markets for debt and equity instruments which are settled *as soon as possible*. The spot market is differentiated from the derivatives market where settlement takes place on dates other than spot dates. This is elucidated further in Chapter 2.

In this section we briefly cover the following:

- Primary and secondary markets.
- Debt market.
- Equity / share market.
- Foreign exchange market.
- Short-selling and scrip borrowing / lending.

1.8.2 Primary and secondary markets

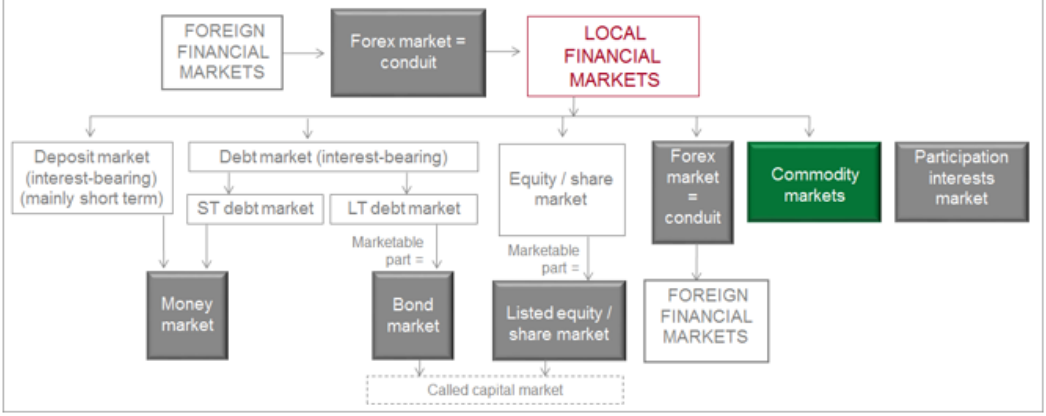
Figure 1.3: primary & secondary markets



As noted, there exist primary and secondary markets. The former are the markets that exist for the issue of new securities (marketable and non-marketable), while the latter are the markets that exist for the trading (i.e. exchange) of existing marketable securities. It should be evident that in the primary markets the issuers (borrowers) receive money from the lenders

(investors), while in the secondary markets the issuers do not; money flows from the buyers to the sellers. This is depicted in Figure 1.3.

Figure 1.4: spot financial markets (plus the spot commodity markets)



The secondary financial markets evolved to satisfy the needs of lenders (investors) to buy and sell (exchange) securities when the need arose. Some markets naturally exist in a safe (i.e. low risk) environment, while for others a safe environment has been created. The former markets are called over-the-counter (OTC) markets, and the latter the formalised (or exchange-driven) markets. The OTC markets are the foreign exchange and money markets (partly exchange-driven), which essentially are the domain of the well-capitalised banks, while the exchange-driven markets are the share (or equity) and bond markets.

The markets may be depicted as in Figure 1.4. As noted above, these markets are also called the spot (or cash) financial markets, as opposed to the derivatives market.

1.8.3 Debt market

There are two financial markets: the share market and the debt market. The debt market is the market in which debt instruments are issued (primary market) and exchanged (secondary market). Interest is paid on debt instruments (hence the other name: interest-bearing market), as opposed to dividends that are paid on shares / equities. The debt markets are also called the fixed-interest

markets, but this is a misnomer because interest may be floating, i.e. reset at intervals, during the life of the instruments.

The debt market can be split into the short-term debt market and the long-term debt market. The money market can be defined as the short-term marketable securities market or as the market for all short-term debt, marketable and non-marketable. Some scholars also term the market as the market for wholesale debt. Our preference is to define the money market as the market for *all* short-term debt, marketable and non-marketable – and the reason is that in this market the volume of non-marketable debt far outstrips the volume of marketable debt. Also, the genesis of money market interest rates takes place in the non-marketable debt market (specifically the interbank markets – there are three interbank "markets", but we will not cover this in detail here).

The other part of the debt market is the long-term debt market, which is (obviously) the market for the issue and trading of long-term debt instruments. The trading of long-term debt only applies to the marketable securities of the long-term debt market, and this applies to bonds. Thus, the bond market is the market for the issue (primary market) and trading (secondary market) of marketable long-term securities.

The money and bond markets are differentiated according to term to maturity: the cut-off maturity is arbitrarily set at one year. Thus, we define the money market as the market for the issue (marketable and non-marketable) and trading (marketable) of debt securities with maturities of less than one year, and the bond market as the issue and trading of *marketable* debt securities with maturities of longer than one year (called bonds).

The definition of the bond market is acceptable but we need to take the money market a little further – because it is much more than the issue and trading of securities of less than one year. It includes the all-important call money market, i.e. the one-day non-marketable deposit market (which plays a major role in interest rate discovery), and the *interbank markets* referred to earlier, which also covers significant operations of the central bank in this market. The central bank operates in the money market in the form of open market operations to

establish a certain desired “money market shortage”, i.e. level of borrowed reserves, and this it provides via the interbank market.

These borrowed reserves are provided at the Bank’s *accommodation rate*, nowadays called the *repo rate* in some countries (in the past called *bank rate*). The genesis of interest rates is here (one of the interbank markets) which has a major impact on another (the bank-to-bank interbank market) and then on bank call money rates ... and so on.

Thus, the money market encompasses the following markets (ignoring the money market derivatives market for a moment):

- Markets in the short-term debt securities of ultimate borrowers.
- Markets in the short-term deposit securities of banks.
- Markets in the short-term deposit securities of the central bank (bank notes and coins and securities issued for monetary policy purposes).
- Interbank market between private sector banks (the interbank rate is discovered here).
- Interbank market between the central bank and the private sector banks (accommodation/loans to the banks at the repo rate).
- Interbank market between the private sector banks and the central bank (reserves required to be held at no interest).

1.8.4 Equity market

The equity market is the market for the issue and trading of shares. The term *equity* refers to the capital of a company; it is made up of three parts:

- Ordinary shares. These shares are permanent capital in the sense that they represent a share in the ownership of a company.
- Preference shares. These shares are long-term capital if they have a maturity date (they usually do), or permanent capital if they are perpetual, i.e. have no maturity date.
- Retained profits.

Ordinary and preference shares are marketable, whereas retained profits are not. Preference shareholders have preference over ordinary shareholders, and

creditors (e.g. holders of bonds and bank loans) enjoy preference over holders of preference shares, in the event of the liquidation of the company.

1.8.5 Foreign exchange market

The foreign exchange (forex) market, strictly speaking, is not a financial market.[2] However, since residents (ignoring exchange controls for a moment) are able to borrow or lend offshore, and foreigners are able to lend to or borrow from local institutions, the forex market (which allows these transactions to take place) has a domestic and foreign lending or borrowing dimension, and can be viewed as being closely allied to the domestic financial market.

When we focus on the ultimate lenders and borrowers in our depiction of the financial system shown earlier, we observe that these sectors include the *foreign sector*. This is where the foreign exchange market fits in. The foreign sector can supply funds to South Africa, domestic institutions are able to lend to the foreign sector, and the foreign sector is able to borrow funds in the local market (i.e. issue securities in the local market). The unbound forex markets of the world allow this to take place. As indicated above, the forex market should be seen as a conduit for foreigners to the local financial and goods / services markets and for locals to the foreign financial and goods / services markets.

It will be apparent that for a forex market to function there needs to be a demand for and a supply of forex. *Demand* is the demand for, say, US dollars, the counterpart of which is the *supply* of rand. This cannot be satisfied without a *supply* of forex (say US dollars), the counterpart of which is a *demand* for rand. The forex market brings these *demanders* and *suppliers* together.

1.8.6 Short-selling and scrip borrowing / lending

A feature of the spot market is short-selling and scrip borrowing / lending. Short-selling is the sale of a security spot and buying it back spot when deemed favourable. To do this, the seller must borrow the security from a scrip lender

[2] Because lending and borrowing domestically do not take place in this market.

(*scrip* is the term used in the past for physical securities when securities registries were not electronic). The scrip lender charges the scrip borrower a fee for the service.

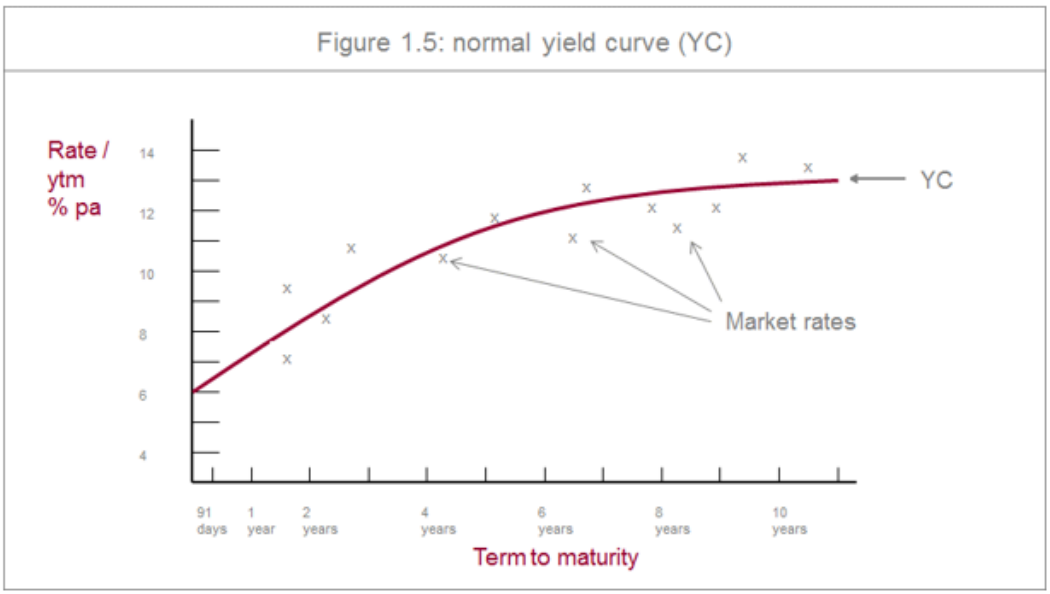
The motivation for short-selling is to profit from a decline in price. It is based on an expectation that the spot price of the security will fall after the spot sale, and the seller will be able to purchase the security at a lower price. There are two risks to consider in short-selling:

- If the spot price of the security rises, the short-seller will make a loss.
- If the liquidity of the market (high turnover in a market means good or efficient price discovery) deteriorates after the spot sale, it may be difficult to purchase the security, with price implications.

1.9 INTEREST RATES

Interest rates have their genesis in the money market, starting with the repo rate. The repo rate is made effective by the existence of a liquidity shortage (borrowed reserves) condition, which in South Africa is a permanent feature of the financial landscape. The repo rate in the context of South Africa's money market, is the rate at which the central bank lends to commercial banks The repo rate has an almost direct influence on the bottom end of the yield curve, which may be depicted as in Figure 1.5.

Figure 1.5: normal yield curve (YC)



The yield curve is a representation of the relationship between interest rates and term to maturity. The money market is represented in the lower end of the yield curve and the bond market the part after one year to maturity. Thus, the bond market can be seen to be an extension of the money market.

1.10 THE DERIVATIVES MARKET

The word “derivative” means that the product that it describes is “derived” from something. The “something/s” are financial market instruments and indices (i.e. indices of prices and interest rates) of financial instruments. This means that the derivatives cannot exist on their own, i.e. they piggyback on the ordinary financial market instruments or indices. However, it must be rapidly added that there are derivatives that piggyback on other derivatives. Examples are options on futures and options on swaps.

Derivatives are contracts between two parties to buy, sell or exchange (optional or obligatory) a standard or non-standard quantity and quality of an asset or cash flow at a pre-determined price on or before a specified date *in the future*. In other words, the settlement dates for derivatives are on dates other than spot settlement dates. The value of the underlying security or index (the spot market instrument that underlies the derivative) changes continuously, and this means that the value of the derivative almost always also changes. For example, the value of a future on a share index changes as the index changes in value. Also, the value of an option on a bond changes because of the rate (i.e. the yield) on the secondary market.

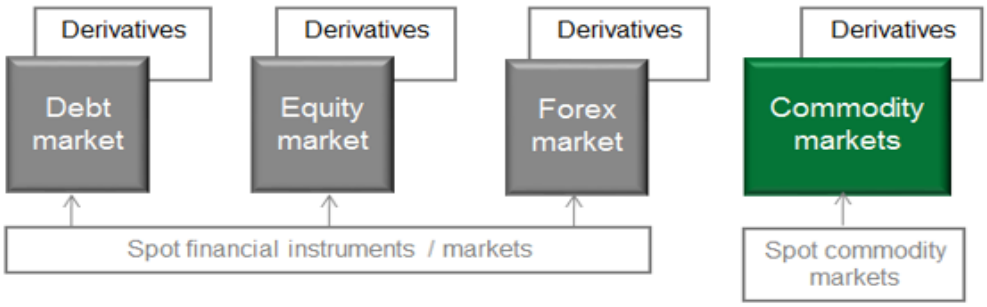
The terminology of the derivatives market can be confusing (caps, floors, collars, options, futures, options on futures, FRAs, repos, swaps, swaptions, and the like), and this leads to the need to categorise these markets in a sensible fashion.

The derivatives market may be broadly categorised according to:

- Commodity derivatives market.
- Financial derivatives market.

The term *financial* or *financial markets* refer to the debt, equity and forex markets. Thus, we can depict the derivatives market as shown in Figure 1.6.

Figure 1.6: spot and derivative markets



This broad categorisation makes sense because there is a fundamental difference between these markets in terms of underlying assets and market turnover. The underlying assets in the commodity derivatives market are various, such as gold, maize, oil, etc., which are fundamentally different to the financial assets or notional financial assets that underlie financial derivatives. Turnover on the latter market dwarfs the turnover on the former.

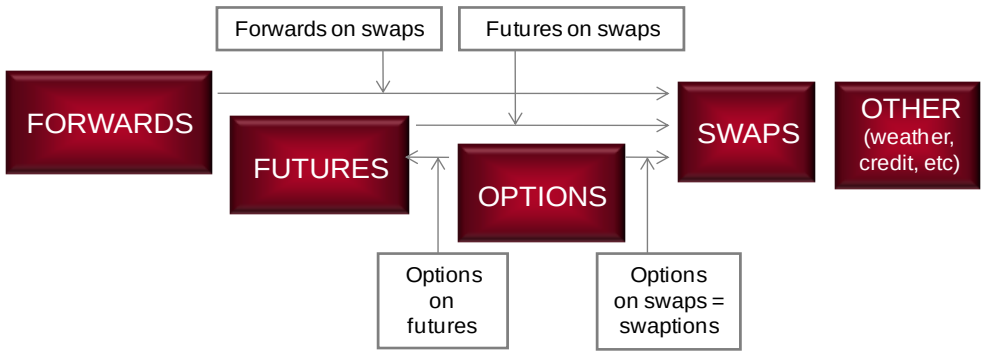
However, there is much overlap in terms of the types of derivatives that are found in both markets. For example, in both market types forwards, futures, options, and swaps are to be found.

It may also make sense to categorise these markets according to whether they are:

- Formalised markets (i.e. exchange traded), as opposed to
- Informal markets (i.e. OTC).

For example, there are *formalised markets* in futures and options on futures; and there are *informal OTC markets* in forwards, interest rate caps and floors, forward rate agreements, interest rate and currency swaps, etc. However, this is not the ideal categorisation because there are derivatives that have feet in both the formal and the OTC markets (for example forward rate agreements).

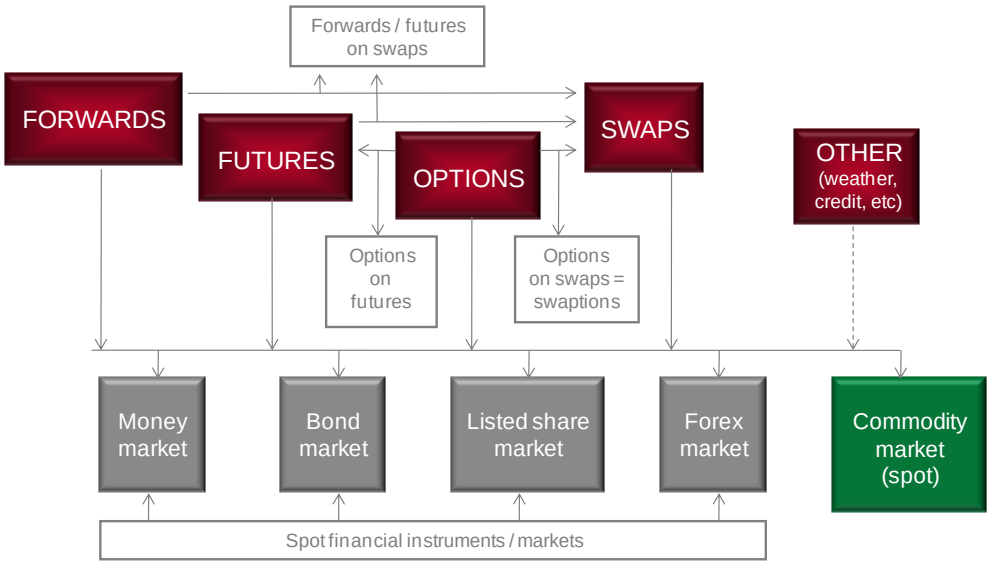
Figure 1.7: derivative instruments / markets



Another way in which one may categorise derivatives is according to the broad types of derivatives: *forwards, futures* (which are similar), *options* (which include options on futures and swaps), *swaps*, and *other* (such as credit and weather derivatives). This classification may be depicted as in Figure 1.7.

However, this is not ideal because there is a need to relate them to the spot (cash) markets. This is shown in Figure 1.8. This illustration is also not ideal because it cannot capture the finer distinctions of the derivatives market (for example forwards do not apply to all the markets). Table 1.3 provides the detail of the derivatives and how they relate to the spot markets.

Figure 1.8: derivatives & relationship with spot markets



Even the classification offered in Table 1.3 is not fool proof, because further explanation is required in some cases to make it absolutely clear. This type of information cannot be captured in an illustration or a table; it requires explanation.

However, Figure 1.8 and Table 1.3 do provide an overarching view of the types of derivative instruments and provide a logical framework for discussion. Taking the above as a cue, the following chapters are arranged as follows:

- Forwards.
- Futures.
- Options.
- Swaps.
- Other.

TABLE 1.3: SPOT MARKETS AND DERIVATIVE INSTRUMENTS

	Spot markets			
Derivatives	Debt market	Equity market	Forex market	Commodity market
Forwards	Yes	Yes	Yes	Yes
Futures	Yes	Yes	Yes	Yes
Options:				
Options on "physicals"[1]	Yes	Yes	Yes	Yes
Options on futures	Yes	Yes	Yes	Yes
Options on swaps	Yes	Yes	Yes	Yes
Warrants[2]	Yes	Yes		
Caps and floors	Yes			Yes
Swaps[2]	Yes	Yes	Yes	Yes
Other:				

Credit derivatives[3]	Yes			
Weather derivatives[3]				
Other (Freight, Energy, etc.)				
1. The actual spot market instruments and indices. 2. Requires explanation (done later). 3. Do not apply to specific financial or commodity markets.				

Each of the derivative instrument groups will be discussed in some detail in this document and, where applicable, we cover the following detail:

- The product/s.
- The mathematics.
- The applications.
- Organisation of the market.
- Participants.
- Clearing and settlement.
- The situation in South Africa at present.
- Variations on the theme.

1.11 REVIEW QUESTIONS AND ANSWERS

Self-test questions

1. Financial markets consist of four distinct markets: the debt markets, the equity market, the foreign exchange market and the derivatives market. True or false?
2. Prices in derivatives markets are not as volatile as prices in spot markets. True or false?
1. Derivatives are found in both formalised (exchange) markets and informal (OTC) markets. True or false?
3. Define a 'derivative'?

Answers

1. False. Derivatives are found in all the financial markets and it is not a market on its own.
2. False. Derivatives derive their values from that of the underlying instruments and will therefore reflect the changes in the prices of the latter.
3. True.
4. Derivatives are contracts between two parties to exchange a standard or nonstandard quantity and quality of an asset or cash flow at a pre-determined price at a specified date in the future.

CHAPTER 2

FORWARDS

2.1 CHAPTER ORIENTATION

CHAPTERS OF “THE DERIVATIVES MARKET”	
Chapter 1	The derivatives market in context
Chapter 2	Forwards
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2.2 LEARNING OUTCOMES OF THIS CHAPTER

After studying this chapter, the learner should / should be able to:

- Understand the characteristics of forward markets.
- Understand the essence and mechanics of forward contracts / instruments.
- Understand the mathematics of the forward markets.
- Calculate a forward price.
- Know the advantages and disadvantages of forward markets vis-à-vis futures markets.
- Understand the organisational structure of the forward markets.

2.3 INTRODUCTION

The largest market in the category *forward markets* is the *forward foreign exchange market*. But there are also other forward markets, such as forward markets in interest rate products and commodities. An understanding of forward markets is required to understand futures, as they were the forerunners of futures markets.

The following are the sections covered in this chapter:

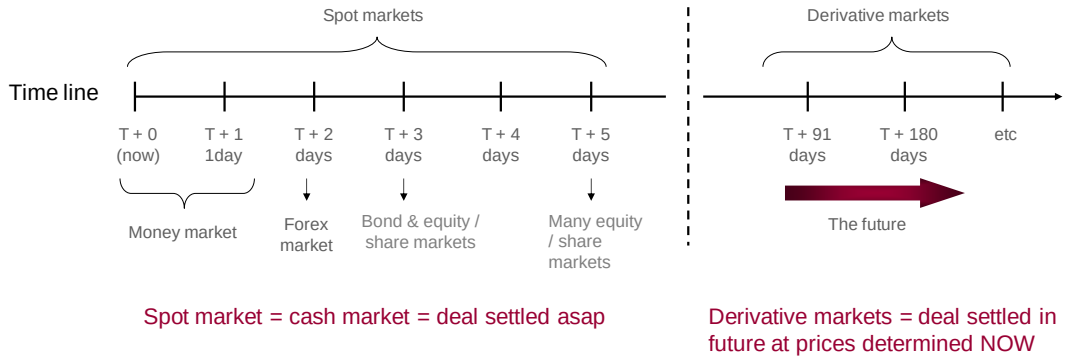
- Spot market.
- Introduction to forward markets.
- A simple example.
- Forward markets.
- Forwards in the debt markets.
- Forwards in the foreign exchange market.
- Forwards in the commodities markets.
- Forwards on derivatives.
- Organisation of forward markets.
- Summary.
- Review questions and answers.

2.4 SPOT MARKET

The spot market is also called the “cash market”, and it refers to transactions or deals (which are contracts) that are settled at the earliest opportunity possible. For example (see Figure 2.1), in the money market a spot deal is where securities are exchanged for payment (also called *delivery versus payment*) on the day the deal is struck / transacted (T+0) or the following day (T+1).

In the South African bond and equity markets a spot deal is a deal done now (day T+0) for settlement in 3 days’ time (T+3). This means that equity trades on the Johannesburg Stock Exchange (JSE) are settled three business days after the transaction date, a standard known as T+3. This settlement period replaced the older T+5 cycle in July 2016, aligning with international best practices. However, some equity markets globally operate on a T+2 basis.

Figure 2.1: settlement in spot / cash markets & derivative markets



The number after the "+" sign is determined primarily by convenience. In the money market it is convenient to settle now or tomorrow, because the market is of a wholesale nature and the securities are kept in safe custody by banks in large metropolitan areas, or in a securities depository, or are dematerialised. In the equity market many individuals are involved that are spread across the county, making it necessary to allow time for the securities to be posted or sent to the exchange. This of course changes with dematerialisation / immobilisation[3].

The process of dematerialisation, where physical securities are converted into electronic form, has greatly enhanced the efficiency and security of the spot market in South Africa. With dematerialised securities held electronically in central securities depositories like Strate, settlement processes have become much faster and less prone to risks such as loss, theft, or forgery. This transition to electronic records also minimises logistical challenges and supports the T+3 settlement cycle in the equity markets by allowing for quicker and more secure transactions. Moreover, dematerialisation aligns South Africa's financial practices with global standards, making its markets more accessible and attractive to international investors.

[3] *Dematerialisation* means that scrip (physical certificates) no longer exists, while *immobilisation* means that scrip exists but is placed in a scrip depository which holds them on behalf of the investors (usually this means one certificate).

A spot deal may thus be defined as a contract between buyer and seller, undertaken on T+0, for the delivery of a security by the seller to the buyer and payment by the buyer to the seller to complete settlement of the deal at time T+0 or T+ a few days, depending on convenience.

2.5 INTRODUCTION TO FORWARD MARKETS

Like a spot deal, a forward deal is a deal done now (T+0) at a price agreed now. However (and this is the difference), the settlement date is *not* a few days after T+0 as in the case of spot transactions, but usually a month or a few months after T+0 (see Figure 2.1).

The motivation for such a deal is usually that the *spot price* that will prevail in the future is uncertain. A forward deal removes the spot price uncertainty.

The best way to describe a forward deal is with an example. Consider a wheat farmer. He plants his crop now and expects to reap the harvest in 3 months' time. He knows the input cost, but he does not know what spot price he will get for his harvested wheat in 3 months' time. Thus, he is faced with (spot) price risk (uncertainty). The solution to his risk is a forward (or futures) market that will enable him to sell his wheat forward, in other words he would like to deal now (T+0) at a price agreed now (T+0) for delivery of the wheat in 3 months' time (T+ 3 months) when he will be paid.

A forward deal in the financial markets is the same except that the instrument dealt in:

- has a term to maturity and
- may have an income (dividend on a share / interest on a bond).

A spot deal on a 3-month financial asset may be depicted as in Figure 2.2. A forward deal is where the price or rate on an asset is determined now for settlement at some stage in the future. *Some stage* means *other than spot*. A 3-month forward deal on a 3-month asset may be depicted as shown in Figure 2.3.

Figure 2.2: spot deal on T+0 on 3-month asset

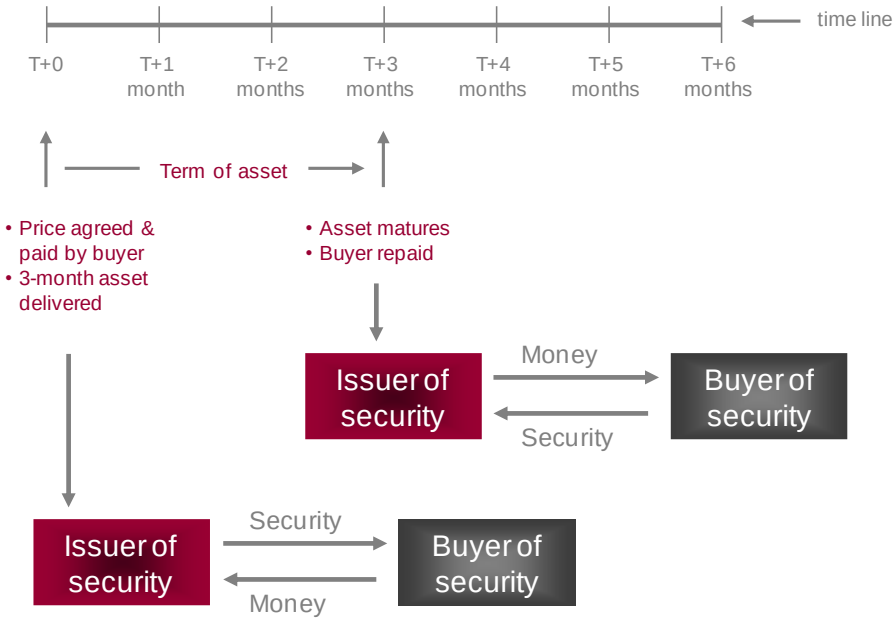
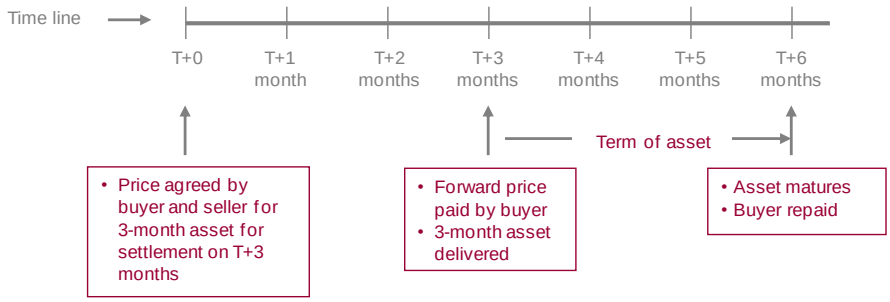


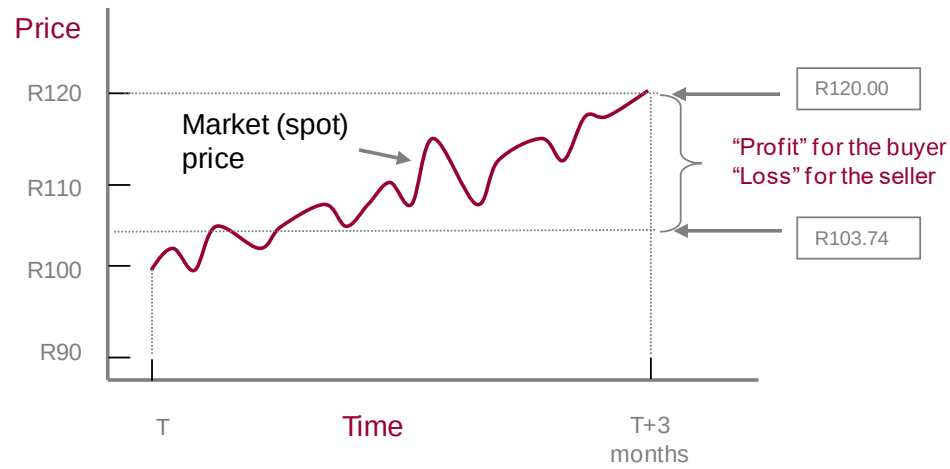
Figure 2.3: forward deal on 3-month asset (settlement in T+3 months)



2.6 A SIMPLE EXAMPLE

A forward contract is an agreement between a buyer and a seller where the seller agrees to deliver, and the buyer agrees to accept, a specified quantity and quality of an asset at a predetermined price (set now) on a future date. This example will help clarify how a forward contract works (see Figure 2.4)

Figure 2.4: example of a forward deal



Scenario:

On 18 September 2022 (T+0), the spot price of a ton of maize is R100. A food factory (the buyer) uses maize as a key ingredient in its products and anticipates that the price of maize will rise significantly in the next three months due to a forecasted drought. To secure its production costs, the factory decides to lock in the price now for maize that it needs in three months.

The farmer (the seller), however, expects the price of maize to drop due to expected rainfall. He proposes a forward price of R103.74 per ton for delivery on 18 December 2022 (T+3 months). This price includes the cost of carrying the maize, considering the interest rate on a loan used to finance maize production.

The forward price is calculated using the cost of carry model:

FP = SP x [1 + (ir x t)]

where

FP = forward price

SP = spot price

t = term, expressed as number of days / 365

ir = interest rate per annum for the term (expressed as a unit of 1)[4]

$$FP - SP \times \left[1 + \left(\frac{ir \times t}{365}\right)\right]$$

FP = R100 x [1 + (0.15 x 91 / 365)]

= R100 x (1.037397)

= R103.74.

[4] The interest rate represents the cost to the farmer of holding a stock of maize, referred to as the "cost of carry". As we will show later, the rate used in calculations of the fair value price (FVP) of forwards / futures in the risk-free rate (rfr).

Both parties sign the forward contract (see Box 2.1).

BOX 2.1: SIMPLIFIED FORWARD CONTRACT	
FORWARD CONTRACT 18 September 2022 Agreement: The Food Factory agrees to buy, and Mr Farmer agrees to sell, one ton of maize on 18 December 2022 at a price of R103.74. Signed ……	……
Mr Farmer	Mr Consumer

On 18 December 2022:

Due to the anticipated drought, the spot price of maize has risen to R120 per ton. The food factory pays R103.74 as per the contract and receives the maize. The financial outcomes are as follows:

- Food Factory: The factory benefits from paying R103.74 instead of the current spot price of R120. By securing the lower price, the factory manages to keep production costs stable and avoid the risk of higher costs, leading to savings of R16.26 per ton (R120 - R103.74).
- Farmer: The farmer could have sold the maize for R120 but instead sold it for R103.74. However, the farmer's profit is still positive. If the production and carrying costs amount to R95, the farmer makes a profit of R8.74 (R103.74 - R95), although less than the potential profit of R25 (R120 - R95) without the forward contract.

Had it rained and the supply of maize increased, the price would most likely have fallen. If we assume the spot price had fallen to R90 per basket on 18 December, the farmer is better off (received R103.74 as opposed to R90),

whereas the buyer is worse off (paid R103.74 as opposed to R90 had he not done the forward deal).

It is important at this stage to attempt to analyse the *advantages and disadvantages* of forward markets. The main *advantages* that can be identified are:

- Flexibility regarding delivery dates.
- Flexibility regarding size of contract.
- Provides price certainty
- Provides protection against price volatility

The disadvantages are:

- The transaction rests on the *integrity of the two parties*, i.e. there is a risk of non-performance.
- Both parties are "*locked in*" to the deal for the duration of the transaction, i.e. they cannot reverse their exposures.
- *Delivery* of the underlying asset took place, i.e. there was no option of settling in cash.
- The *quality of the asset* may be different to what is expected.
- *Transaction costs are high* (for example, the consumer visits the farmer at least twice, has a lawyer to draw up the contract, etc.).

2.7 FORWARD MARKETS

Futures markets developed out of forward markets because of the disadvantages of forward deals. However, forward markets do still exist, and this is because of their advantages as mentioned above and the *lack of the disadvantages mentioned above in some markets*.

The following will make this clear:

- Flexibility regarding delivery dates.
- Flexibility regarding size of contract.

- The transaction rests on the integrity of the two parties, but this is not a problem in certain markets where the participants are substantive in terms of capital and expertise (e.g. the forex market).
- Both parties are “locked in” to the deal for the duration of the transaction, but in certain markets they can reverse their exposures with other instruments (e.g. futures in the forex market).
- Delivery of the underlying asset is the purpose of doing a forward deal in most cases (i.e. the client does not want the option of settling in cash) (e.g. forex market).
- The quality of the asset does not vary in many cases (e.g. forex market).
- Transaction costs are not high in certain markets (e.g. forex market because of high degree of liquidity).

As will have been guessed, the largest forward market is the forward foreign exchange market. In addition, forward markets exist in the debt market, the equity market and in the commodities market. This means that there are forward markets in all the financial markets.

In addition to the forwards that exist in all the financial markets there are also forwards on one of the derivatives, i.e. swaps. The forward markets are discussed under the following sections:

- Forwards in the debt markets.
- Forwards in the equity market.
- Forwards in the foreign exchange market.
- Forwards in the commodity markets.
- Forwards on derivatives.

2.8 FORWARDS IN THE DEBT MARKETS

2.8.1 Introduction

The forward market contracts that are found in the debt markets are:

- Forward-forward interest rates.
- Forward rate agreements.

- Repurchase agreements.

2.8.2 Forward-Forward interest rates

Forward-forward interest rates are prices which pertain today to deposit periods commencing in the future. The calculated forward-forward interest rate is also referred to as the implied forward rate.

Derivation of forward-forward rates

How can you tell today what 3-month interest rates are going to be in, say, 3 months' time? The answer is you cannot say with any certainty what will happen to rates over the next three months. However, it is possible to fix a rate now which actively applies to funds traded three months forward.

If a dealer borrows money for three months and lends the same amount of money for six months, then the dealer has a short position in three months funds in three months' time.

From this information, it is possible to establish the rate at which the dealer is short of funds for three months starting in three months' time.

Assume that the dealer borrows the funds at 6%p.a. for three months (91/365). Assume also that they lent the same amount of funds for six months at a rate of 7%p.a.(182/365). What the dealer wishes to determine is the interest rate at which they borrow, principal plus interest, after three months for the remaining three months to break even. This rate is described as the break even or 'no arbitrage' rate.

We can calculate the implied forward-forward rate as we know the following:

- Rate for the six-month period
- Number of days in the six-month period
- Rate for the first three-month period
- Number of days in the first three-month period
- Number of days in the second three-month period.

The formula for finding the forward rate is as follows:

FFR = $\{[1 + (ir_L \times t_L)] / [1 + (ir_S \times t_S)] - 1\} \times [365 / (t_L - t_S)]$

where

FFR = forward-forward rate
ir_L = spot interest rate for the longer period (182 days)
ir_S = spot interest rate for shorter period (91 days)
t_L = longer period, expressed in days/365) (182/365)
t_S = shorter period, expressed in days/365) (91/365)

FFR = $\{[1 + (0.07 \times 182/365)] / [1 + (0.06 \times 91/365)] - 1\} \times 365/(182-91)$
= $[(1.03490 / 1.01496) - 1] \times 365/91$
= $(1.01965 - 1) \times 365/91$
= 0.07882×100
= 7.882%p.a.

This is the rate at which the dealer has effectively lent funds for three months starting in three months' time. This forward period is known as a 3x6 "gap" (starting three months forward, ending six months forward).

To break even, the dealer will have to borrow three-month funds at this rate in three months' time, or lower to make a profit.

Looking at a practical example using an actual value

The dealer lends 10m at 7% for 182 days results in interest receivable of: R349,041.10 and;

borrows 10m at 6% for 91 days results in interest payable of:

R149,589.04

The difference in interest that needs to be paid for break-even is R199,452.06

(349,041.10 less 149,589.04)

To calculate the fair value interest rate for the remaining 91 days, the rate calculated must utilise the capital plus interest after the first 91 days to achieve

the amount repayable at the end of 182 days. This fair value rate is calculated as follows:

199,452.06/10,149,589.10 x 365/91 = 0.07882 x 100 = 7.882%

7.882% is the rate at which the dealer would need to borrow the principal plus interest after the first three months to break even.

Simply put, the total amount of funds at the end of the six-month period should be the same, regardless of whether the funds have been on deposit for the whole of the six months, or for two separate three-month periods. The calculation also compounds the two three-month rates - it assumes all the funds payable at the end of the first three months are reinvested at the currently unknown rate.

Using the forward interest rate market.

A lot of customer-based business takes place in the future. For example, many corporations fix their borrowing in advance for rolling credit facilities. Another reason for exposure to future interest rates is mismatched dealing - where institutions have lent and borrowed in different periods and find themselves with a “maturity gap”. This is most common with commercial banks.

Financial institutions with future commitments have several choices in covering these positions:

- wait until the start of the transaction
- use the forward-forward market

If a dealer leaves a forward position uncovered, they run the very real risk that the markets will move against them and they will make a loss on that position. If the dealer agrees, for instance, to lend in three months’ time at a rate agreed now, based on the current interest rates, they may find they has to pay more than the agreed rate to fund the loan in three months’ time.

If they agree to take a deposit in the future, the rate they can achieve when lending it out may be lower than the rate they have agreed to pay the depositor.

If they use the forward-forward market, they can “lock in” their rate now, to cover future positions. A bank dealer can quote customers based on the rate which they know they can achieve, thereby making sure of their margins of profit at the outset.

Another use of the forward-forward market is for speculative purposes. Some institutions are prepared to “take views” on future interest rate movements. If a dealer is speculating on rates falling in future, they may go “short” of a forward period and cover the position in the future when rates have fallen.

However, there are drawbacks to using the forward-forward market.

- Any physical cash transaction inflates the balance sheet
- Full capital adequacy requirements apply
- Full credit line implications apply
- Cash market spread implications
- Loss of liquidity
- Market risk

These considerations make the forward-forward market unattractive to speculators and hedgers alike.

The preferred route for dealing in future interest rates is using the derivative market.

A forward rate agreement (FRA) is the most actively used short-term interest rate derivative traded for this purpose.

2.8.3 Forward Rate Agreements

A forward rate agreement, known generally as an FRA, is an agreement between two counterparties - a buyer and a seller - to fix a rate of interest on a ***notional*** amount for a period in the future. On the start of the forward period the FRA rate will be compared to the relevant market benchmark. If the benchmark is above the FRA rate, then the buyer will receive the difference

and vice versa. FRAs are referred to as contracts for difference-CFDs because there is no delivery of the notional value. Only the difference between the FRA rate and the market benchmark is settlement as a cash payment.

Who uses the FRA market?

FRAs are very actively traded OTC contracts to hedge or speculate against the expected path of future interest rates. This is not a market for retail or private clients of the banks. The major participants in the market are:

- **Banks** – banks as borrowers and lenders of money are active market makers in FRAs quoting bids and offers both to the interbank market and their corporate clients.
- **Corporate borrowers** – with floating rate commitments exposed to interest rates rising, they will be buyers of FRAs
- **Investment funds and lenders** - with floating rate commitments exposed to interest rates falling, they will be sellers of FRAs
- **Speculators -** FRAs are used by speculators to benefit from their view on interest rates.

FRAs as market indicators of anticipated changes in the bank rate

Economist will often refer to the FRA yields as a strong indicator of the anticipated move by the SA Reserve Bank on the repo rate at the bi-monthly monetary policy committee meetings.

Dealing in the FRA market

FRA prices are quoted as interest rates in the same way that deposits are quoted.

There are conventional trading periods for FRAs, however the market will trade in any period providing counterparties can be found.

The most common forward period for Rand FRAs is three months and in the overseas markets they are quoted for 1-, 3-, and 6-month forward periods.

The benchmark rate for FRAs

The JIBAR benchmarks for 1, 3, 6 and 12months' are fixed at 11.00am CAT and published every day by the Johannesburg Stock Exchange. The 3-month JIBAR rate remains the dominant benchmark used for Rand FRA and Interest rate swap contracts.

The table below is a typical example of a banks screen quotes:

ZAR FRAs

Period	Bid	Offer
1x4	9.25	9.30
2x5	9.50	9.80.
3x6	9.90	10.10
6x9	10.35	10.45
9x12	10.45	10.55
12x15	10.15	10.25

The Transition from JIBAR to ZARONIA

With ongoing reforms in global benchmark rates, the South African Reserve Bank (SARB) has introduced ZARONIA[5] (South African Rand Overnight Index Average) as the replacement for JIBAR in certain financial contracts. While JIBAR has historically served as the primary benchmark for FRAs and interest

[5] ZARONIA is available for all linear derivatives. The transition from JIBAR to ZARONIA is expected to be completed by the end of 2024, in line with the South African Reserve Bank's efforts to replace interbank-offered rates with more reliable risk-free rates. ZARONIA publication: https://www.resbank.co.za/en/home/what-we-do/financial-markets/south-african-overnight-index-average

rate swaps, ZARONIA, being a risk-free rate, is expected to gradually take over as the preferred benchmark for many financial instruments, particularly those that require a rate free of credit risk.

ZARONIA reflects overnight unsecured lending rates between banks and is seen as a more accurate representation of risk-free borrowing costs. As the South African market transitions, contracts like FRAs, swaps, and floating-rate notes may increasingly reference ZARONIA. The transition is expected to align South Africa's financial market practices with global reforms aimed at enhancing benchmark reliability and integrity.

A summary of the key differences between the ZARONIA and JIBAR is shown below:

	ZARONIA	JIBAR
Credit premium[6]	Near risk-free	Built-in credit premium with a term premium component
Reference	Backward-looking (actual) rate	Forward-looking (expected) rate Various tenors
Reference period[7]	Overnight rate	(one-, three-, six- and 12-month)
Source data	Fully transaction based	Indicative rates
Contributors	Commercial banks with transactions greater than R20m	Only five banks contribute

The Buyer of the FRA

- The buyer is a potential future borrower and exposed to rates rising (short cash in the forward period)

[6] Credit premium: the difference in yield between default-free obligations (e.g. government bonds), and securities issued by entities subject to credit risk, usually stated in terms of basis points

[7] Reference period: the time period over which the term/tenor is applied to calculate the applicable rate

- buying the FRA is like borrowing money at a fixed rate for a future period.
- The buyer will receive the difference between the FRA and the 3-month JIBAR at fixing if the JIBAR rate is above the FRA rate, and pay if the JIBAR rate is below the FRA rate.
- as a hedger, the buyer has eliminated any loss or benefit from a move in the JIBAR rate

A borrowers hedge

A corporate borrower is rolling over their R20 million 3-month commercial paper borrowing today. As a floating rate borrower, they are exposed to interest rates rising, so they decide to buy the 3x6 (91 day) FRA quoted at 10.10% from the banks price in the table above.

Three months' later, 3-Month JIBAR fixes at 10.50%.

The hedge result

- The corporate borrower will roll over the commercial paper at the base rate of 10.50%.
- As the JIBAR fixes above the FRA rate, they will receive the difference of 0.40% which will be paid to their account on the fixing date as a discounted value.
- The hedge has been effective as their net borrowing cost is a base rate 10.10%.

Most corporate borrowers will pay a spread in basis points over the JIBAR rate, and this additional cost is a function of the credit spread that investors require to hold the corporate borrower's paper.

The Seller of the FRA

- The seller is a potential future investor, and is exposed to rates falling (long cash in the forward period).
- selling the FRA is like lending money at a fixed rate for a future period.

- The seller will receive the difference between the FRA and the 3-month JIBAR at fixing if the JIBAR rate is below the FRA rate, and pay if the JIBAR rate is above the FRA rate.
- as a hedger, the seller has eliminated any loss or benefit from a move in the JIBAR rate.

An investor fund hedge

An investment fund is rolling over their R100 million 3-month commercial paper holdings is 6 months' time. As, they are exposed to interest rates falling, they decide to sell the 6x9 (91 day) FRA quoted at 10.35% from the banks price in the table above.

Six months' later, 3-Month JIBAR is fixed at 10.40%.

The hedge result

- The investment fund reinvests in the commercial paper at the base rate of 10.40%.
- As the JIBAR fixes above the FRA rate, they will pay the difference of 0.05% which will be debited from their account on the fixing date as a discounted value.
- Although interest rates did fall, they didn't fall as quickly as expected and net effect of the hedge is that their net investment yield is 10.35%.

Settlement of an FRA

The settlement amount of an FRA is done at the start of the forward period instead of simple interest paid at the end of the notional borrowing period. This is done by discounting the simple interest using the JIBAR fixing rate. The formula is as follows:

FRA settlement = principal x (JIBAR – FRA) x days/365/(1+(JIBAR x days/365)

Using our borrower hedging example above:

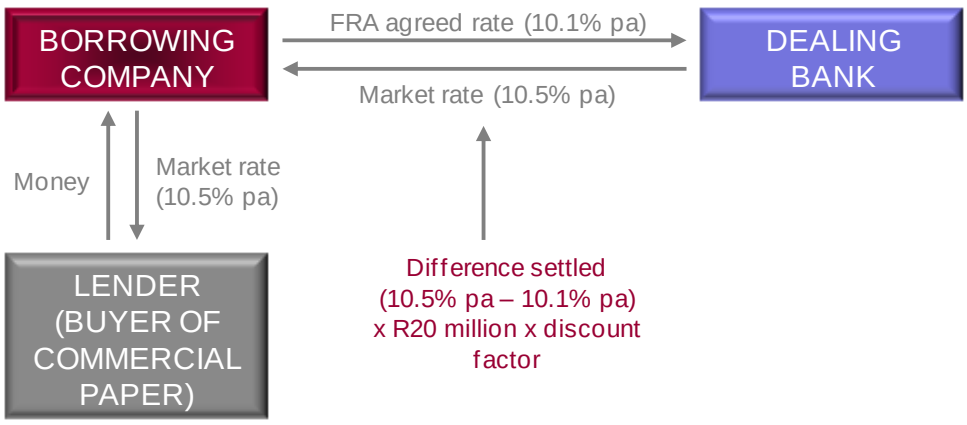
FRA Settlement = 20,000,000 x (0.1050 – 0.1010) x 91/365/(1+(0.1050 x 91/365)

= 19,945.21/1.026178

= 19,436.40 credited to the borrowers account on the fixing date

This transaction is illustrated in Figure 2.10. The exchange of interest on R20 million does not take place; the dealing bank only settles the difference.

Figure 2.10: example of FRA: bank settles difference



2.8.3 Repurchase agreements

Introduction

A knowledgeable student will have noted that the above deal (the OTC FIRC) could have been executed by the insurer by way of the celebrated *repurchase agreement* (repo). The insurer could have bought the NCDs outright and sold them to some other holder of funds under repo for 100 days. Similarly, the bank could have bought the NCDs outright, sold them under repo for 100 days and then sold them outright to the insurer.

In most international textbooks, the repo transaction itself is often not covered under derivative instruments but is rather regarded as a money market instrument. We regard the repo as a derivative because it is *derived* from money or bond market instruments, and its value (i.e. the rate on it) is *derived*

from another part of the money market (the price of money for the duration of the repo).

The repo may also be seen as a combination of a spot and a forward transaction, specifically a spot sale and a simultaneous forward purchase of the same instrument (from the point of view of the seller / maker). The buyer of the repo does a simultaneous spot purchase and forward sale.

The repo may also be regarded as a short-term loan secured by the assets sold to the lender. Another way of putting this is that the repo is similar to a collateralised loan in that the purchaser of the securities under repo is providing funds to the seller and its loan is backed by the securities for the period of the agreement; the lender receives a return based on the fixed price of the agreement when it is reversed.

The repo is discussed in much detail here because it is a versatile instrument and the market in this instrument is vast. The sections we cover here are:

- Definition.
- Terminology.
- Example.
- Purpose of effecting repurchase agreements.
- Participants in the repurchase agreement market.
- Types of repurchase agreements.
- Securities that underlie repurchase agreements.
- Size of repurchase agreement market.
- Mathematics of repurchase agreements.
- Repos and the banking sector.
- Listed repurchase agreements.

Definition

A repurchase agreement (repo) is a contractual transaction in terms of which an existing security is sold at its market value (or lower) at an agreed rate of interest, coupled with an agreement to repurchase the same security on a

specified, or unspecified, date. This definition perhaps requires further elaboration.

Agreement

The transaction note confirming the sale of the security can contain a note stipulating the agreement to repurchase. Alternatively, two transaction notes can be issued, i.e. a sale note together with a purchase note dated for the agreed repurchase date. It is market practice that underlying all repurchase agreements is one of the internationally recognised *Master Repurchase Agreements*.[8]

The key features of the agreements are that[9]:

- Repos are structured as outright sales and repurchases.
- Full legal title to securities and cash is transferred.
- The buyer of the repo has an obligation to return equivalent securities.
- There is provision for initial margin and top-up margin.
- The equivalent of the coupon received from the issuer on a security is paid to the seller on the same day.
- Legal title to collateral is robust, which overcomes doubts when an event of default occurs.

Existing security

The maker of the repo sells a security already in issue to the buyer of the agreement.

Market value

The security is sold at its market value (and sometimes at better, i.e. lower, than market value), to protect the buyer of the repo against default of the

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[8] The SIFMA/ ICMA Global Master Repurchase Agreement (GMRA), is the most widely accepted Master Repo Agreement.

[9] Source: www.euromoneyplc.com

maker/seller. If the seller fails to repurchase the security at termination of the repo, the holder acquires title to it and has the right to sell it in the market. For example, if the value of the securities sold is R9 500 000, the repo is done at a value of R9 450 000, and the interest factor for the period of the repo is R35 000 (total = R9 485 000), the buyer is protected should the maker default.

Agreed rate of interest

The agreed rate for the term of the agreement is the interest rate payable on the repo by the seller for the relevant period. This applies in the case where the maturity date of the agreement is specified. A small number of repos are “open repos”, i.e. both the buyer and the seller have the right to terminate the agreement at any time. The rate payable on these open repos is a rate agreed between the two parties to the deal; the rate may be benchmarked or it may be agreed daily.

Specified maturity date

The specified maturity date is the date when the agreement is terminated. The buyer sells the security / securities underlying the repo back to the maker for the original consideration plus the amount of the interest agreed.

Unspecified maturity date

In the case of an agreement where the maturity date is not specified (the *open* repo), the termination price (original consideration plus interest) cannot be agreed at the outset of the agreement. The rate at which interest is calculated can be fixed or floating but is usually the latter. In the case of a floating rate, as noted, the rate would be an agreed differential below or above a benchmark rate.

Terminology

The terminology related to repo is often confusing to those not involved in the money market. The term *repurchase agreement* applies to the seller of the agreement. He agrees to *repurchase* the security. The buyer of the agreement,

on the other hand, is doing a *resale agreement*. He agrees to *resell* the security to the maker of the agreement.

Synonyms for the repurchase agreement are *buy-back agreement* (point of view of the maker) and *sell-back agreement* (point of view of the buyer). Repurchase agreements are also frequently referred to *warehousing transactions*. The seller is doing a *warehousing transaction* and the buyer is *warehousing* an asset.

Terminology also used by some participants is *repo-in* and *repo-out*. The former is a *resale agreement* and the latter a *repurchase or buy-back agreement*. Both makers and buyers, however, sometimes use the word *carry*. The maker would say he is having securities *carried*, while the buyer would say he is *carrying* securities.

The terminology used by the Reserve Bank in its accommodation procedures and open market operations is also a challenge. The Reserve Bank accommodates the banks by doing *repos* at the *repo rate*. What the Reserve Bank is actually doing is *resale agreements* with the banks. The banks are doing *repurchase agreements* with the Reserve Bank.

At times the Reserve Bank sells securities to the banks to “mop up” liquidity, i.e. to increase the money market shortage. It refers to these as *reverse repos*. In fact, they are not reverse repos from the Reserve Bank’s point of view; they are *repos*.

Similarly, when the Reserve Bank sells foreign exchange to the banks to “mop up” liquidity, it says it does *forex swaps* with the banks. This is true, but the transactions may be seen to be repurchase agreements with the banks in foreign exchange at the money market rate, less the relevant foreign interest rate for the term of the repo. This is discussed in detail later.

Most participants and certainly the central bank mainly use the term repo, and we will acquiesce in this regard, but use the correct terminology where appropriate to avoid confusion.

Example

Figure 2.6: example of repo

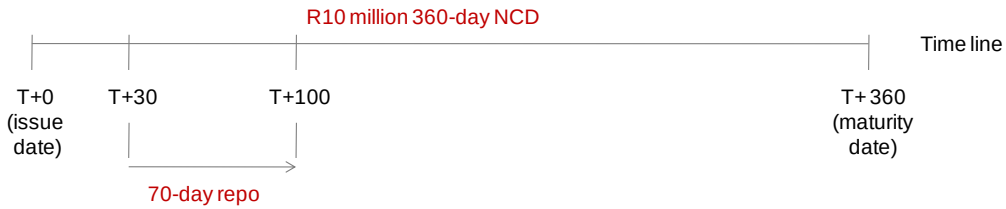


Figure 2.6 provides an example of a repo deal. A bank has in portfolio a R10 million NCD of another bank that it is holding to make a capital profit when rates fall. The NCD had 360 days to maturity when it was purchased. It is now day 30 in the life of the NCD (i.e. it has 330 days to run), and the bank needs funding for a particular deal that has 70 days to run. The bank sells the NCD to a party that has funds available for 70 days under agreement to repurchase the same NCD after 70 days. The rate agreed is the market interest rate for 70 days.

Motivation for repos

One of the main reasons which give rise to repos is best described by way of an example. A client of a broker-dealer may wish to invest R50 million for a 7-day period. If the broker-dealer cannot find a seller of securities with a term of 7 days, he will endeavour to find a holder of securities who requires funds for this period. If the rate for the repurchase agreement can be agreed, the broker would effect a *resale agreement* with the seller of the securities and a *repurchase agreement* with the buyer.

Another way of putting this is that the seller is having the broker *carry* his securities for a period, while the broker is having these same securities *carried* by the buyer for the same period. Another reason which gives rise to repurchase agreements is holders of securities requiring funds for short-term periods.

Yet another transaction that gives rise to a repo is the taking of a *position* in a security. For example, a speculator who believes that bond rates are about to fall (say in the next week) would buy, say, a 5-year bond to the value of, say, R5 million at the spot rate of, say, 9.5% (the consideration of course will not be a nice round amount). He does not have the funds to undertake this transaction but has the creditworthiness to borrow this amount in the view of a broker-dealer. The speculator would thus immediately sell the bond to the broker-dealer (who is involved in the repo market) for 7 days at 10.2% pa (the rate for 7-day money). The broker-dealer in turn would on-sell the bond to, say, a pension fund for 7 days at, say, 10.0% pa.

Assume now that the 5-year bond rate falls to 9.4% on day seven. The broker-dealer unwinds the repo deal and pays the pension fund R5 million plus interest at 10% for 7 days (R5 000 000 x 7 / 365 x 0.10 = R9 589.04). The broker-dealer then sells the bond back to the speculator for R5 million plus interest at 10.2% (R5 000 000 x 7 / 365 x 0.102 = R9 780.82). The broker's profit is 0.2% on R5 million for 7 days (i.e. the difference between the two above amounts (R191.78). The speculator sells the bond in the bond market at 9.4% (remember he bought it at 9.5%). His profit on the 5-year-less-7-days bond is 0.1% (which is probably around R50 000 – we assume this), i.e. the consideration on the bond is R5 000 000 + R50 000 = R5 050 000. His overall profit is thus R50 000 minus the cost of the *carry* (R9 780.82), i.e. R40 219.18. This deal may be depicted as in Figure 2.7 and Figure 2.8.

It will be evident that the speculator sold his bond position to the broker under *repurchase agreement* for 7 days (or had them *carried* for this period). The broker did a *resale agreement* for 7 days with the speculator (or *carried* the bonds), and a *repurchase agreement* with the pension fund (or had the bonds *carried* by the pension fund). The pension fund did a *resale agreement* with the broker or *carried* the bonds for 7 days.

Another rationale for the repo market is the interbank market. This is covered in the following section.

Figure 2.7: cash and security flows at onset of repo

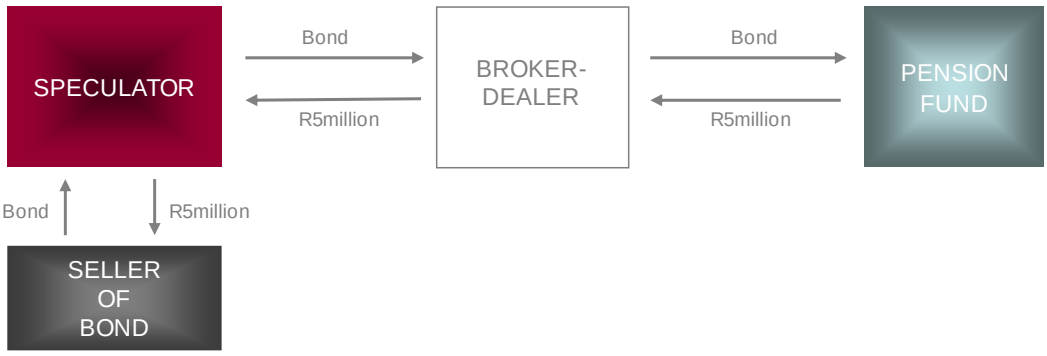
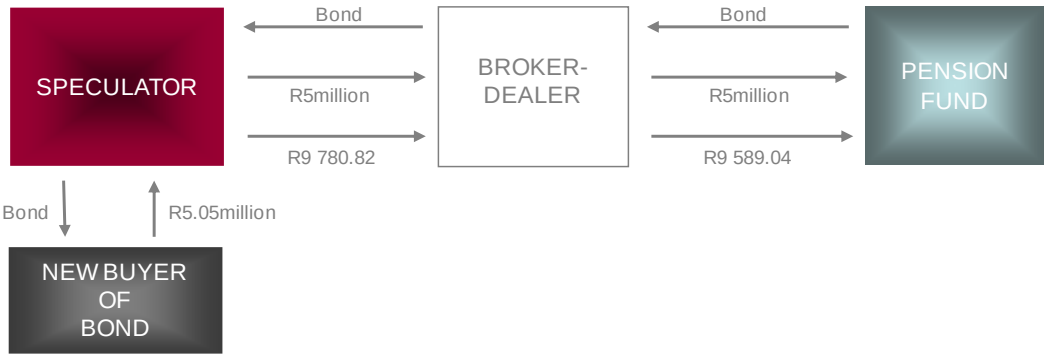


Figure 2.8: cash and security flows on termination of repo



Institutions involved in the repo market

The above are the main reasons that give rise to repurchase agreements, i.e. a party wishing to acquire funds for a period and a party with a matching investment requirement. And there are many strategies that underlie these agreements.

The parties involved in this market are the money market broker-dealers, the banks, corporate entities, pension funds, insurance companies, money market funds, the Reserve Bank, foreign investors, speculators in the bond market, etc.

Of all these institutions, the Reserve Bank and the banks are the largest participants, because the *repo* is the method used by the Reserve Bank to provide accommodation to the banks (see below).

Types of repurchase agreements

As noted earlier, there are two main types of repurchase agreements, i.e. the *open repurchase agreement* and the *fixed term repurchase agreement*. The former agreement is where there is no agreed termination date. Both parties have the option to terminate the agreement without notice. The rate on these agreements is usually a floating rate, the basis of which is agreed in advance.

Fixed term repurchase agreements are repurchase agreements where the rate and the term are agreed at the outset of the agreement. The term of repos usually range from a day to a few months.

Securities that underlie repos

Only prime marketable securities are used in repos, and this includes money market and bond market securities. Repos are usually done at market value of the underlying securities or lower than market value, and the securities are *rendered negotiable*. Securities are rendered negotiable to protect the investor against the maker of the repo, i.e. in the event of the maker reneging on a deal, the investor has the right to sell the underlying securities (in terms of the relevant Master Repurchase Agreement).

What is meant by *rendered negotiable* is that the underlying securities are prepared in negotiable form. For example, a bank acceptance made payable to a particular investor is endorsed in blank. In the case of bond certificates this means that a signed securities transfer form accompanies each certificate.[10]

Size of repo market

It is unfortunate that no data are available on the size of the repurchase agreement market. The market size is estimated to be in the region of R100-R200 billion, i.e. the outstanding value of repurchase agreements at any point is between these numbers. This is not an unreasonable range when it is

[10] Certificates are only applicable in markets where dematerialisation or immobilisation has not been implemented.

considered that the repos between the Reserve Bank and the banks are often close to R60 billion, and that the JSE's bond repo market is in excess of R25 billion (and has spiked to R200 billion).

It should also be recollected that the foreign sector is at times a huge holder of bonds and equities, much of which is *carried* in the local money market. Also, there are many speculators in the local bond market. Proof of this is found in the mammoth turnover in the bond market. It is often contended by some that the South African bond market is one of the most liquid in the world.

Mathematics of the repurchase agreement market

Repurchase agreements are dealt on a yield basis, i.e. the interest rate is paid on an add-on basis. The amount of interest is calculated in terms of the following formula:

IA = C x ir x t

Where:

IA = interest amount
C = consideration (i.e. the market value or lower of the securities)
ir = agreed interest rate per annum expressed as a unit of 1
t = term of the agreement, expressed in days / 365

If, for example, R10 million (nominal value) NCDs with a maturity value of R10 985 000, and a market value of R10 300 000, were sold for seven days at a repo rate of 12.0% pa, the interest payable would be as follows:

IA = C x ir x t

= R10 300 000 x 0.12 x 7 / 365

= R23 704.11.

It should be clear that the buyer (lender of Money) would pay R10 300 000 for the NCDs in the repo and receive R10 323 704.11 upon termination of the agreement from the borrower.

Repos and the banking sector

Because the banks are the largest initiators of repos, and a large slice of the market takes place between banks, it is necessary to afford this sector a separate section.

Because repos are one method through which banks can acquire funding, the Reserve Bank requires banks to report *on balance sheet* all their repos, for purposes of their capital adequacy requirement, i.e. banks are required to allocate capital to this activity (because the asset must be bought back). It will be evident that if a bank brings back on balance sheet securities sold, it must create a liability, and this liability item is termed “loans under repurchase agreements”.

There are many reasons for banks engaging in the repo market. Perhaps the most prominent is that the repo instrument is a convenient method to satisfy wholesale clients’ needs (retail clients do not feature in this market).

All the major banks have Treasury Departments, and this department is the hub of these banks. All wholesale transactions and portfolio planning take place in the Treasury Department. If a large mining house client, for example, would like to purchase R100 million securities that have 63 days to run (because it needs the funds for an acquisition in 63 days’ time and is “full”[11] in terms of its limit for the bank), the bank is able to satisfy the client’s investment requirement by selling R100 million of its strategic holding of government bonds to the client for 63 days.

[11] In terms of credit risk management practices, companies have limits on their exposure to individual banks (and other institutions).

Another example is a small bank losing a R100 million deposit at the end of the trading day, and not being able to negotiate a deposit to fund the shortfall with the non-bank sector. Assuming a large bank has a R100 million surplus, and that this bank does not want to be exposed to the small banks, it may offer the R100 million to the small bank against a repo, i.e. the small bank will sell securities to the value of R100 million to the large bank for a day or two (at the rate for this period). Clearly, if the small bank fails in this period, the large bank has claim to the repo securities.

In South Africa, banks are accommodated by the Reserve Bank effecting repos with them, i.e. the banking sector sells eligible securities to the Reserve Bank under repo. The style of monetary policy adopted in South Africa is ensuring that the banks are indebted to the Reserve Bank at all times (i.e. borrow cash reserves on a permanent basis), to "make repo rate effective". These repos between the banks and the Reserve Bank presently amount to over R56 billion per week.

Listed repurchase agreements

The repo market is an OTC market. However, repos on bonds are widely used instruments. For this reason, a listed repo was created by the JSE in 2004, called a *j-carry,* and it was simply a repo (or *carry*) on a specific bond. The *j-carry* was available on all the listed bonds and had tenors for 1-13 weeks. This instrument was later discontinued, but the market continues in its OTC form. Repo deals are reported on the JSE's electronic trading system, without the JSE assuming risk (repo transactions are subject to bilateral credit arrangements between the two parties).

The mathematics of repos in the case of bonds is similar to that of bond forwards (remember a repo is a *combination of a spot sale and a forward purchase*). The carry rate is applied to the all-in price at the first settlement date

of the deal (called reference price) to determine the price at termination (second settlement date).[12]

2.9 FORWARDS IN THE EQUITY MARKET

There is only one type of forward contract in the equity market, and this is the outright forward. An outright forward is simply the sale of equity at some date in the future at a price agreed at the time of doing the deal. The mathematics (called the cost of carry model) is straightforward:

FP = SP x [1 + (ir x t)]

where

FP = forward price
SP = spot price
t = term, expressed as number of days / 365
ir = interest rate per annum for the term (expressed as a unit of 1).

An example is required: a pension fund believes the price of Company XYZ shares will increase over the next 85 days when its cash flow allows the purchase of these shares. It requires 100 000 shares of the company and approaches a broker-dealer to do an 85-day forward deal. The broker-dealer buys the 100 000 shares now at the spot price of R94 per share and finances them by borrowing the funds from its banker at the prime rate of 12.0% pa for 85 days.

It offers the pension fund a forward deal based on the following (assumption: non-dividend paying share; the calculation for a dividend paying share is introduced later):

SP = 100 000 shares of Company XYZ at R94.0 per share = R9 400 000
t = 85 days
ir = 12.5% = 0.125 (note that it includes a margin of 0.5%)

[12] A calculator for such transactions is provided by the JSE at https://bondcalculator.jse.co.za

FP = R9 400 000 x [1 + (0.125 x 85 / 365)]

= R9 400 000 x 1.029110

= R9 673 634.00.

After 85 days the pension fund pays the broker-dealer this amount for the 100 000 Company XYZ shares, and the broker-dealer repays the bank:

Consideration = R9 400 000 x [1 + (0.12 x 85 / 365)]

= R9 400 000 x 1.027945

= R9 662 684.93.

The broker-dealer makes a profit of R10 949.07 (R9 673 634.00 – R9 662 684.93).

Clearly, the pension fund at the start of the deal is of the opinion that the price of the shares will increase by more than the price of money for the period. Pension funds do outright forward equity transactions because they are not permitted to incur borrowings. The pension fund would also "shop around" to find the best deal.

2.10 FORWARDS IN THE FOREIGN EXCHANGE MARKET

2.10.1 Introduction

Foreign exchange is payments for the proceeds of commercial transactions, deposits and financial transactions in a currency other than the domestic currency, and an exchange rate is an expression of units of a currency in terms of one unit of another currency. An example is USD/ZAR 17.5125, which means that ZAR 17.5125 is required to buy USD 1[13]. The 1 is left out of the expression because it is known to be 1. The one unit currency is called the *base currency* and the other the *variable or quoted currency*.

[13] Many authors prefer to write this example as: ZAR 17.5125 / USD 1.0 or simply as R/$ 17.5125, meaning rand per dollar. Note that with this format the "/" in USD/ZAR is not a mathematical sign but implies the currency on the left is 1 unit in relation to a variable number of unit of the currency on the right.

There are two broad types of deals in foreign exchange, spot and forward, and there are four types of forwards. The five deal types in foreign exchange are:

- Spot foreign exchange transactions.
- Forward foreign exchange transactions:
    - Outright forwards.
    - Foreign exchange swaps (not to be confused with cross currency interest swap).
    - Forward-forwards.
    - Flexi-forwards also referred to as time options. (not to be confused with conventional call and put options).
    - Non-deliverable forwards NDFs

A *spot foreign exchange transaction* is a deal done now (on T+0) for settlement on T+2 (an international convention), and essentially amounts to the exchange of bank deposits in two different countries. Investments or the purchase of goods then occur as a second phase, i.e. the foreign bank deposit is used to buy the foreign investment or goods. A *forward foreign exchange transaction* is a transaction that takes place (i.e. is settled) on a date in the future other than the spot settlement date of T+2, but the price and amount is agreed on the deal date (i.e. now – T+0). This transaction is called an outright forward. This type of forward foreign exchange transaction and the other slight variations on the main theme are discussed in the following section.

Note: some countries use different day-count/annual basis conventions for calculating simple interest. As we will focus on the USD/ZAR, the USD uses ACT/360 and the ZAR uses ACT/365.

2.10.2 Outright forwards

Introduction

As noted, *outright forwards* are forward foreign exchange contracts, i.e. contracts between the market making banks[14] and clients, and may be defined as contracts in terms of which the banks undertake to deliver a currency or purchase a currency on a specified date in the future other than the spot date, at an exchange rate agreed upfront. The formula is:

Outright forward = SP x {[1 + (ir_{vc} x t/db)] / [1 + (ir_{bc} x t/db)]}

where

SP = spot price / exchange rate
ir_{vc} = interest rate on variable currency
ir_{bc} = interest rate on base currency
t = term, expressed as number of days
db = 360 or 365

The above is the standard formula, because most forwards are done for standard periods of less than a year (30-days, 60-days, 90-days, 180-days, etc.).

In calculating the price for the future of a financial instrument or commodity, the cost-of-carry model also holds true for forward exchange rates. The difference being that there are two interest rates that are to be considered. If the rate on the variable currency is higher than the rate on the base currency, then the units of the variable currency will be higher, i.e. it takes more ZAR to buy one USD on a forward date. Conversely, it takes less USD to buy one ZAR on the forward date. An example is called for.

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[14] Most large commercial banks are market makers in both the spot and the forward foreign markets. Market makers quote bid and offer exchange rates simultaneously at all times in response to the approaches of other banks and large corporate treasuries clients.

Example one

Forward period = 60 days
Spot rate = USD/ZAR 17.5000
ir_{bc} = 5.0% pa
ir_{vc} = 10.0% pa
Outright forward rate = SP x {[1 + (ir_{vc} x t)] / [1 + (ir_{bc} x t)]}

= 17.5000x{[1+(0.10x60/365)]/[1+ (0.05 x 60/360)]}
= 17.5000 x (1.016438/1.00822)
= 17.6407 (rounded to 4 decimal places)

Let us test the logic. An investor has the choice of investing in a ZAR 60-day deposit at 10.0% pa or in a USD 60-day deposit at 5.0% pa. In the former case the investor will earn (assuming ZAR 10,000,000 is available to invest):

Forward consideration = present consideration x [1 + (ir_{vc} x 60/365)]

= ZAR 10,000,000 x [1 + (0.10 x 60/365)]
= ZAR 10,000,000 x 1.01643836
= ZAR 10,164,383.60

In the latter case the investor buys the USD equivalent of ZAR 10,000,000 = USD 571,428.57 [ZAR 10 000 000/17.5000)]. The investor immediately deposits this amount for 60 days at 5.0% pa, and sells the USD forward consideration forward for ZAR at the forward rate of USD/ZAR 17.6047

Forward consideration = present consideration x [1 + (ir_{bc} x 60/360)]

= USD 571,428.57 x [1 + (0.05 x 60/360)]
= USD 571,428.57 x 1.008333
= USD576,190.47

The forward exchange rate may be calculated by dividing the ZAR forward consideration by the USD forward consideration:

ZAR 10,164,383.60 / USD 576,190.47 = 17.6407.

In the above example the spot exchange rate was USD/ZAR 17.5000 and the forward exchange rate USD / ZAR 17.6407 (rounded). Thus, the *forward points* (or forward *swap* points) are not quoted as 0.1407 but rather as 1407. This is clarified in the following section on foreign exchange swaps.

Interest Parity Theorem

The interest rate parity theorem states that there is no advantage of going from a low interest rate currency into a high interest rate currency if you hedge the exchange rate risk. The reason being that the forward points are equal to the difference between the interest rates of the two currencies for the period of an investment.

Despite the so-called interest parity theorem, many speculators globally, in particularly hedge funds, have concluded so called ‘carry trades’ where they borrow a low interest rate currency like USD and invest in a high interest rate currency like ZAR. These speculators take on the currency risk believing that the USD/ZAR will not depreciate by more than the interest rate differential for the term of the trade.

Banks often undertake ‘covered interest rate arbitrage’ where they take on no currency risk. This is achieved by converting through a swap a deposit in one currency into a borrowing in the other currency (or vice versa). This then creates a borrowing (or deposit) at a more favourable rate than those currently offered in the money market.

2.10.3 Foreign exchange swaps

Foreign exchange swaps (called *forex swaps* or just *swaps*) A Foreign exchange swap involves two legs; one for the start and one for the end; done with the same counterparty usually in the same base currency or quoted amount. Most swaps are done in the interbank market. Swaps are often done to effect early drawdown or extension of a client’s forward outright deal.

Dealers in the interbank swap market will trade with each other based on the swap points. The dealers agree the spot rate which will be used for the start of the swap. This is usually the mid-rate of the current spot bid/offer in the market.

Swap points

Swaps points are also called forward points and are quoted as whole numbers and not decimals. In calculation the forward outright in the example above, the difference between the forward outright rate 17.6407 and the spot of 17.5000 was 0.1407. Swap traders will quote this as 1407 swap points (the decimal multiplied by 10,000). A forward trader will quote a bid/offer spread around the calculated swap points of 1407. The bid/offer spread may widen or narrow as market conditions dictate. Let us assume that the bank forward FX dealer quotes a bid/offer of 1380/1430 for the 60 day swap. This quote is interpreted as follows:

- The left side (spot + 1380 points) is the rate at which the quoting bank will buy USD in 60 days for USD sold spot now (counterparty buys spot and sells forward to the quoting bank).
- The right side (spot + 1430 points) is the rate at which the quoting bank will sell USD after 60 days for USD bought spot now (counterparty sells spot and buys forward from the quoting).

To get the forward outright bid/offer we add 0.1380 and 0.1430 to the spot respectively.

The following should also be clear:

Forward swap = outright forward – SP
Outright forward = SP + forward swap

Using the numbers from the previous section (example 2):

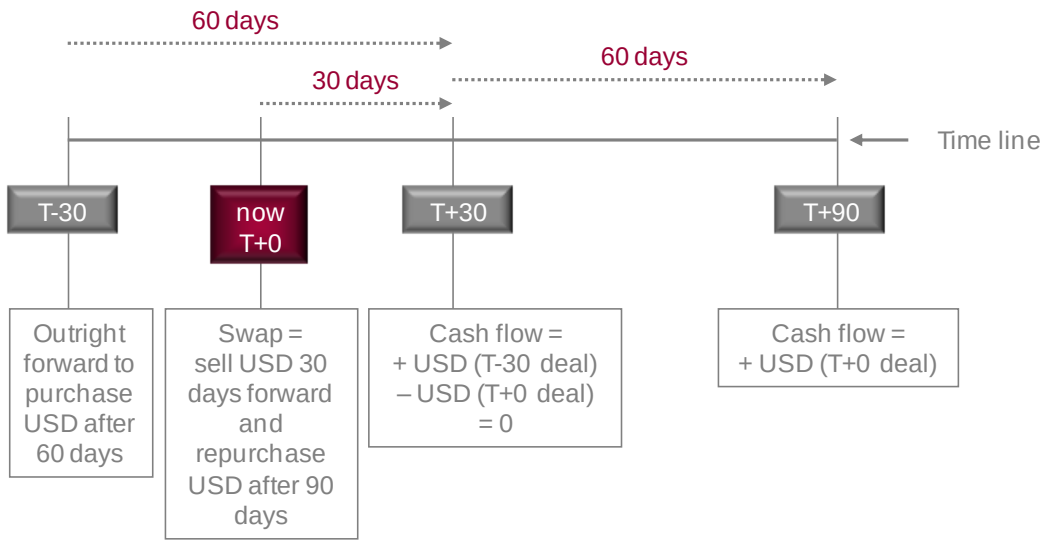
Forward swap = outright forward – SP
= 17.6407 – 17.5000
= 0.1407

Outright forward mid-rate = SP + forward swap
= 17.5000 + 0. 1407
= 17.6407.

2.10.4 Forward-forwards

A forward-forward is a swap deal between two forward dates as opposed to an outright forward that runs from a spot to a forward date. An example is to sell USD 30 days forward and buy them back in 90 days' time. The swap is for the 60-day period *between* 30 days from deal date (now = T+0) and 90 days from deal date. The backdrop to this deal may be that the client (company) previously bought USD forward (30 days' ago for the date 30 days from now) but wishes to defer the transaction by a further 60 days because it will not need the USD until then. This deal[15] is illustrated Figure 2.13.

Figure 2.13: example of a forward-forward deal



Variations of forward-forwards are *foreign exchange agreements* (FXAs) and *exchange rate agreements* (ERAs). Together they are referred to as *synthetic agreements for forward exchange* (SAFEs). The FXA is the same as a forward-forward as explained above, but on the first settlement date, T+30 in our example, the settlement takes place as in the case of a FRA, i.e. in *cash* reflecting the *difference* between the exchange rate set in the outright forward contracted on T-30 and the exchange rate set in the swap on T+0. The

[15] Example adapted from Steiner, R (1998: 7-8)

difference may be a profit or a loss for the client, which of course will be the reverse for the bank. An ERA is the same as an FXA but takes no account of the movement in spot rates between T-30 and T+0.[16]

2.10.5 Time options

As noted above, when a bank does an *outright forward* it is undertaking to buy or sell a specified currency on a specified future date at an exchange rate agreed in the contract. This type of contract does not suit every non-bank client. A client may have a requirement for a hedge but is not sure exactly when forex is required (e.g. an importer), or to be sold (e.g. an exporter). In these cases, *forex time options* are appropriate instruments. This instrument is the same as an outright forward with the maturity date specified, but the client has the option to settle at any time within a specified period. The *specified period* may be anytime during the period of the contract, or anytime between a future date and the expiry date of the contract.

A forex time option is not to be confused with a *currency option* in terms of which the holder has the option but not the obligation to buy (call) or sell (put) a specified currency at a specified strike rate before or on the expiry date. An option premium is payable, which is not the case with a time option.

In the case of a time option, the *holder has the obligation to settle* but has *flexibility in terms of the settlement date*. Time options are often referred as '*flex forwards'* because of the flexibility of the drawdown date.

2.10.6 Functions/uses of the forward foreign exchange market

There are many reasons for the existence of the forward foreign exchange market, but it is essentially used to cover several risks that are encountered by investors and commercial companies that are engaged in importing and exporting.

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[16] See Steiner (1998: 177).

Exchange Control Act

One must bear in mind that any foreign exchange transaction undertaken between a bank and its South African resident clients falls under Exchange Control regulation. Banks will not entertain any speculation by their clients in the forward exchange market, as all transactions must be supported by an underlying commercial transaction. The main uses of the forward market between banks and their clients are:

- Commercial covering.
- Hedging an investment.

The interbank market

The interbank FX swap is very active and large volumes are traded daily both in the short dates - overnight up to 4 weeks - as well as the fixed dates – 1-month up to 12-months. The is table below is evidence of the size of the market for outright forward and swaps as opposed to the volumes in the spot market.

As the banks are responsible for supporting their client needs in multiple currencies, they need to ensure that they meet the necessary cashflows on their various foreign exchange accounts offshore that they have both for spot and for the forward dates. The relationship between the money market and the forward exchange dealers is also critical as forward points are a function of interest rates as has been illustrated.

2.10.7 Size of forward foreign exchange market in South Africa

TABLE 2.2: AVERAGE DAILY TURNOVER IN THE SOUTH AFRICAN FOREIGN EXCHANGE MARKET (USD MILLIONS)				
YEAR	TRANSACTIONS AGAINST THE RAND			TRANSACTIONS IN THIRD CURRENCIES
	Spot	Swaps	Outright forwards	Total

2005	1 513	7 703	580	3 506
2006	2 021	7 968	882	3 344
2007	2 808	8 843	904	3 931
2008	3 218	8 695	865	3 670
2009	2 711	7 419	684	3 439
2010	3 296	8 518	856	3 817
2011	3 543	12 526	1 404	4 667
2012	3 230	10 488	1 243	4 433
2013	3 493	11 862	1 205	4 892
2014	3 294	15 692	1 354	4 720
2015	2 820	12 816	1 564	4 668
2016	2 940	11 239	1 380	5 116
2017	3 168	8 285	1 031	6 655
2018	2 421	6 537	948	5 995
2019	1 876	7 660	1 077	4 203
2020	1 977	7 056	893	3 655
Source: South African Reserve Bank Quarterly Bulletin. N/A = Not available.				

The turnover in 2014 was USD 4 227 408 million or USD 4.2 trillion. This gives a good idea of the mammoth size of the market.

2.10.8 Non- Deliverable forward contracts - NDFs

NDFs are currency contracts for difference (CFDs). They are traded in countries where there is no formal forward exchange market or an illiquid forward market, NDFs can be used for hedging or speculation.

They are like forward outright FX deals where:

- a future rate of exchange is agreed between the parties
- only the DIFFERENCE between the exchange rate fixing at expiry and the NDF contract rate is settled in the convertible currency (the base currency – usually USD) with no settlement of the notional principal.
- If at fixing the prevailing exchange rate is higher than the NDF rate, the seller pays the buyer the difference and vice versa.

An example

A speculator believes the USD/KES will strengthen in the next month. They sell a USD/KES 1,000,000 NDF at an exchange rate of 150 to the bank.

At fixing a month later, the USD/KES fixes at 145. The speculator receives the difference between 150 and 145 settled in USD.

The settlement is calculated as follows: 1,000,000 x 5/145 = USD 34,482.76 paid by the bank to the speculator.

2.11 FORWARDS IN THE COMMODITIES MARKET

Above we have discussed the forward markets in the debt market and the foreign exchange market. There are also forward markets in many commodities, but they will not be discussed here, because the principle remains the same. Only the maths is slightly different because other costs, such as storage (which usually includes insurance), is considered:

$$FP = \{SP \times [1 + (ir \times t)]\} + (SC \times dte)$$

where

FP = forward price

SP = spot price

ir = interest rate for period, i.e. period from now until the forward deal date

dte = days to expiry (of forward contract, i.e. until forward deal date)

t = dte / 365

SC = storage costs.

It will be evident that this is a “carry cost” (CC) model, where there are two costs, interest and storage, and no income on the asset is forthcoming (if income were forthcoming the model becomes a “net carry cost” (NCC) model.

Example: forward grain market: one ton of grain will be delivered to a buyer 91 days from today:

SP (of grain) = R1 200 per ton

ir = 12.0% pa

dte = 91

t = 91 / 365

SC = 35 cents per ton per day

FP = {R1 200 x [1 + (0.12 x 91 / 365)]} + (0.35 x 91)

= (R1 200 x 1.0299) + R31.85

= R1 267.75 per ton.

2.12 FORWARDS ON DERIVATIVES

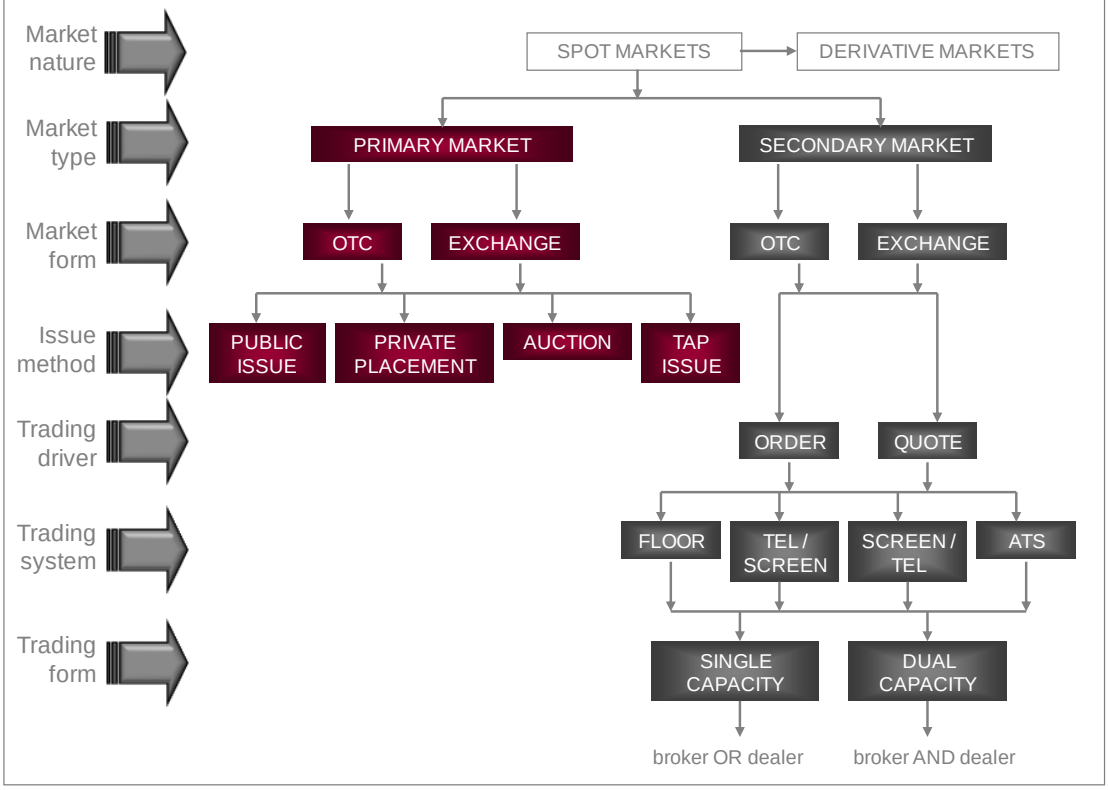
In addition to the forwards that are found in the four financial markets, forwards on swaps also exist.

The specific swaps on which forwards are written are interest rate swaps (IRSs). The forward IRS is an agreement to enter into a swap at some stage in the future at terms agreed upfront. It differs from a swaption (discussed later) in terms of which the holder has the right to allow the option to lapse. In the case of a forward swap, the *holder is obliged to undertake the swap* at the future agreed date (swaps are discussed in some detail later).

2.13 ORGANISATIONAL STRUCTURE OF FORWARD MARKETS

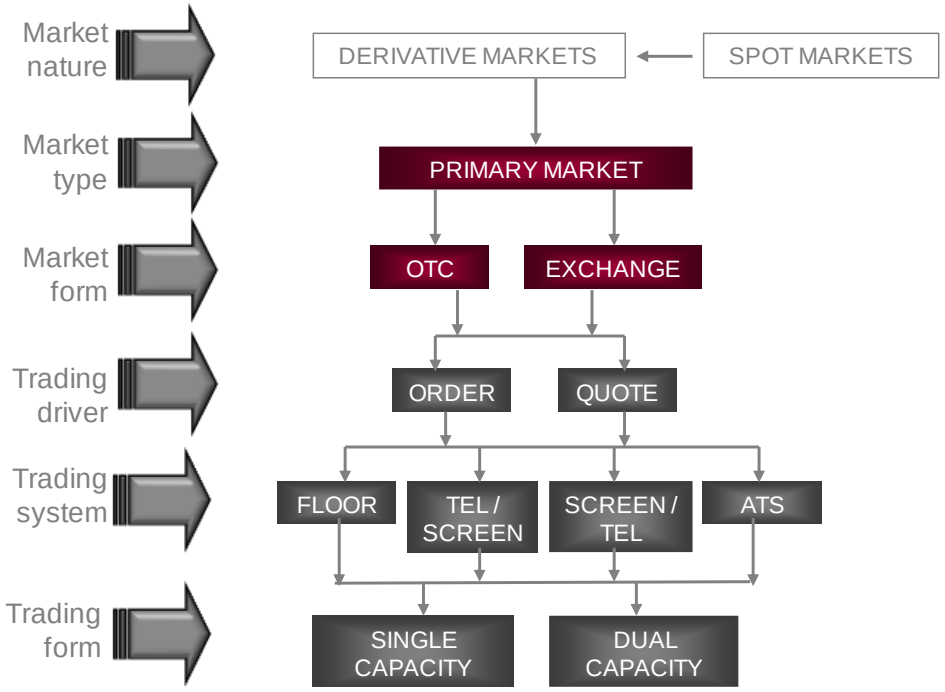
Figure 2.14 is one way of depicting the organisational structure of the spot financial markets.

Figure 2.14: organisational structure of spot financial markets



However, this applies to the “normal” financial markets, i.e. the money, bond and equity markets. It is not well suited to the foreign exchange and derivatives markets. Figure 2.15 is an attempt to visualise the derivatives market.

Figure 2.15: organisational structure of derivative financial markets



The derivatives market in the form of the OTC forward markets are entirely primary markets (there are minor exceptions such as repos that are marketable, but trading in them is rare); thus, generally, one cannot talk of a secondary OTC derivatives market (in the normal sense of the term). The reason for this situation is that the forward market instruments are usually custom made for clients. However, this does not mean that the holder of a forward transaction is “stuck” with the deal until maturity; the instruments are “marketable” in the sense that the positions created by them may be “closed out” quite easily by the purchase / sale of an opposite deal. The “closing out” will result a net loss or profit, as in the case of a spot instrument sale.

The same applies in the case of listed (on an exchange) forwards, but with a difference. A secondary market in these listed instruments also does not exist in the normal sense of the term. However, the contracts are standardised and can therefore be “closed out” by doing an equal but opposite transaction. In the case of the OTC forward markets, it is not always possible to do the exact opposite transaction, leaving thus a measure of risk.

This brings us to the trading driver: quote or order. Participants can get quotes from the banks or place an order with a broker-dealer. “Quote” means that the banks provide quotes (as in market making – explained earlier). This leads to the trading system. In the South African derivatives markets, all the trading systems apply (except “floor”; it does however still apply in some international markets).

The trading system “telephone / screen” means applies where broker-dealers quote indication prices on the screen (for example, the Reuters Monitor System) and clients phone in and ask for firm prices. “Screen / telephone” is where prices quoted on screen are firm for a certain size deal and the deal is consummated on the telephone. ATS stands for “automated trading system” and here deals in the form of orders are inputted into the ATS and are matched by it if there is an opposite order. The various types of forward transactions fit into one of these three trading systems.

Single and dual capacity trading means that the broker-dealers either act as brokers *and* dealers (dual) or as brokers *or* dealers (single).

2.14 REVIEW QUESTIONS AND ANSWERS

Review questions

1. The term 'spot market' refers to derivatives where payments are made in cash. True or false?
2. The motivation for a forward contract is usually that the *spot price* that will prevail in the future is uncertain. True or false?
3. A seller who believes that the price of the underlying asset will decline will enter into a forward contract to deliver the underlying asset. True or false.
4. The forward price can be calculated using the formula: FP = SP/(1 + (ir – t)]. True or false?
5. In a repurchase agreement the seller of the agreement agrees to resell the security at a later date. True or false?
6. A 3 x 6 FRA (3-month into 6-month): the 3 in the 3 x 6 refers to 3 months' time when settlement takes place, and the 6 to the maturity of the FRA deal, i.e. the rate quoted for the FRA is a 6-month rate at the time of settlement. True or false?
7. *Swaps points* are also called *forward points* and are quoted, for example, as 590 / 600. The left side is the rate at which the quoting bank will buy ZAR now for USD for resale after 60 days, and the right hand is the rate at which the quoting bank will sell ZAR now for USD for repurchase after 60 days. True or false?
8. The settlement on a Non-Deliverable Forward contract is the full value of the principal amount at the agreed exchange rate. True or false?
9. Define a forward market.
10. Define a forward contract.
11. What are the main advantages and disadvantages of forward markets?
12. If the 6-month (182 day) interest rate is 8.50% and the 3-month (91-day) interest rate is 8.20% What is the 3x6 implied forward- forward rate?
13. Define a repurchase agreement.
14. A speculator who believes that bond rates are about to fall (in the next week) buys a 5-year bond to the value of R5 million at the spot rate of 10.2%. The speculator sells the bond to a broker-dealer for 7 days at

9.5% pa (the rate for 7-day money). Assume now that the 5-year bond rate falls to 10.1% on day seven and the bond's value goes up by R50 000. What is the profit or loss of the speculator?

15. R10 million (nominal value) NCDs with a maturity value of R10 985 000, and a market value of R10 500 000, were sold for seven days at a repo rate of 12.5% pa. What would be the interest payable on this repurchase agreement?
16. Define a forward rate agreement (FRA).
17. The treasurer of a company decides to deal at the 10.20% pa offer rate for the 6 x 9 FRA for an amount of R20 million, which matches the company's requirement perfectly. The benchmark is the relevant JIBAR rate. On settlement date (at the "6" in the "6 x 9") the benchmark 91-day JIBAR rate is 10.60% pa. How much does the bank that sold the FRA now owe the company?
18. The rate now (spot rate) for 182 days is 9.0% pa and the rate now (spot rate) for 273 days is 10.5% pa, and we know that the latter rate covers the period of the first rate. What is the implied forward rate?
19. Forward period = 60 days

    Spot rate = USD/ZAR 17.5000 (1 USD = 17.5 ZAR)

    Relevant interest rate on a dollar investment = 3.0% p.a.

    Relevant interest on a rand investment = 6.0% p.a.

    What is the price of a 60-day forward outright?

Answers

1. False. The spot market is also called the “cash market”, and it refers to transactions or deals (which are contracts) for the delivery of securities that are settled at the earliest opportunity possible.
2. True.
3. True.
4. False. The correct formula is FP = SP x (1 + (ir x t)).
5. False. In a repurchase agreement the buyer of the agreement agrees to resell the security at a later date.
6. False. A 3 x 6 FRA (3-month into 6-month): the 3 in the 3 x 6 refers to 3 months’ time when settlement takes place, and the 6 to the expiry date of the FRA from deal date, i.e. the rate quoted for the FRA is a 3-month rate at the time of settlement.
7. False. The left side is the rate at which the quoting bank will buy back USD in 60 days for USD sold now, and the right hand is the rate at which the quoting bank will sell USD in 60 days for USD bought now.
8. False. Only the difference between the NDF rate and the fixing rate is settled based on the notional principal. There is never delivery of the principal amount.
9. A forward market is a market (essentially a primary market) where a deal on an asset is concluded now for settlement at a date in the future at a price / rate determined now.
10. A forward is a contract between a buyer and a seller that obliges the seller to deliver, and the buyer to accept delivery of, an agreed quantity and quality of an asset at a specified price (now) on a stipulated date in the future. The main *advantages* that can be identified for forward markets are:
    - Flexibility regarding delivery dates
    - Flexibility regarding size of contract.

    The main *disadvantages* are:

    - The transaction rests on the *integrity of the two parties*, i.e. there is a risk of non-performance

- Both parties are "*locked in*" to the deal for the duration of the transaction, i.e. they cannot reverse their exposures
- *Delivery* of the underlying asset takes, i.e. there is no option of settling in cash
- The quality of the asset may vary
- Transaction costs are high.

11. FFR =((1+(0.0850x182/365))-(1+(0.0820x91/365))-1)x(365/(182-91)

= 0.08624 x 100

=8.624% p.a.

12. A repurchase agreement (repo) is a contractual transaction in terms of which an existing security is sold at its market value (or lower – to protect the buyer) at an agreed rate of interest, coupled with an agreement to repurchase the same security on a specified, or unspecified, date.
13. R40 890.41 [= 50 000 – (5 000 000 x 7/365 x 0.095)]
14. R25 171.23 [= 10 500 000 x 0.125 x 7/365]
15. A *forward rate agreement* (FRA) is an agreement that enables a user to hedge itself against unfavourable movements in interest rates by fixing a rate on a notional amount that is (usually) of the same size and term as its exposure that starts sometime in the future.

16. R19 526.54 = (20 000 000 x 0.004 x 91/365)/(1 + (0.086 x 91/365))
17. FFR = ((1+(0.105 x 273/365))/(1+(0.09 x 182/365))–1) x 365/(273-182)

= 0.1292 x100

= 12.92%p.a.

18. Outright forward rate =17.5000 x (1+(0.06x60/365)/(1+(0.03x60/360))

= 17.5847

CHAPTER 3

FUTURES

3.1 CHAPTER ORIENTATION

CHAPTERS OF "THE DERIVATIVES MARKET"	
Chapter 1	The derivatives market in context
Chapter 2	Forwards
Chapter 3	Futures
Chapter 4	Swaps
Chapter 5	Options
Chapter 6	Other derivative instruments

3.2 LEARNING OUTCOMES OF THIS CHAPTER

After studying this chapter, the learner should / should be able to:

- Define a futures contract.
- Understand the constituents of the definition of futures contracts.
- Understand the payoff (risk) profile of futures contracts.
- Understand the characteristics of the futures market, such as getting out of a position in futures, and cash settlement versus physical settlement.
- Understand the concepts of margins, marking to market and open interest.
- Comprehend the principles applied in the pricing of futures contracts (fair value).
- Calculate the fair value prices of futures contracts.
- Understand the concepts of convergence, basis and carry cost in relation to basis.
- Understand the motivation for undertaking deals in futures, particularly hedging, and the participants in the futures market.
- Comprehend basis and spread trading.

3.3 INTRODUCTION

In the previous chapter on forwards, we defined a forward market as a market where a transaction (buy or sell) on an asset is concluded now (at T+0) for settlement on a date in the future at a price determined now. A forward contract may therefore be defined as a contract between a buyer and a seller at time T+0 to buy or sell a specified asset on a future date at a price set at time T+0. We also identified the advantages and disadvantages of forward markets. We also covered variations on this main theme, such as FRAs, FIRCs and repos.

Essentially, futures contracts are standardised forward contracts, and they developed because forward contracts have some disadvantages, the most obvious one being that forward contracts are difficult (usually impossible) to reverse. There is also a need for efficient price discovery which means that liquidity needs to be enhanced, and this only comes about when activity in the market increases, and in pursuance of this contracts need to be standardised in terms of quality, quantity and expiry date. Once this need is satisfied an exchange is an appropriate market form, and an exchange mitigates risk, which further enhances the breadth and depth of the market.

This does not mean that all forward markets are destined to become futures markets. In some markets reversibility of deals is not crucial and customisation in terms of quantity and expiry is required. The best example is the outright forward forex market where commercial transactions (importing and exporting) require customisation and rarely require reversal.

Futures are discussed in the following sections of this chapter:

- Futures defined.
- An example.
- Trading price versus spot price.
- Types of futures contracts.
- Organisation of futures markets.
- Clearing house.
- Margining and marking to market.
- Open interest.

- Cash settlement versus physical settlement.
- Payoff with futures (risk profile).
- Pricing of futures (fair value versus trading price).
- Fair value pricing of specific futures.
- Basis.
- Participants in the futures market.
- Hedging with futures.
- Basis trading.
- Spread trading.
- South African futures market contracts.
- Risk management by JSE (derivatives divisions).
- Size of futures market in South Africa.
- Economic significance of futures market.

3.4 FUTURES DEFINED

3.4.1 Introduction

A futures contract may be defined as a contractual obligation in terms of which one party to the deal undertakes on T+0 to sell an asset at a price (determined on T+0) on a future date, and the other party undertakes to buy the same asset at the same price on the same future date. This sounds pretty similar to the forward contract.

It is, but the differences are that the contracts are *standardised*, the underlying assets are *standardised*, and the *contracts are exchange-traded*, because these qualities render the contracts marketable (sort of – later we will see that futures are marketable in the sense that they can be “closed out” by undertaking an equal and opposite transaction).

As noted, essentially the futures markets of the world developed to overcome the disadvantages of forward markets. By their very nature, forward markets are OTC markets (mostly), whereas futures markets are all formalised in the form of financial exchanges, the members of which effect all trading, and the

exchange guarantees all transactions by interposing itself between buyer and seller.

The definition of a future may now be extended: a standardised contract which obligates the buyer to accept delivery of, and the seller to deliver, a standardised quantity and quality of an asset at a pre-specified price on a pre-stipulated date in the future.

It may be useful to break up this definition into its constituents:

- Standardised contract between two parties.
- Buyer and seller.
- Delivery.
- Standardised quantity.
- Standardised quality.
- Asset.
- Price.
- Expiry date.
- Market price.

3.4.2 Standardised contract between two parties

Figure 3.1: participants in futures deal

All futures contracts in all international futures markets are standardised. A future is a legal contract between two parties setting out the details: price, expiry date, etc. At least one party to the contract must be a member of the exchange. As noted, even though a client may buy a future from, or sell a future to, a member of the exchange, the transaction is guaranteed by the exchange, i.e. the exchange acts as the seller for each buyer, and as the buyer for each seller:

it interposes itself in each futures deal. This may be illustrated simply as in Figure 3.1.

3.4.3 Buyer and seller

It should be evident that the futures market is a typical example of a “zero sum game”, i.e. for every buyer of a contract there is a seller. Consequently, if the buyer makes a loss, the seller gains by the same amount. The converse is obviously also true. As noted earlier, the buyer and the seller deal with a member of the exchange, unless the buyer and seller are members of the exchange.

3.4.4 Delivery

Even though the standard definition of a future emphasises delivery, in practice this is rare, particularly in the *financial* futures markets. The reason for this is simply that the participants in the futures markets prefer settlement of the profit or loss on expiry date. Even if they wanted delivery, in many cases this is not possible. In the case of a future on an equity index, for example, it is impossible to deliver the index. Nowadays, delivery takes place in only a few financial and commodity futures contracts.

3.4.5 Standardised quantity

Every futures contract obviously has a specific size, as opposed to a forward contract where size is negotiated between buyer and seller. For example, in the case of the equity index futures contracts in South Africa, the size of each contract is R10 x the index value. In the commodities futures markets the contract sizes are usually multiples of standard units, for example, tons, ounces, barrels, bushels, etc.

3.4.6 Standardised quality

This is important in the commodities futures markets, particularly in the case of perishable assets. Quality is obviously not an issue in the case of financial futures markets. In these markets contracts are based on underlying specific assets or notional assets the qualities of which do not vary.

3.4.7 Asset

A futures contract is a derivative instrument, i.e. it and its value are derived from an underlying asset and it cannot exist in the absence of this asset. The underlying assets of futures contracts can be divided into two broad categories, i.e. specific assets and notional assets, and there are various subcategories under each, such as storable assets, perishable assets, income-producing assets, etc. Specific (also called “physical”) assets include specific bonds, pork bellies, etc., while notional assets include indices and interest rates, for example the FTSE/JSE Top 40 Index, the FTSE/JSE ALTX 15 Index, the FTSE/JSE FINI 15 Index, etc.

One may also categorise futures broadly into financial futures and commodity futures, and then split them further into sub-categories as follows:

- Financial futures:
    - Interest rates (for example, future on a specific bond, future on a bond index).
    - Shares / equities (for example, future on an individual share, future on equity index).
    - Currencies (for example, future on the USD/ZAR exchange rate, future on currency index).
- Commodity futures:
    - Agricultural (for example, future on livestock, future on maize).
    - Metals and energy (for example, future on gold price, future on crude oil).

3.4.8 Price

Price is the core of a future. Essentially, futures market participants are fixing a price now for settlement in the future. Clearly therefore, the price of the future is related to the price of the underlying instrument. As the price of the underlying instrument varies, so does the price of the future (but not always to the same extent).

3.4.9 Expiry date

The other vital feature of futures contracts is the expiry date, i.e. the date when delivery or cash settlement takes place. The price of the future at the expiry time on the expiry date is equivalent to the spot price. It will therefore be clear that the futures price moves closer to the spot price as time goes by (i.e. it converges on the spot price).

3.4.10 Market price

The contract trades (in the sense that it can be reversed = “closed out”) because it has a value, and this value is largely influenced by the spot price of the underlying asset, but also by expectations. Price is the only feature of the future that varies. Each contract has a minimum movement size or “tick size”, for example R1

3.5 AN EXAMPLE

The above definitional section may be rendered more meaningful if an example of a futures transaction is introduced at this stage (see Box 3.1). This is an actual deal supplied by the JSE (but names, dates and numbers have been changed).

BOX 3.1: EXAMPLE OF FUTURES DEAL

Entry trade

ABCM buys 1 DEC 20 ALSI @ 55490 (Long)

PQRM sells 1 DEC 20 ALSI @ 55490 (Short)

Ref no	Member	Dealer	Buy/ Sell	Qty	Contract	Price	Counter-party
000003993	ABCM	IMR	B	1	DEC 20 ALSI	55490	PQRM
000003993	PQRM	DRC	S	1	DEC 20 ALSI	55490	ABCM

Close-out trade

ABCM sells 1 DEC 20 ALSI @ 55510 (closes out) (Profit: 55510 - 55490 = R20)

PQRM buys 1 DEC 20 ALSI @ 55510 (closes out) (Loss: 55490 - 55510 = -R20)

Ref no	Member	Dealer	Buy/ Sell	Qty	Contract	Price	Counter-party
000003995	ABCM	IMR	S	1	DEC 20 ALSI	55510	PQRM
000003995	PQRM	DRC	B	1	DEC 20 ALSI	55510	ABCM

Profit/loss = the difference in the buy price and the sell price multiplied by the nominal multiplied by the number of contracts. The example above assumes the nominal is 1.

Member (of the exchange) ABCM bought one Dec 2020 ALSI futures contract at the price 55490. It is a notional contract with the underlying “asset” being the ALSI index, and it expires at 12 noon on 1 December 2020. It can therefore not be delivered by the seller to the buyer and will be settled in cash. The counterparty (seller) to the deal is member (of the exchange) PQRM: he sold the contract at price 55490. Both parties dealt at 55490, i.e. the agreed price

(i.e. the *price at which willing buyer and willing seller were prepared to deal*), which is the "trading" (or market) price of the ALSI at the time (let's assume 10 am) on the date of purchase / sale (let's assume 3 January 2020). (Note that the trading / market price is different, but related, to the actual index value.) If these were naked positions (i.e. not hedged), they indicated:

- The buyer expected the ALSI to increase.
- The seller expected the ALSI to decline.

At 3 pm on 3 January 2020 both parties "closed out" their positions at the trading price of the future: 55510. Members ABCM and PQRM each did an *equal and opposite* trade to their original trade, and therefore made a profit or a loss. This indicates an important point on the nature of the futures market (and indeed of the derivatives market in general): it is a zero-sum market: for every buyer there is a seller (in equal amounts) and for every profit there is an equal-sized loss.

Thus, in the above example member ABCM made a profit of R20, while member PQRM made a loss of R20. Note that this assumes the "nominal" is 1 (we did this to keep it simple). The nominal is 10, i.e. the contract size / value = 10 x the market prices dealt at. Thus, when the trade was opened, both parties had an exposure to the ALSI market of 10 x R55 490 = R550 490, and when the trade was closed out the profit / loss was R200.

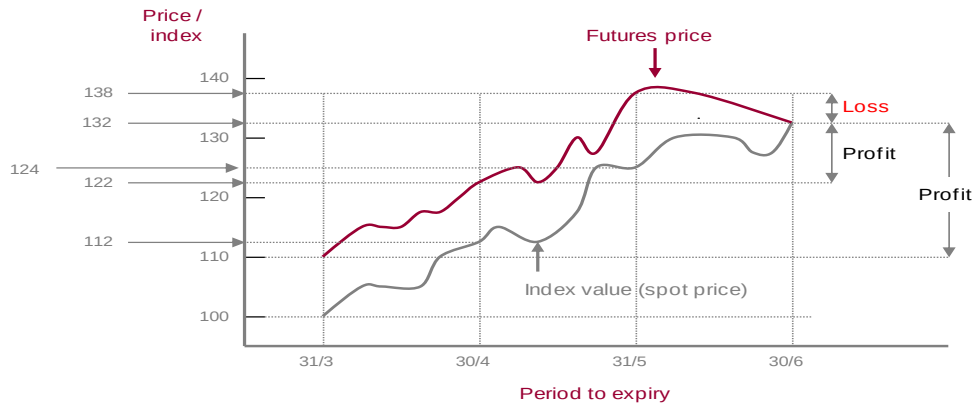
It is a feature of futures markets that no money changes hands when a deal is struck. However, both buyer and seller are required to make a "good faith" deposit - termed the "margin" (note: this was the origin of the margin, but it is now part of the risk management procedures of the exchange). This deposit is made with the broker who, in turn, passes it on to the exchange.

In conclusion, it is important to again point out that the exchange interposes itself between the buyer and the seller and guarantees the transaction. For each buy-deal the exchange creates a sell-deal, and for the opposite deal (the sell-deal) the exchange creates a buy-deal. Thus, the counterparty to each leg of a deal is the exchange.

3.6 FUTURES TRADING PRICE VERSUS SPOT PRICE

It should be clear at this stage that buyers and sellers of futures contracts trade at the *market prices* for the relevant futures, i.e. at the prices established in the market by the interplay of supply of and demand for the futures contracts. It is also apparent that these prices are different from the spot prices of the underlying assets, but that the prices of futures are closely related to the spot prices of the underlying assets. An example is required.

Figure 3.2: example of a 3-month future (index)



The example in Figure 3.2 depicts the life of a three-month future (assume it is a share index future) created on 31 March and expiring on 30 June. It will be evident that the buyer of the future on 31 March who holds it to expiry on 30 June profits (and the seller loses of course). She bought the future at 110 when the spot price was 100 and it "closed out" at 132. Similarly, the buyer of the future on 30 April at 122 (when the spot price was 112) also profits, but to a lesser extent. The buyer of the future on 31 May at 138 (when the spot price was 124), held to expiry, however, makes a loss because the futures price declined to 132 on expiry date (= spot price).

As noted earlier, the price of a future always converges upon the spot (cash market) price as the expiry date gets closer. The reason is that the so-called *basis* (which is similar to net carry cost – see below) becomes smaller with the passage of time. On expiry date the basis (and net carry cost) is zero.

Table 3.1 tracks the life of a fictitious March YEAR3 All Share Index (ALSI) future as at month-ends. As noted above, “spot” refers to the *value of the index* on the particular dates, while market rate refers to the *price for the future* established in the market, i.e. the price at which the future traded on the relevant dates. This is also illustrated in the Figure 3.3.

TABLE 3.1: MARCH YEAR3 ALSI INDEX FUTURES CONTRACT

Year	Month	Value of index (spot rate)	Market rate (price / value) of future (mark-to-market)
YEAR1	March	13535	13665
	April	13733	13860
	May	13992	14120
	June	14054	14223
	July	14177	14525
	August	14011	14282
	September	13792	14030
	October	13916	14252
	November	14183	14425
	December	14889	15415
YEAR2	January	14754	15262
	February	14846	15235
	March	14939	15185

	April	15357	15870
	May	15396	15865
	June	15404	15515
	July	15651	15865
	August	15833	15948
	September	15676	15712
	October	15724	15862
	November	15756	15840
YEAR3	December	15860	15965
	January	15054	15165
	February	15147	15173
	March (15th)	15277	15277

It can be seen that the future traded above the spot price for the entire life of the contract. This is not always the case, however. At times the future can trade at a discount to the spot price. Also clear from the above is that the difference between the two prices is not consistent. This is because expectations at times play a major role in the determination of the futures price.

Figure 3.3: March YEAR3 All Share Index (ALSI) future

Two examples may be useful (the numbers are from the Table 3.1):

- A buyer of 10 contracts (one contract = R10 x market price) of the March YEAR3 ALSI on 30 April YEAR1 would have "bought" an exposure in the equity market (ALSI) to the value of R1 386 000 (10 x R10 x 13860). If this position were held until "close out", i.e. 15 March YEAR3, the buyer would have profited to the extent of R141 700 [R1 527 700 (10 x R10 x 15277) – R1 386 000]. The seller of the contract would of course have lost this amount (if she held the contract until expiry).
- A buyer of the 10 contracts on 30 July YEAR2 would have bought exposure to the ALSI of R1 586 500 (10 x R10 x 15865). If she held the future until expiry, she would have made a loss R58 800 [R1 527 700 (10 x R10 x 15277) – R1 586 500].

3.7 TYPES OF FUTURES CONTRACTS

There are many futures exchanges around the world, and the variety of contracts is vast. Table 3.2 shows an excerpt of the contracts that are listed (from Wall Street Journal).

There are various contracts under each of these names, i.e. contracts that have different expiry dates. For example, there may be four S&P 40 contracts running simultaneously – the 15 March, the 16 June, the 15 September, and the 15 December.

TABLE 3.2: EXAMPLES OF FUTURES CONTRACTS				
FINANCIAL			COMMODITIES	
Interest rate	Equity	Foreign currencies	Agricultural	Metals and energy
Physical Treasury bonds Treasury notes Treasury bills Federal funds Canadian govt bond Eurodollar Euroyen Eurobond	Physical Various specific shares Index (notional) DJ Industrial S&P 500 NASDAQ 100 CAC-40 DAX-30 FTSE 100 Toronto 35	Physical Japanese yen Euro British pound Swiss franc Australian $ Canadian $ Brazilian real Mexican peso Index (notional)	**Grains and oilseeds** Wheat Soybeans Corn (maize) **Livestock and meat** Cattle – live Hogs – lean Pork bellies Food and fibre Cocoa	Physical - Metals Gold Platinum Silver Copper Aluminium Palladium Physical - Energy Crude oil – light sweet Natural gas Brent crude

Index (notional) Short sterling bond index Long sterling bond index Municipal bond index	Nikkei 225 NYSE Comp.	US dollar index	Coffee Sugar Cotton Orange juice	Propane Index (notional) CRB index
Physical = the actual instrument, currency, commodity. Index = indices of exchanges, etc. CRB index = Commodity Research Bureau.				

TABLE 3.3: SELECTION OF SOUTH AFRICAN FUTURES CONTRACTS				
FINANCIAL			COMMODITIES	
Interest rate	Equity	Foreign currencies	Agricultural	Metals and energy
Physical Futures on: R186 bond	Physical Futures on: Over 200 shares (called single stock futures – SSFs)	Physical USD/ZAR EUR/ZAR	Physical Local: White maize	Physical Local: None

(10.5% 2026) 3-month JIBAR interest rate Index (notional) Futures on: ALBI index GOVI index	Dividends (local & foreign) Index (notional) Futures on: FTSE/JSE Top 40 FTSE/JSE INDI 25 FTSE/JSE FINI 15 FTSE/JSE FNDI 30 FTSE/JSE RESI 20 FTSE/JSE Gold Mining	GBP/ZAR AUD/ZAR JPY/ZAR CAD/ZAR Etc Index (notional) None	Yellow maize Soybeans Wheat Sunflower seed Beef Foreign (underlying = foreign futures): Chicago corn CBOT soybeans Index (notional) None	Foreign (underlying = foreign futures): Gold Platinum Crude oil Index (notional) None

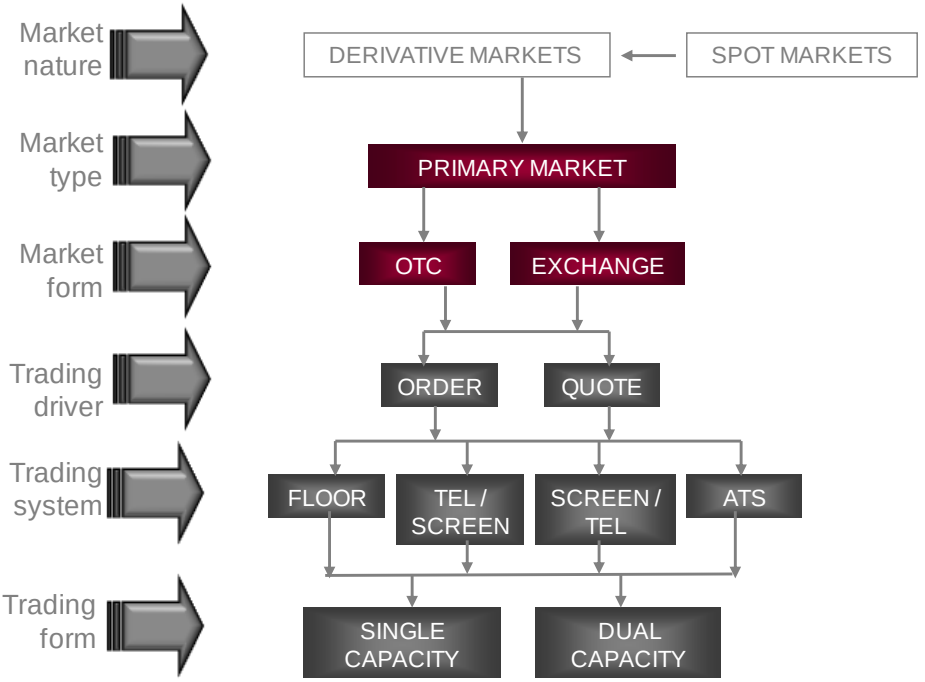
It is to be noted that The Wall Street Journal's futures contract complete list is about three times the above list provided. In South Africa, the futures market is young: it only emerged in 1987 (OTC at first, and then formally as an exchange in 1990). Consequently, the number of futures listed is relatively small; a selection is shown in Table 3.3.

3.8 ORGANISATIONAL STRUCTURE OF FUTURES MARKETS

Financial markets have many aspects to them. One way of depicting the organisational structure of financial markets is as in Figure 3.4.

Does the futures market have both *primary markets* and *secondary markets*? The answer is that the market type is primary market; however, while futures cannot be sold, they can be "closed out" at any time by dealing in the opposite direction. The "closing out" results a loss or profit as in the case of a spot instrument sale (or purchase in the case of a "short" sale[17]) in the secondary market.

Figure 3.4: organisational structure of derivative financial markets



[17] "Short" sale means the sale of an instrument that the seller does not own. The seller borrows the instrument from an investor / lender for a fee and delivers it back to the lender when the short sale is unwound by the purchase of the instrument. A short sale is undertaken to profit opportunistically from an expected decline in price.

The *market form* of the futures market is formal in the shape of an exchange. There are many futures exchanges in the world or futures divisions of exchanges as in the case of South Africa.

As regards *trading driver* and the *trading system,* the futures market in South Africa is *order* and *ATS* (automated trading system), i.e. an *order-matching method* on an ATS is followed. This requires some elucidation:

- The broking members of the exchange register their clients with the exchange. This is in fact unique in that most futures exchanges do not know who the clients of the members are.
- The members we refer to by the generic term *broker-dealers*, because they may deal as principals or agents and the capacity of trading is disclosed to the client. The broker-dealers at times deal in dual capacity in a single deal (see last bullet point).
- Some broker-dealers do not have clients and only deal as principals, and some broker-dealers deal only as agents with clients (both are called single capacity).
- The ATS is constructed in such a way that broker-dealers input their orders into the system (directly onto a computer). An example is buy 300 December ALSI (= the FTSE/JSE Top 40 Index) contracts at 55 820 (this is an assumed index value). Sellers do so also. The system places on the screen the best buy and sell orders for all the different contracts and has a drop-down facility where the non-best buy and sell orders appear (to show the depth of the market).
- Because the buyers and sellers are ultimately to deal with the exchange, the identities of the broker-dealers are not displayed.
- When two opposite orders match, the deal is automatically consummated by the ATS, and the two members are informed via the system. The clients (if applicable) are informed in turn by their broker-dealers.
- A broker-dealer, as noted, can deal in dual capacity, meaning that a single order can be split between principal and agent. For example, the buy example mentioned earlier can be 100 contracts as principal and 200 contracts as agent.

Because large deals (defined as for example over 500 contracts) may affect prices unduly, the Rules of the exchange allow for *off-ATS trading*. These deals are negotiated between members and then reported on the ATS. However, most futures deals are done via the ATS.

The above is the organisation of the South African futures market. In some futures markets, the open outcry floor method of trading is preferred. This is also an order driven trading system, which is highly transparent because the broker-dealers face each other in a “trading pit”, i.e. ensuring that clients’ orders (and broker-dealers’ own orders) are transacted at the best prices. An ATS may be seen as *imitating the transparency of floor trading*.

As regards delivery, in the futures markets delivery of the underlying asset usually does not take place. This is discussed in the later section “cash settlement versus physical settlement”. However, unlike as in the case of forwards (the unsophisticated future) margin is required. This is discussed after the following section on clearing.

3.9 CLEARING HOUSE

All deals are cleared through a clearing house (called JSE Clear) that is usually separate from the exchange. The clearing house may be regarded as being responsible for the management of the market.

We noted earlier that as soon as a deal is struck, the exchange (in fact the clearing house) interposes itself between the two principals that concluded the deal. This means that it takes on the opposite side of each leg of each deal. The clearing house is backed by a Fidelity fund.

3.10 MARGINING AND MARKING TO MARKET

As mentioned above, the Clearing House (CH) of the exchange becomes the buyer form every seller and the seller to every buyer the minute a trade matches on the trading platform. This process is known as *novation.* As a result of this, the exchange now assumes the credit risk of each party that holds and open position, whether short or long.

The exchange uses two lines of defence to protect the exchange from potential loss through the default by the open position holder.

These are:

- initial margin and
- variation margin.

Initial margin

The CH requires that for an open position, either long or short, to place with it a “good faith deposit’ known as an initial margin. (see contracts below). It is usually 5-8% of the value of the contract and is usually sufficient to cover a single day loss on an open position.[18]

The initial margin essentially protects the exchange from default because it is extremely unlikely that losses on positions in a single day will exceed the initial margin.

When a position is closed out (a long position is sold or vice versa) or the contract reaches expiry, the initial margin is refunded to the client.

Variation Margin

Each open position is *marked-to-market* (M-T-M) at the end of each trading day and it is based on the *daily settlement price.* This generates a variation margin which is a cash payment to the CH from the losing position and payment to the winning position from the CH.

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[18] Note that the percentage differs from exchange to exchange and from contract to contract. With some contracts the initial margin is calculated on the basis of the riskiness (measured as standard deviation) of the contract. For example, a Market Notice (Y128) the JSE stated: "After consultation with the Clearing Banks the JSE has recalculated all the IMRs using a revised statistical methodology which takes into account 3.5 standard deviations as opposed to the 6 standard deviations previously used. The revised IMR percentages for all contracts will change monthly depending on the movement in the underlying spot market, but the 3.5 standard deviation remains constant."

As a result of this daily process, futures trading is often referred to as a 'zero-sum game'- the CH simply transfer variation margin from the loser to the winner.

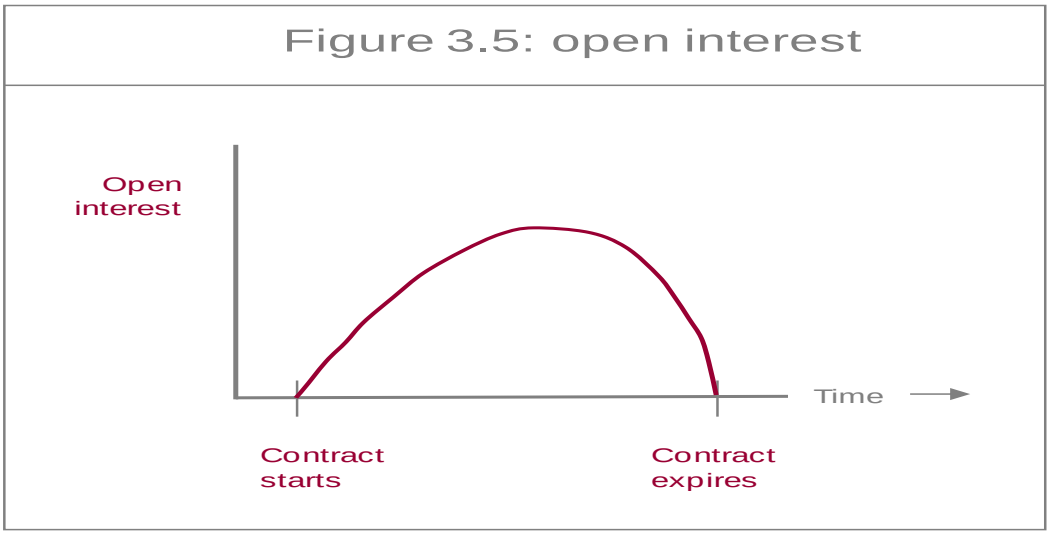
If an open position holder is unable to meet a variation margin call, the exchange will "close the member out". This means that the exchange takes an offsetting contract. The loss is covered from the client's initial margin

3.11 OPEN INTEREST

A term that often crops up in the futures market is "open interest". This is the term for the number of outstanding contracts of a particular contract, i.e. the number of contracts that are still open and obligated to delivery (physical or cash settlement). Double counting is avoided in the number. If broker-dealer A takes a position in a future and B takes the opposite position, open interest is equal to 1. Open interest on a particular contract may be depicted as in Figure 3.5 (daily from start of contract to its expiry date).

When a contract is launched by an exchange, open interest is zero. As participants begin to trade, open interest rises, and this continues until the maturity date approaches. On the maturity date the future is "closed out" and open interest is again zero (because the contract is replaced with another that has a new maturity date).

Figure 3.5: open interest



3.12 CASH SETTLEMENT VERSUS PHYSICAL SETTLEMENT

In many of the commodities markets physical settlement takes place. This means that the commodities that underlie futures contracts are delivered at the expiry of the contract. In the financial futures markets, physical delivery also takes place in some cases (for example, certain of the bond contracts), but in most cases settlement takes place in the form of cash settlement.

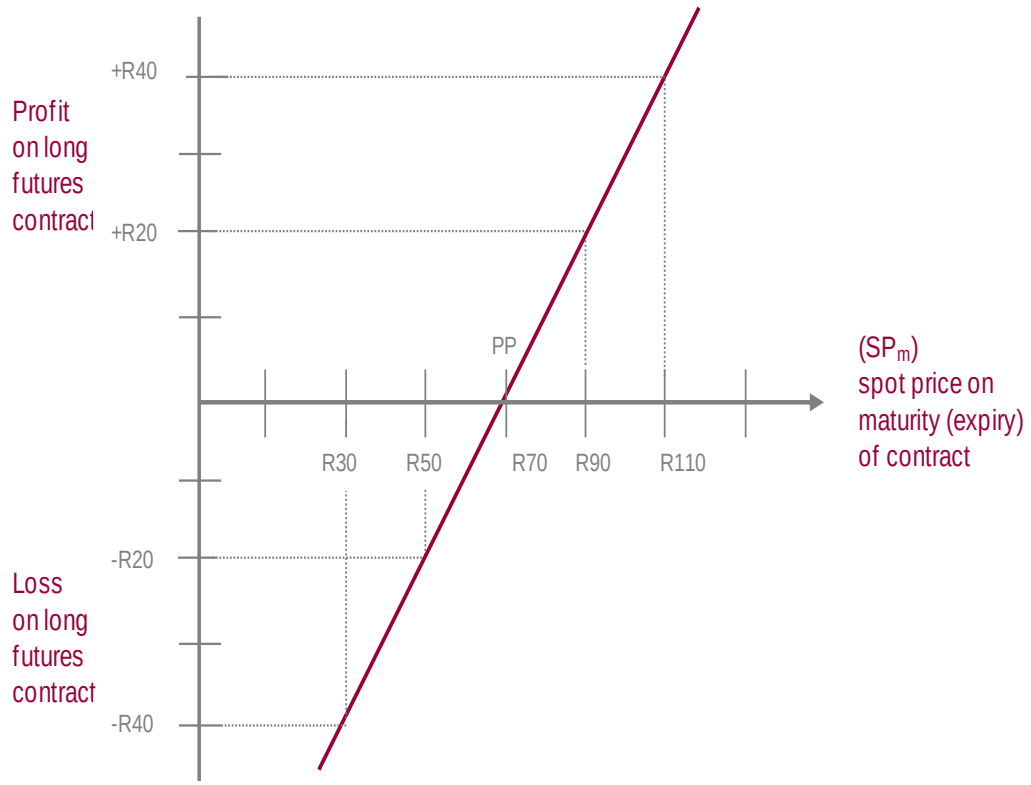
Many traders in futures markets where delivery is required resort to *trade reversing* prior to expiry of the contract, and the reason for doing so is that they do not want to deliver or receive the physical goods/metals etc. These traders are involved in the market for speculative or hedging reasons and take an opposite position to the one they hold prior to maturity, in so doing liquidate their position at the clearing house.

3.13 PAYOFF WITH FUTURES (RISK PROFILE)

The gains and losses on futures are symmetrical around the difference between the spot price on expiry of the futures contract and the futures price at which the contract was purchased. A simple example may be useful (see Figure 3.6): one futures contract = one share of ABC Corporation Limited.

On the vertical axis we have the profit or loss scale of the future. On the horizontal axis we have the price of the future at expiry (= spot price). If the long future is bought at R70 and the price at expiry is R71, the profit is R1, i.e. for each R1 increase in the price of the future, the profit is R1. Thus, if the spot price on maturity is R90, the profit is R20 (R90 – R70).

Figure 3.6: payoff with long futures contract (risk profile)



It will be apparent that if the spot price on maturity is SP_m, and the purchase price is PP, then the payoff on a *long position* per one unit of the asset is:

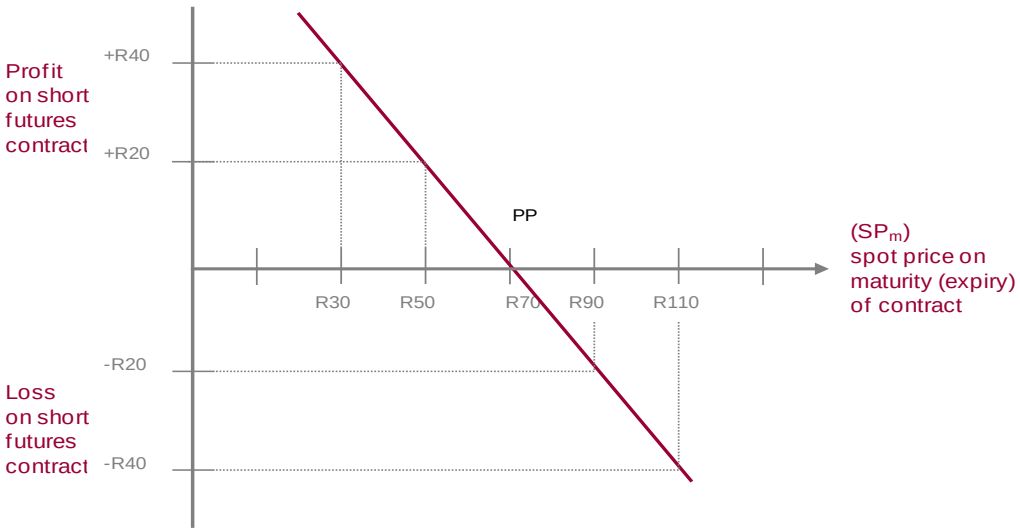
$SP_m - PP$.

It follows that the payoff in the case of a *short future* (see Figure 3.7) is:

$PP - SP_m$.

It will also be clear that the payoff on a future is a *total payoff* because nothing was paid for the contract (remember the margin is a deposit that earns interest and is repayable in full).

Figure 3.7: payoff with short futures contract (risk profile)



3.14 PRICING OF FUTURES (FAIR VALUE VERSUS TRADING PRICE)

The reader should at this stage already have a good idea of the principle involved in the pricing of futures contracts. Some elaboration, however, will be useful. All or some of the following factors influences the *theoretical price* of a future, which is also termed the *fair value price* (FVP):

- Current (or "spot") price of the underlying asset.
- Financing (interest) costs involved.
- Cash flows (income) generated by the underlying asset.
- Other costs such as storage and transport costs and insurance.

The theoretical price / FVP of a future is determined according to the *cost-of-carry model* (CCM): the FVP is equal to the spot price (SP) of the underlying asset, plus the cost-of-carry (CC) of the underlying asset to expiry of the contract. Thus:

FVP = SP + CC.

CC = {SP x [(rfr – I) x t]} + OC

where:

rfr = risk free rate[19] (i.e. the financing cost for the period)

I = income earned during the period (dividends or interest)

t = days to expiry (dte) of the contract / 365

OC = other costs (which apply in the case of commodities: usually transport, insurance and storage).

Thus, in the case of financial futures:

FVP = SP + CC

= SP + {SP x [(rfr – I) x t]}

= SP x {1 + [(rfr – I) x t]}.

TABLE 3.4: MARCH YEAR3 ALSI INDEX FUTURES CONTRACT

Year	Month	Value of index (spot rate)	Market rate (price / value) of future (mark-to-market)	Fair value price (FVP)
YEAR1	March	13535	13665	15124
	April	13733	13860	15277
	May	13992	14120	15494
	June	14054	14223	15493
	July	14177	14525	15557
	August	14011	14282	15303
	September	13792	14030	14996
	October	13916	14252	15060
	November	14183	14425	15279
	December	14889	15415	15963
YEAR2	January	14754	15262	15744
	February	14846	15235	15773

[19] In most derivative formulae the risk free rate (rfr) is used, and this is so because it is a well-known and easily accessible rate. There is no standard definition for the rfr but most analysts / academics apply this term to the 91-day treasury bill rate.

	March	14939	15185	15796
	April	15357	15870	16162
	May	15396	15865	16125
	June	15404	15515	16057
	July	15651	15865	16235
	August	15833	15948	16343
	September	15676	15712	16104
	October	15724	15862	16073
	November	15756	15840	16028
YEAR3	December	15860	15965	16053
	January	15054	15165	15160
	February	15147	15173	15184
	March (15th)	15277	15277	15277

An example may be handy (the numbers are fictitious). The table and graph shown earlier (Table 3.1 and Figure 3.3) are expanded to include the fair value prices (FVPs) at the end of each month[20] (see Table 3.4 and Figure 3.8). Taking April YEAR2 as an example, we have the following:

SP (index value) = 15357
rfr (assumed) = 8.0% pa
I (assumed dividend yield) = 2.0% pa
t = dte / 365 = 319 / 365

FVP = SP + CC
= SP + {SP x [(rfr – I) x t]}
= SP x {1 + [(rfr – I) x t]}
= 15357 x {1 + [(0.08 – 0.02) x (319 / 365)]}
= 15357 x {1 + [0.06 x 0.873973]}
= 15357 x 1.052438
= 16162.

[20] Prices are of course available minute to minute and the mark-to-market price is set once a day.

As can be seen from Table 3.4, the March YEAR3 future traded (15870) at lower than its FVP (16162).

Figure 3.8: March YEAR3 ALSI Index future

It will be apparent that in the above use was made of simple interest. In the case of *compound interest*, the formula changes to:

$$FVP = SP \times [1 + (rfr - I)]^t$$

Using the above example:

$$FVP = SP \times [1 + (rfr - I)]^t$$
$$= 15357 \times 1.06^{0.87397}$$
$$= 15357 \times 1.052244$$
$$= 16159.$$

It is clear that compounding makes little difference in the case of short-term contracts.

3.15 FAIR VALUE PRICING OF SPECIFIC FUTURES

In the previous section we covered the basic principle (CCM) for valuing futures. However, there are a number of variations on the theme, because there are different types of futures contracts traded.

The (valuation) mathematics pertaining to the different futures is illustrated with the following futures:

- Short-term interest rate futures.
- Individual bond futures.
- Equity index futures. Individual equity futures (single stock futures).
- Commodity futures.
- Currency futures.
- Futures on other derivatives.
- Other futures.

3.15.1 Short-term interest rate future

In the case of short-term interest rate futures, the theoretical price or fair value price (FVP) is determined from the calculated *forward-forward rate* (which is also called the *implied forward rate*). An example is required here: the South African 3-month JIBAR future, the specifications of which are shown in Table 3.5.

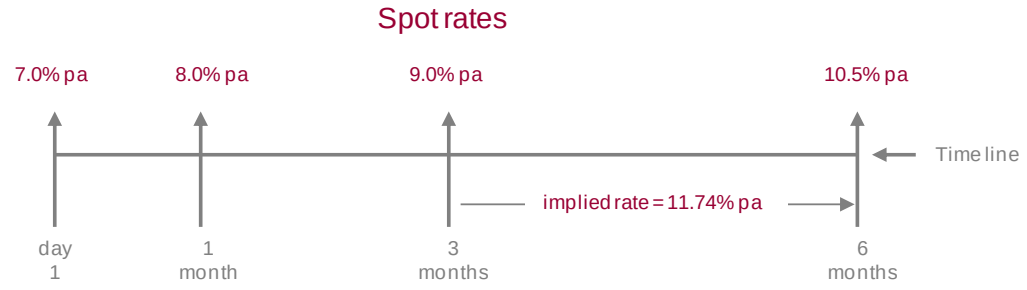
TABLE 3.5: SPECIFICATIONS OF THE 3-MONTH JIBAR FUTURE	
UNDERLYING INSTRUMENT (CONTRACT BASE)	The 3-month Johannesburg Interbank Agreed Rate (JIBAR)
CONTRACT SIZE (NOTIONAL)	R100 000 nominal
QUOTATION STYLE	Effective interest rate
CONTRACT MONTHS	March, June, September and December
EXPIRY DATES & TIMES	11h00 on third Wednesday of the contract month (or previous business day)
MINIMUM TICK SIZE	0.001% (1/10 of a basis point)
BASIS POINT VALUE	ZAR 2.50 per basis point (rate change = 0.01% pa)
MARK-TO-MARKET (MTM)	Explicit daily fixing
SETTLEMENT	Cash
SETTLEMENT YIELD (DAILY MTM)	Closing MTM yield
SETTLEMENT YIELD (ON EXPIRY)	3-month JIBAR on expiry

INITIAL MARGIN	R100 per contract (based on current risk model)
Source: JSE (2010).	

A note on how the basis point value (ZAR 2.50 per basis point) is arrived at is required. A basis point = 0.01% *per annum*. Because there are four 3-month periods in a year, 3 months is taken to be 91.25 days (365 / 4). Therefore, if the 3-month JIBAR rate changes from 7.81% pa to 7.80% pa (i.e. by 1 basis point), the profit on a 91.25-day asset = (0.01 / 100) x (91.25 / 365) x ZAR 100 000 = ZAR 2.50.

The FVP of a 3-month JIBAR future is arrived at by calculating the implied forward rate from the current spot rates. An example is required: shown in Figure 3.9 are the JIBAR rates quoted on the day a client wishes to buy a 3-month JIBAR futures contract (i.e. a 3-month rate in 3 months).

Figure 3.9: JIBAR spot rates and implied rate



The rate now (spot rate) for three months is 9.0% pa and the rate now (spot rate) for six months is 10.5% pa, and the period of the latter rate covers the period of the first rate. The rate of interest for the three-month period *beyond the first three-month period* can be calculated by knowing the two spot rates mentioned. This is called the *forward rate of interest,* or the *implied forward rate*, or the *forward-forward rate*. This is calculated as follows (assumption 3-month period = 91 days; 6-month period = 182 days):

$$FFR = \{[1 + (ir_L \times t_L)] / [1 + (ir_S \times t_S)] - 1\} \times [365 / (t_L - t_S)]$$

where

FFR = implied forward-forward rate

ir_L = spot interest rate for 6-month (i.e. long) period

ir_S = spot interest rate for 3-month (i.e. short) period

t_L = 6-month (i.e. long) period, expressed as number of days/365

t_S = 3-month (i.e. short) period, expressed as number of days/365

IFR = {[1 + (0.105 x 182/365)] / [1 + (0.09 x 91/365)] –1} x [365 / (182 – 91)]
= [(1.05235616 / 1.02243836) –1] x (365 / 91)
= 0.02926123 x 4.010989
= 0.11736647
= 11.736647% pa.

This derived interest rate may be tested as follows: if R1 million (present value, PV) is placed on deposit for 6 months (182 days) at the abovementioned 6-month rate of 10.5% pa, the future value ($FV_{6\text{-}m}$) amount would be:

$FV_{6\text{-}m}$ = PV x [1 + (0.105 x 182 / 365)]
= R1 000 000 x 1.05235616
= R1 052 356.16.

Alternatively, if an investment were made for 91 days, the following would be the total:

$FV_{3\text{-}m}$ = PV x [1 + (0.09 x 91 / 365)]
= R1 000 000 x 1.02243836
= R1 022 438.36.

If this amount (R1 022 438.36) is invested for another 91 days at the implied forward rate of 11.736647%, the $FV_{6\text{-}m}$:

$FV_{6\text{-}m}$ = PV x [1 + (0.11736647 x 91 / 365)]
= R1 022 438.36 x 1.02926123
= R1 052 356.16.

As expected, this number is identical to the FV of the six-month investment calculated above.

As seen, the implied forward-forward rate is 11.736647% pa. This is the fair value price /rate, i.e. the rate that should apply to the future.

Keep in mind that the fair value is not necessarily equal to the market value (= MTM value as determined by the exchange). It will also be apparent that the forward-forward pricing of futures is the same as the pricing of an FRA. An FRA can thus be seen as the OTC equivalent of the interest rate future. This calculation also applies to the forward-forward foreign exchange swap.

3.15.2 Individual bond futures[21]

The principle that underlies the fair value price of a bond future is the CCM as discussed. However, the calculation is more elaborate because of the existence of coupon payments, clean and dirty (all-in) prices, ex and cum interest and so on. The fair value price (FVP) of an individual bond future is made up of:

A + B – C

where

A = bond spot price (i.e. all-in price)
B = carry cost (i.e. rfr)
C = income.

An example is required: a fictitious bond future (government bond R123):

Bond	= R123
Maturity date	= 15 September 2035
Coupon (c)	=13.5% pa
Coupon payment dates (cd_1 and cd_2)	=15 March and 15 September
Yield to maturity (ytm)	= 8.2%

[21] The author acknowledges the assistance of Alan Joffe and Colin Wakefield in respect of this section.

Carry cost (rfr) = 7.5% pa
Purchase (valuation) date of future (fvd) = 20 June
Termination date of future (ftd) = 31 August[22]
Books (register) closes = one month before coupon dates[23].

As noted, the FVP of a bond future is made up of three parts:

FVP = A + B – C (i.e. bond spot price + carry cost (excl income) – income[24])

where

A = dirty (all-in) price of underlying bond at market (current) rate on bond futures valuation date (fvd) [25]
= 105.71077 (note: this price is fictitious)

B = A x {(rfr / 100) x [(ftd – fvd) / 365]}
= 105.71077 x [0.075 x (72 / 365)]
= 105.71077 x (0.075 x 0.19726)
= 105.71077 x 0.014795
= 1.56394

C = (c / 2) x (1 + {(rfr / 100) x [(ftd – cd_2) / 365)]})

[if the futures termination date crosses a books closed date and its associated coupon date (i.e. is not ex-interest)]

---

[22] Assumed for purposes of the example; futures generally terminate in the middle of the relevant months.

[23] We assume this for purposes of the example (spacing in the illustration); in practice the books close 10 days before the coupon dates.

[24] “Income” is too simple a description; it should be described as "accumulated value of income received during the life of the futures contract" (suggested by Colin Wakefield).

[25] Another assumption made is that bond transactions are settled on deal date (so that the example is rendered uncomplicated). In practice bond deals are settled on T+3. Thus, in the example, the fvd and the ftd should be regarded as settlement dates.

or

$= (c / 2) / (1 + \{(rfr / 100) \times [(cd_2 - ftd) / 365)]\})$

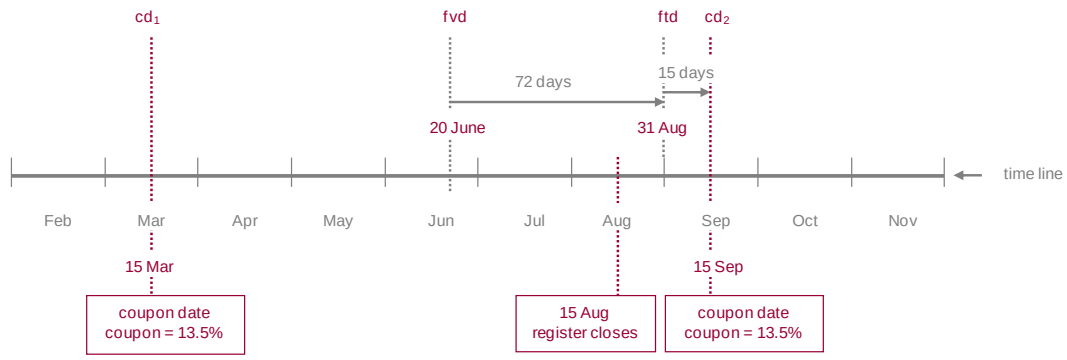
[if the futures termination date crosses a books-closed date but not the associated coupon date (i.e. is in ex-interest period, which is the case here)]

$= (13.5 / 2) / (1 + \{0.075 \times [(cd_2 - ftd) / 365]\})$
$= 6.75 / \{1 + [0.075 \times (15 / 365)]\}$
$= 6.75 / [1 + (0.075 \times 0.04110)]$
$= 6.75 / 1.00308$
$= 6.72927.$

Thus:

FVP $= A + B - C$
$= 105.71077 + 1.56394 - 6.72927$
$= 100.5454.$

Figure 3.10: example of individual bond future



3.15.3 Equity index futures

We covered the case of equity index futures in our first example where the simple interest *cost of carry* calculation was introduced:

FVP $= SP + CC$
$= SP + \{SP \times [(rfr - I) \times t]\}$
$= SP \times \{1 + [(rfr - I) \times t]\}.$

Here we provide another example (All Share Index - ALSI - future):

SP (i.e. index value)	= 10765 (a fictitious value)
rfr	= 11.5% pa
I (dividend yield, assumed)	= 3.5% pa
t (number of days to expiry of contract / 365)	= 245 / 365

FVP = SP + CC)
= SP + {SP x [(rfr – I) x t]}
= SP x {1 + [(rfr – I) x t]}
= 10765 x {1 + [(0.115 – 0.035) x (245 / 365)]}
= 10765 x (1 + (0.08 x 0.6712329))
= 10765 x 1.05369863
= 11343.

3.15.4 Individual equity futures

Individual equity / share futures are also called *single stock futures* (in short SSFs). Calculation of the FVP of SSFs is the same as above – i.e. as for equity index futures, except that the dividend yield will be easier to predict.

The JSE also offers an increasing array of SSFs on internationally listed shares (the underlying). Examples are Apply, Nokia, BP, bank of America, Berkshire Hathaway, Vodafone and Coca-Cola. They are termed IDXs in short by the JSE.

It is appropriate to mention a futures product which is closely allied with SSFs: the *dividend future* (DIVF). They are used to hedge against the dividend risk that accompanies a position in an SSF. As we have seen, dividend expectations (I) are part of the FVP calculation; therefore, there is a need for such contracts.

3.15.5 Commodity futures

With commodities, where insurance and storage are payable (as in the case of maize), and the amount is not proportional to the spot price, it is simply added to the FVP. An example follows [we assume there are only storage costs (SC); note: there is no income (I)]:

Contract = WMAZ (white maize)
Contract size = 100 metric tons
Number of contracts = 1
Date of valuation = 31 March
Expiry of contract = 21 September
Days to expiry (dte) = 174 days (31 March to 21 September)
t = dte / 365 = 174 / 365
rfr = 7.5% pa
SP = R2732.20 (per metric ton)
Storage costs (SC) = 36 cents per ton per day

FVP (per ton) = SP + CC

= SP + [SP x (rfr x t)] + (SC x dte)
= SP x [1 + (rfr x t)] + (SC x dte)
= 2732.20 x [1 + (0.075 x 174 / 365)] + (0.36 x 174)
= 2732.20 x 1.03575 + 62.64
= 2829.88 + 62.64
= R2892.52

FVP (per contract) = 100 x 2892.52
= R289 252.00.

3.15.6 Currency futures

Currency futures are contracts for difference – CFDs which means they are cash settled in ZAR with no delivery of the principal foreign currency amount.

Retail and wholesale market participants can use futures to speculate or hedge as there are no exchange control restrictions on currency futures trading

Futures attract margin where cash flows usually only occur at maturity of forward exchange contracts.

Who can trade currency futures?

- A South African individual - no limits applicable.
- A South African corporate entity - no limits applicable.
- A non-resident individual or non-corporate entity - no limits applicable.
- A resident financial service provider and collective investment scheme subject to their foreign portfolio allowance.
- A resident pension fund organisation subject to their foreign portfolio allowance.
- A resident long-term or short-term insurer subject to their foreign portfolio allowance.
- A hedge fund may trade in an unlimited capacity provided that they are not regulated under investment managers' rules.
- Individuals, in other words, have no limits to the value traded in the currency futures market.

Currency Futures example

A speculator goes long 100 Dollar/Rand futures contracts as she is hoping that the USD strengthens against the ZAR in other words she is expecting the exchange rate to go up. The contract size for the USD/ZAR contract is $1,000.

At transaction date

- She buys 100 contracts with a notional value of $100,000 (100 x 1,000)
- Futures price: R 18.3000
- Exposure at transaction date: R1,830,000 or $ 100,000
- Deposit/initial margin: R 31,000 (R 310 initial margin x 100 contracts) NB. This can vary depending on market conditions.
- End of the day
- Mark to market: 18.1500
- Variation margin call: 18.1500 - 18.3000 x 100 x 1,000 = R15,000 loss
- This margin call will have to be paid by her by 12h00 the next day.
- She is now long 100 contracts at 18.1500 the following day.

A variation on the “normal” currency future is the “Quanto currency future”, for example, a EUR/USD futures contract which is settled in ZAR at a fixed rate. This contract is useful for participants who wish to have exposure to the underlying (the EUR/USD exchange rate) but without the exchange rate risk.

Another variation is the “Any day currency future”, in terms of which clients can hedge exposure to a specific date by selecting the contract expiry date. The JSE (Derivatives Market Division) lists the benefits:

- “Effective and transparent edge against currency risk (for all importers and exporters).
- Hedge foreign portfolios precisely to a specific date.
- Ability to swap the futures for physical delivery through market participants.
- Eliminates the possibility of a client being over- or under-hedged.
- Eliminates the necessity to buy-back or sell forward points as a result of being over- or under-hedged.”[26]

3.15.7 Futures on other derivatives

As in the case of forwards (forwards on swaps) there are futures on other derivatives, for example futures on FRAs and futures on swaps.

The first South African futures on swaps (generally called *swap futures*), were launched on 31.08.2015 by the JSE. Officially, they are *JSE Eris Interest Rate Swap (IRS) Futures*. According to the JSE, they are “… based on … JIBAR … and denominated in … ZAR. The product will follow the standard South African swap market conventions while using the Eris [Exchange, USA] Methodology™, allowing the contracts to replicate the cash flows of … OTC swaps. They will be … cleared through JSE Clear … The swap futures … remain futures throughout the full lifecycle of the contract with no risk of physical

[26] https://www.jse.co.za/content/JSEFactSheetItems/Anyday%20Futures%20Contract%20Fact%20Sheet.pdf

delivery and can be held to their maturity date."[27] The contract specifications can be found on www.jse.co.za.

3.15.8 Other futures

Another future listed on the JSE deserves mention: the *variance future* (VARF). Variance is a statistical measure of volatility (= risk). The generally accepted measure of risk in the Finance discipline is the standard deviation of an asset's return (= the extent of deviation from the mean return). Standard deviation is closely related to variance, in that it is the square root of variance.

The variances and standard deviations of returns on assets (like shares) change considerably from period to period. It is also a major input in the pricing of options. There is a need by some investors to hedge against this risk, and certain speculators seek exposure to this risk. These two parties make the trading of this instrument a possibility. In short, a variance future is a futures contract on realised annualised variance of returns on assets / indices. This instrument is regarded by some as a new asset class.

3.16 BASIS

Participants in the futures market frequently use the terminology "basis" (B), "cost of carry" (CC) and "convergence". As regards the latter: as time in the life of a futures contract goes by, the futures price (FP) and the fair value price of the future (FVP) converge on the spot price (SP), and they are equal on the expiry date of the future, as indicated in Figure 3.11.

It will be evident from the discussion above on the CCM, which gave us

FVP = SP + CC,

that cost of carry (CC) is the difference between the fair value price (FVP) and the spot price (SP) of the underlying asset as follows:

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[27] Source: https://www.jse.co.za

CC = FVP – SP.

Basis (B), on the other hand, is the difference between the SP and the FP of the underlying asset:

B = SP – FP.

Figure 3.11: basis, carry cost & convergence

The above concepts are illustrated in Figure 3.11. It will be apparent that the FVP is higher than the SP when the CC is positive (i.e. when rfr > I on the underlying asset). However, when I > rfr, i.e. CC is negative, FVP < SP. When CC is negative, B is positive.

What is the significance of basis? It is that the basis is a known number when a hedge is undertaken (buy the underlying and sell the future or sell the underlying and buy the future). If the basis changes during the life of the hedge (which is likely), risk (called basis risk) emerges, and the hedge will not be a perfect one, i.e. if the basis strengthens or weakens, the outcome of the hedge will be different from that hoped for or expected.

3.17 PARTICIPANTS IN THE FUTURES MARKET

3.17.1 Introduction

The participants in the futures market can be categorised in several ways. One can, for example, categorise participants according to membership of the relevant divisions of the JSE in which case one would have two categories: members and non-members. One could further split members into clearing members and non-clearing members, and members may also be split into broking members and non-broking members. Thus, we have:

- Members:
  - Clearing members:
    - Broking member.
      - Non-broking members.
  - Non-clearing members:
    - Broking members.
    - Non-broking members.
- Non-members (deal only with members).

3.17.2 Participants according to membership of the exchange

As seen in the previous section, there are several categories. Clearing members are those entities which:

- Enter into a clearing house agreement with the exchange.
- See to the settlement of proprietary trading and client trading and those deals conducted by non-clearing members for whom it clears.
- Maintain and keep in force a suretyship in favour of the clearing house by a financial institution.

Clearing and non-clearing members may be *broking members* or *non-broking members*. The former deal for own account and/or for non-members, while the latter deal only for own account. Non-clearing members are obliged to appoint a clearing member and settle all trades with their clearing member.

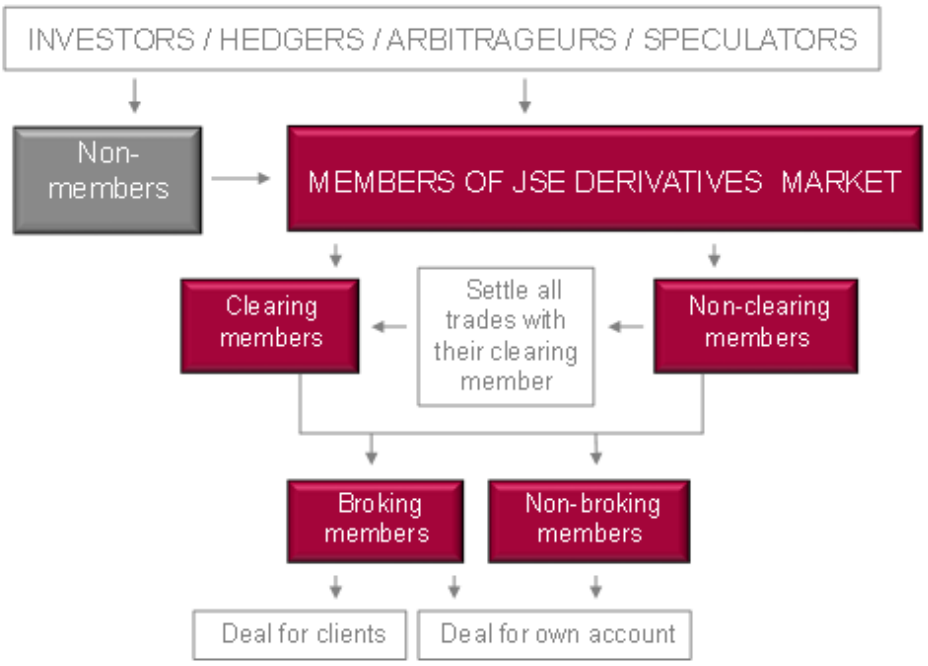
All members are required to abide by the Rules of the exchange, which includes requirements in respect of:

- Fixed expenditure base (higher of 13 weeks' fixed expenditure or a stipulated amount).
- Capital adequacy.
- Bank accounts.
- Internal controls and risk management.
- Minimum training.
- Minimum connectivity.

Non-members are obviously all the participants in the market that are not involved in broking / dealing for others and that are obliged to effect all futures transactions through broking members. One could classify non-members in various ways, such as:

- Foreign sector.
- Household sector (individuals).
- Corporate sector.
- Financial intermediaries:
    - Banks
    - Insurers
    - Retirement funds
    - Collective investment schemes (CISs).

Figure 3.12: participants in the futures market



3.17.3 Participants according to functionality

3.17.3.1 Introduction

One could also classify participants in the futures market according to functionality as follows:

- Investors.
- Arbitrageurs.
- Hedgers.
- Speculators.

These participants are found in both the categories non-members and members of the exchange, meaning that some members themselves are engaged in investing, arbitrage, hedging and speculation. All the participants in the futures market may be depicted as in Figure 3.12.

3.17.3.2 Investors

Investors in the futures market are those participants that view the futures market as an *alternative to the cash market* (i.e. the underlying market). For

example, an investor may wish to earn the All Share Index (ALSI) and, instead of buying the shares in the proportions that make up the index, can achieve this by buying the appropriate number of ALSI futures contracts. She may do this for the sake of convenience; to avoid transactions costs (depending on the fair value price) or she may view the underlying market as lacking in liquidity.

An investor may also use long-term instruments and *short* futures contracts to invest short-term or use short-term financial instruments and *long* futures contracts to invest long term.[28] These positions are alternatives to straightforward investing for the desired investment horizon (see Table 3.6).

TABLE 3.6: USE OF FUTURES TO MANAGE THE INVESTMENT HORIZON

Investment term desired	**Cash market alternative**	**Use of futures market alternative**	**What is known?**	**To do**
3 months (March to June)	Buy 3-month treasury bill (TB) (in March; maturity June)	• Buy govt bond with 10-year maturity • Sell (go short of) a 10-year govt bond futures contract with June maturity	• Buy rate • Sell rate locked in	• Sell govt bonds in June • Contract expires in June
10 years (it is now March)	Buy 10-year govt bond (in March)	• Buy (go long of) a 10-year govt bond contract with June maturity • Invest funds in 3-month TB (March – June)	• Buy rate locked in • 3-month rate locked in	• Rollover bond future • Rollover TB

[28] In this regard see McInish (2000: 334).

3.17.3.3 Arbitrageurs

Arbitrageurs endeavour to profit from price differentials (mispricing) that may exist in different markets on similar securities. For example, if the INDI futures price is trading far in excess of its fair value price, the arbitrageur may sell the future and buy the equities that make up the industrial index.

Arbitrageurs play a significant role in the futures market by ensuring that futures prices do not stray too far from fair value prices and by adding to the liquidity of the market.

3.17.3.4 Hedgers

Hedgers are those participants that have exposures in cash markets and wish to reduce risk by taking the opposite positions in the futures markets. Most investors, such as pension funds, life offices and banks hedge their portfolios from time to time in the financial futures market. The equivalents in the commodity futures markets are the producers and consumers of commodities.

The opposite parties to hedgers are usually the speculators that willingly take on risk to profit from their views in respect of the future movement of prices / rates. Thus, *hedgers transfer risk to speculators*.

3.17.3.5 Speculators

Speculators are those participants that endeavour to gain from price movements in the futures market. Given the small outlay (i.e. the margin) in comparison with cash markets (where the full price is paid), speculators are attracted to futures markets because they can “gear up”.

For example, if a speculator has R1 million with which to speculate, she can buy shares to the value of R1 million in the cash market. In the futures market she can get exposure (and risk) to the extent of the amount on hand times the reciprocal of the margin requirement. Thus, if the margin requirement is 8% of

the value of the future/s, she can go long of futures by 12.5 (1 / 0.08) times R1 million.[29]

Speculators and hedgers play a significant role in the futures market in terms of enhancing the liquidity of this market. It should be apparent that hedgers endeavour to eliminate or reduce risk faced from holding inventories of financial instruments or commodities, while speculators assume the risk. Thus, *speculators willingly take on the risks transferred to them by hedgers.*

It will be evident that there is no clear-cut distinction between membership of the exchange and functionality. For example, an arbitrageur may be a member of the exchange. Similarly, a speculator may be a member of the exchange, and he may be a broking or a non-broking member. Broking members can generally be divided into 3 categories, i.e. those dealing for own account (i.e. arbitrageurs and/or speculators) (in which case they may be non-broking members), pure brokers and those dealing for own account and for clients. Note that it is one of the significant Rules of the exchange that if a broking member takes the opposite position of a client, she is obliged to inform the client as such.

One may also categorise participants in the exchange into local and foreign participants.

3.17.3.6 Closing remark

Because of the significant role played by hedgers in the futures market, the function of hedging is covered further in some detail in the following section.

3.18 HEDGING WITH FUTURES

3.18.1 Introduction

Hedging may be defined as the transferring of risk from the hedger, who has a portfolio or who is awaiting a certain sum of cash, to some other party in the

[29] It is this property of the futures market, and the significant losses made by some irresponsible traders, that gives the futures market a bad name.

market, usually another hedger or speculator. The hedger *is concerned with price movements* that may influence her existing portfolio, or a planned or anticipated portfolio.

The opportunities for hedging are many, and many a book has been written on hedging strategies. As this is an introductory text, this section deals with hedging basics and jargon and provides a few hedging examples.

3.18.2 Hedging basics and jargon

The jargon for hedging operations is interesting. For example, the investment community uses the terms ***micro hedging*** and ***macro hedging***[30]. *Micro hedging* is where each item in a balance sheet (liabilities and/or assets) is valued separately and an autonomous hedge set up for each item. *Macro hedging* is where the aggregate asset and/or liability portfolios are considered, and the overall risk is hedged in one operation. Examples are interest rate gap management (a banking problem) and changing asset allocation (an institutional problem).

A hedger may have a certain ***hedging horizon***, i.e. a certain date on which the hedge will end (for example, a maize farmer who wishes to hedge from the planting stage to the harvest stage), or have no horizon at all (for example, a maize dealer who holds a permanent portfolio of maize and supplies feedlots and millers as they demand the product).

A hedge may be a ***long hedge*** or a ***short hedge***, and they may be ***anticipatory hedges*** (hedging a cash/spot position not yet taken) or ***cash hedges*** (hedging an existing position in the cash/spot market). A hedge may also be a ***direct hedge*** or a ***cross hedge***. For example, a manufacturer of bread requires wheat on a regular basis. If the manufacturer requires additional wheat in two months' time and is concerned that the price will rise over this period, it is able to put in place a ***long anticipatory hedge*** by buying an appropriate number of wheat

[30] In this regard see Falkena (1989: 39-59).

contracts now that mature in two months' time (if it is happy with the two-month futures price). This action fixes the delivery price in two months' time.

A ***short hedge*** is where the hedger sells a futures contract. For example, a gold producer is concerned that the gold price will fall sharply over the next three months when it will have 5 000 ounces to market, which will adversely affect profitability. Assuming that the producer is pleased with the three-month delivery futures price, it will sell an appropriate number of gold contracts (assuming no physical delivery) and thereby fix its price of delivery. If the spot price in three months' time is lower than the futures price it will sell the 5 000 ounces at the spot price; but it will profit on the futures contracts to the extent of the difference between the spot price and the futures price. Thus, the producer's delivery price will be the futures price.

Generally, it is difficult to exactly match the cash market position with the futures hedge position undertaken, in terms of:

- Time horizon.
- Amount of the asset / commodity.
- Characteristics of the goods (e.g. maize or wheat grade).

In these cases, the hedger will attempt to match as closely as possible the characteristics of the cash market asset with the futures position; the hedge will be a ***cross hedge***.

Hedgers wish to establish a ***hedge ratio (HR)***. This ratio establishes the number of futures contracts to buy / sell for a given position in the cash market. The hedge ratio is given by:

HR = - (futures position / cash market position).

The hedger will undertake HR units of the futures to establish the futures market hedge. For example, if HR = -1, the hedger will have a matched long cash position and a short futures position. A few examples of hedging follow.[31]

3.18.3 Hedging using the 3-month JIBAR future

- As a borrower you would *sell* JIBAR futures to hedge against rising interest rates in the future.
- As lender you would *buy* JIBAR futures to hedge against falling interest rates in the future.

A borrower hedge example

- It is 23 June 2022.
- Company A has a loan of R1 million at an interest rate of 3-month JIBAR + 2%
- The loan is rolling over today.
- The current 3-month JIBAR is 11%, so their all-in cost of funding for the next three months is 13.00% p.a. (11% + 2%)
- The company is concerned that the 3-month JIBAR rate on 22 September will be higher when they will be rolling over their borrowing.
- To hedge, they sell 10 September 3-month JIBAR futures at 11.30% which expire on 22 September.

At expiry

- The company was correct about interest rates increasing
- 3-month JIBAR fixes at 12.30% on the 22 September 2022 when the futures close out.
- They have received variation margin of R2,500 over the life of the contract as the difference between the contract rate and the final close out was 100 basis points (12.30 – 11.30). 100 basis points x 10 contracts x R2.50.

[31] With some assistance from Pilbeam.

- The cost of funding for the next three months will be the current 3-month JIBAR + credit spread – profit on the futures position.
- 12.30% + 2% - 1% = 13.30% p.a.

TABLE 3.7: HEDGING WITH INTEREST RATE FUTURE			
Date / rate	Cash market position	Problem	Solution
• 23 June • 3-month JIBAR rate = 11.%	• Borrowing of R1,000,000 • Rate = JIBAR + 200bp • Repricing every 91days	• Borrowing rate = 11% + 2% = 13% • Concerned that rates will rise and borrowing rate will increase on next repricing date of 22 September	• Sell ten R100,000 September 3-month JIBAR futures (maturity 22 September) • Rate/price = 11.3%
• 22 September • 3-month JIBAR rate = 12.30%	• Roll over borrowing at new rate = 12.30% + 2%	• No problem	• Future closes out at 12.3% • Profit = 100 x 10 x R2.50 = R2,500 • Result: borrowing rate of 13.30% locked in • 12.30+2-1 = 13.30%
Tick size = 0.001 (in price) = R2.50			

It will also be apparent that a speculator, who does not have a cash market position, but believes interest rates will rise, and who undertook the above futures position, would have benefited to the extent of R2 500. Had rates declined by 100 basis points over the period, the speculator would have lost this amount.

3.18.4 Hedging with share index futures

TABLE 3.8: HEDGING WITH SHARE INDEX FUTURE			
Note: the numbers are not related to the market at present			
Date / price	Cash market position	Problem	Solution
• 28 June • ALSI = 28000 • 19 September ALSI future price = 28100	• Share portfolio of R280 000 well spread over share market (representative of share market)	• Concerned that share prices will fall over next few months and that portfolio will be worth less	• Sell September ALSI future at current price of 28100 (maturity 19 September) • Contract size = 10 x index value = 10 x 28100 = exposure of R281 000
• 19 September • ALSI = 27000	• Share portfolio value declines by 3.6% (1 - 27000 / 28000 x 1) to) R269 920	• No problem	• Future closes out at 27000 • Profit = R281 000 – R270 000 = R11 000 • R11 000 profit added to new portfolio value of R269 920 = R280 920 = similar to original value

An individual has a portfolio valued at R280 000 that is well spread over the share market (meaning he will earn the change in the ALSI value more or less). The All Share Index (ALSI) currently (28 June) is 28000, and the September all share index future (September ALSI, due 19 September) is trading at 28100.

The individual is concerned that share prices “across the board” are about to fall sharply, and that the value of his portfolio will fall commensurately.

The individual decides to sell the September ALSI future. The contract size is 10 times index value, i.e. R281 000 (10 x 28100). He sells the ALSI future, and it closes out at 27000 on 19 September. The profit made is R11 000 (R281 000 – R270 000).

He compares this with the loss in the *market value* of the portfolio of R10 080 (280 000 – 269 920 (= a decline of 3.6% = the decline in the value of the ALSI from 28000 to 27000). This loss is more than compensated for by the profit on the futures position of R11 000.

3.18.5 Hedging with currency futures

A South African exporter is convinced that the USD proceeds of USD 100,000 from an export order will be worth less when it is received in three months’ time, as a result of the dollar depreciating against the rand. To hedge, the exporter *sells* 100 contracts on the USD/ZAR futures (contract size USD 1,000) at USD/ZAR 18.2000 which is higher than the current spot of 17.9500[32]. the futures have three months to expiry.

The value of the contract now in rand terms is R1,820,000 (100,000 x 18.2000)

At the end of the three-month period when the contract expires, the spot exchange rate for USD/ZAR is 17.5500. A they sold the futures, they have benefited from the USD/ZAR weakening and have received in the last three months variation margin of R65,000 on the future contracts t (R1,820,000 – R1,755,000).

The exporter sells the USD to their bank at the current spot rate of USD/ZAR 17.5500 for R1,755,000 (100,000 x 17.5500).

[32] Based USD and ZAR interest rate differential.

The effective proceeds from their dollars is R1,820,000 (the sum of the sale of the USD proceeds R1,755,000 plus the profit on the futures of 65,000).

If the USD/ZAR rate had weakened to a level above 18.2000, the exporter would have been better off without the futures contracts. Hedging never guarantees the best price for the future, but it gives the exporter certainty.

TABLE 3.9: HEDGING WITH CURRENCY FUTURE			
Note: the numbers are not related to the market at present			
Date / price	Cash market position	Problem	Solution
• Now • Spot rate = USD / ZAR 17.9500 • Futures price = USD / ZAR 18.2000	• Exporter expecting USD 100,000 in 3 months' time	• Concerned that USD will depreciate (ZAR appreciate)	• Sell 3-month USD/ZAR future at 18.2000 • 100 contracts = USD 100,000 • Contract value = R1 820 000 (USD100,000 x 18.2000)
• Three months later • Spot rate = USD / ZAR 17.5500	• Sell proceeds of USD 100 000 at spot rate = R1,755,000 • Profit on futures R65,000 • Total benefit R1,820,000	• No problem	• Future closes out at USD / ZAR 17.5500 • Contract value = R1,755,000 (USD100,000 x 17.5500) • Profit = R1,820,000 – R1,755,000 = R65,000 • Profit = loss on cash market position

3.19 BASIS TRADING

We saw earlier that basis (B) is the difference between the SP and the FP of the underlying asset:

B = SP – FP (note that B is often also calculated as B = FP – SP).

Basis trading in the futures market is a trading tactic consisting usually of the purchase of a security and the sale of a futures contract with the same underlying security. The motivation is that the speculator / arbitrageur is of the opinion that the two securities are mispriced with respect to each other, and that the mispricing will correct itself at some stage in the near future, or that a profit will occur upon expiry of the contract.

The best example of a successful basis-trade is where the spot purchase price of a share (SP) plus the cost of carry (CC) (remember, SP + CC = FVP) is less than the futures price (FP) (i.e. the basis number is larger than the CC).

The (almost) risk-free profit will be evident in this case: the speculator / arbitrageur will (1) buy the share (at the SP), have it carried in the market at the CC until expiry (remember, SP + CC = FVP), (2) sell the corresponding futures contract. In effect, the overvalued security (the future) is sold and the correctly priced security is purchased. This trade is also called cash-and-carry trade.

3.20 SPREAD TRADING

A *spread* is the difference between the prices of two similar or related securities (here regarded as futures contracts), and a *spread trade* has two legs, usually executed simultaneously as a unit (to avoid *execution* aka *leg* risk): the purchase of one security and sale of a similar or related security. The result is a spread (a value), and the motivation is an expected change (narrowing or widening) in the spread over time. It will be evident that the speculator / arbitrageur hopes to profit not from the changes in the prices of the legs directly, but from the narrowing or widening of the spread. Also clear is that the volatility in the spread will be lower than that of the legs, thus lowering risk, but also lowering the potential profit. This is reflected lower margin requirements.

TABLE 3.10: EXAMPLE OF SPREAD TRADE			
Note: the numbers are not related to the market at present			
	Price per ton		
	Opened position	Position after 1 month	Change
September white maize (**buy** one contract)	ZAR 2700	ZAR 2900	+ZAR 200
December white maize (**sell** one contract)	(ZAR 2500)	(ZAR 2600)	(+ ZAR 100)
Spread	ZAR 200	ZAR 300	+ZAR 100

There are two categories of spreads: *intra-market spreads* and *inter-market spreads*. The former is where a spread trade is undertaken in the same market but in *different maturities* of contracts, for example: the sale of a June contract on Share A, and the purchase of a December contract on Share A. An intra-market spread is also referred to as a *calendar spread*. In the commodity futures market, intra-market spreads are referred to as *intra-commodity spreads.* An example of the latter follows (one contract = 100 tons) in Table 3.10.

The prices of both futures increased, but the nearby contract by more than the distant one. The spread started off at ZAR 200 and increased to ZAR 300: by ZAR 100. The speculator / arbitrageur makes a profit of ZAR 100 x 100 tons = ZAR 10 000.

The example above is an example of *selling the spread*: sale of distant contract and purchase of nearby contract. *Buying the spread* is the opposite: sale of nearby contract and purchase of distant contract.

An *inter-market spread* is where a trade is undertaken in different but related assets, for example the sale of a June soybean contract and the purchase of a June wheat contract. Another example is the purchase of a September GBP deposit future and the sale of a September Eurodollar deposit future. In the case of commodities, inter-market spreads are also referred to as *inter-commodity spreads*. Intra- and inter-commodity spreads are sometimes called *commodity product spreads*.

3.21 SOUTH AFRICAN FUTURES MARKET CONTRACTS

TABLE 3.11: SELECTION OF JSE CONTRACTS AND SPECIFICATIONS				
FUTURES CONTRACT	FTSE/JSE TOP 40 INDEX FUTURE	FTSE/JSE GOLD MINING INDEX FUTURE	FTSE/JSE SA LISTED PROPERTY INDEX	BOND FUTURES
CODE	ALSI	GLDX	SAPI	VARIOUS
UNDERLYING INSTRUMENT	FTSE/JSE Top 40 Index	FTSE/JSE Gold Mining Index Future	FTSE/JSE SA Listed Property Index	Various listed bonds
CONTRACT SIZE	R10 x Index Level	R10 x Index Level	R10 x Index Level	R100 000 nominal
EXPIRY DATES & TIMES	15h40 on 3rd Thursday of Mar, Jun, Sep & Dec. (or previous business day if a public holiday)	13h40 on 3rd Thursday of Mar, Jun, Sep & Dec. (or previous business day if a public holiday)	13h40 on 3rd Thursday of Mar, Jun, Sep & Dec. (or previous business day if a public holiday))	12h00 on the first business Thursday of February, May, August & November
QUOTATIONS	Index Level (no decimal points)	Index Level (no decimal points)	Index Level to Two Decimal points	Ytm (generally nacs) for settlement on the delivery date
MINIMUM PRICE MOVEMENT	One Index Point (R10)	One Index Point (R10)	0.01	$1/10^{th}$ point
SETTLEMENT METHOD	Cash Settled	Cash Settled	Cash Settled	Delivery of the physical bond

A selection of JSE-listed futures contracts, and their specifications,[33] is as shown in Table 3.11 [excluding the individual share futures contracts (single stock futures - SSFs), the specifications of which are shown in Table 3.12].

There are close on 200 SSFs listed on the JSE. Their specifications are identical (except for the futures codes) and are shown in Table 3.12.[34]

TABLE 3.12: INDIVIDUAL SHARE FUTURES CONTRACTS LISTED ON THE JSE	
FUTURES CODE	Various
UNDERLYING INSTRUMENT	The various listed companies
CONTRACT SIZE	100 x the share price (e.g. share price 85.25, future price R8,525.00) 110 x the share price for NEDQ
EXPIRY DATES & TIMES	If the contract is a constituent of any of the traded indices, 15h40 on the 3rd Thursday of Mar, Jun, Sep & Dec. (Or the previous business day if a public holiday) If the contract is not a constituent of any of the traded indices, 17h00 on the 3rd Thursday of Mar, Jun, Sep & Dec. (Or the previous business day if a public holiday)
QUOTATIONS	Price per underlying share to two decimals
MINIMUM PRICE MOVEMENT	R 1 (R 0.01 in the share price)
EXPIRY VALUATION METHOD	If the contract forms a constituent of any of the traded indices, then, arithmetic average of 100 iterations taken every 60 seconds between 14h01 and 15h40 will be used. If the contract does not form a constituent of any of the traded indices, then, the official closing price determined by the JSE Securities Exchange will be used
SETTLEMENT METHOD	Physically settled in terms of Rule 8.4.7.

[33] Almost verbatim from www.jse.co.za. All the futures and their specifications can be found on this website.

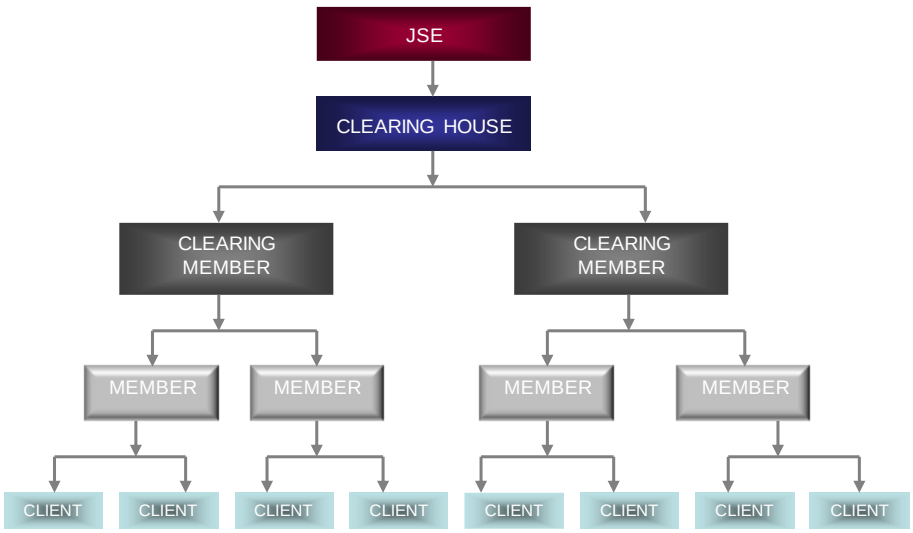
[34] Verbatim from www.jse.co.za.

3.22 RISK MANAGEMENT BY JSE (DERIVATIVES DIVISIONS)

The JSE (Safex in the past) itself states boldly that its risk management philosophy "… is very simple – 'You stand good for your client.' What this means is that each member will carry its client's losses if the client defaults just as each clearing member will carry its member's (for whom it clears) losses if the member defaults. This pyramid structure forms the basis of the ... Risk Management Structure." The structure is depicted as in Figure 3.13.

The responsibility of appropriate risk management is placed on the shoulders of the clearing members who, in turn, pass this accountability onto the members for whom they clear, i.e. the non-clearing members. They, in turn, risk manage in terms of the Rules of the exchange which stipulates the "levying" of a margin deposit.

Figure 3.13: risk management by JSE (derivatives divisions)



As noted, the JSE requires a margin deposit to be paid by all participants when they take on a position in futures. This margin is registered in the name of the client or member, and it is equivalent to between 2% and 8% of the value of the contract. This reflects the parameters of the risk that is associated with trading in the futures market in one day. As noted earlier, the initial margin is reassessed each day by the JSE and brings into play the variation margin.

Ultimately, the risk that the JSE bears is the risk that one of the clearing members defaults, whether the result of a non-clearing member causing it to default or as a result of its own activities. However, this is remote, as the clearing members are all major banks.

3.23 SIZE OF FUTURES MARKET IN SOUTH AFRICA

Table 3.13 provides a summary of the activity in the South African futures markets for several years.

TABLE 3.13: DERIVATIVE MARKET ACTIVITY

Year	Number of futures contracts			
	Equity derivatives	Commodity derivatives	Interest rate derivatives	Currency derivatives
2008	451 477 034	2 646 108	433 309	5 720 586
2009	161 667 629	1 908 580	565 358	7 907 348
2010	160 529 887	2 138 874	899 540	7 480 082
2011	148 822 929	2 643 140	1 335 721	13 777 892
2012	137 058 773	2 999 444	2 481 759	16 926 011
2013	217 465 511	2 788 187	3 665 646	32 031 416
2014	252 378 555	2 729 959	5 031 551	43 725 844
2015	448 041 117	3 500 065	5 692 757	44 637 555
2016	427 451 830	3 426 080	9 435 718	48 324 320
2017	311 565 908	3 009 693	12 253666	68 368 701
2018	113 181 024	3 431 946	12 217 063	73 992 712
2019	85 117 279	3 510 686	11 423 782	69 737 470
2020	103 238 394	3 495 598	13 319 174	61 557 306

Source: South African Reserve Bank Quarterly Bulletin

3.24 REVIEW QUESTIONS AND ANSWERS

Review questions

1. Futures can be bought and sold in the secondary market like NCDs or treasury bills. True or false?
2. A futures exchange is a “marketplace” where buyers and sellers can “find” each other to enter into a futures contract. True or false?
3. In practice the delivery of the underlying asset on the expiry date of a futures contract is rare, particularly in the *financial* futures markets. True or false?
4. A future will always trade at a value above the spot price of the underlying asset up to the expiry date, when the two values will be the same. True or false?
5. At the start of a futures deal the "initial margin" deposit that has to be paid at the start of a futures deal is set at a level that essentially protects the exchange from default because it is extremely unlikely that losses on positions will exceed the initial margin. True or false?
6. In South Africa settlement of a financial futures contract can only be done in cash. True or false?
7. The fair value price of a short-term interest rate future cannot be calculated without an implied forward rate. True or false?
8. The fair value price of a bond future is its clean price less the applicable interest factor. True or false?
9. What is the relationship between a futures contract on the one hand and specific and notional assets on the other?
10. An investor bought an index future on 5 September with an expiry date of 30 September. The trading price was 7535. The value of a contract was R10 times index value and the investor bought 5 contracts at a total transaction cost (commission) of R50. On 30 September the index value was 7685. What was the total profit (+) or loss (–) to the investor?
11. What is a "short sale"?
12. Why are members of the futures exchange referred to generically as "broker-dealers"?

13. Why is each futures contract "valued" at the end of every working day?
14. Define "open interest" in the futures market.
15. Given the following information, what is the fair value price of an index future?
    - Spot price (SP) = 5375
    - risk free rate (rfr) (assumed) = 12.5% pa
    - assumed dividend yield = 2.1% pa
    - term to maturity of contract = 320 / 365.
16. The rate now (spot rate) for three months (91 days) is 7.90% pa, the rate now (spot rate) for six months (182 days) is 8.20% pa, and the rate now for nine months (273 days) is 8.70% pa. What is the implied forward rate for six months starting in 3 months' time (3x9)?
17. The rate / price of a 3-month JIBAR interest rate future was 8.89% on the date the contract (nominal value R100,000) was purchased. On the expiry date the rate / price of this future is 7.66%. what is the margin call due based on a basis point value of R2.50?
18. You have the following information:
    - Bond (a fictitious bond) = R123
    - Maturity date = 15 September 2035
    - Coupon (c) = 13.5% pa
    - Coupon payment dates (cd_1 and cd_2) = 15 March and 15 September
    - Yield to maturity (ytm) = 8.2%
    - rfr = 7.5% pa
    - Purchase (valuation) date of future (fvd) = 16 July
    - Termination date of future (ftd) = 16 October
    - Books (register) close/s = one month before coupon dates

If the dirty price of the bond is 105.71077, what is the fair value price of the futures contact?

19. You are given the following information regarding an ALSI future:
    - SP (i.e. index value) = 11232
    - rfr = 8.5% pa
    - I (dividend yield, assumed) = 3.5% pa
    - t (number of days to expiry of contract / 365) = 132 / 365

    What is the fair value price of this future?

20. Summarise the concepts of "cost of carry " (CC) and "basis" (B) in one equation that gives the fair value price (FVP) in terms of the spot price (SP) and these two concepts.
21. A *spread* is the difference between the prices of two similar or related securities. True or false?

Answers

1. False. Futures are not negotiable in the same sense as NCDs or TBs. Futures are fully fungible contracts which means that when you take an equal and opposite position to the position you hold, you no longer have a position. This is referred to as closing out or netting off a position.
2. False. Even though a client may buy a future from, or sell a future to, a member of the exchange, the transaction is guaranteed by the exchange, i.e. the exchange acts as the seller for each buyer, and as the buyer for each seller.
3. True.
4. False. At times the future can trade at a discount to the spot price.
5. True.
6. False. In the financial futures markets, physical delivery also takes place in some cases (for example, certain bond contracts), but in most cases settlement takes place in the form of cash settlement.
7. True.
8. False.
9. A futures contract is a derivative instrument, i.e. it and its value are derived from an underlying asset and it cannot exist in the absence of this asset. The underlying assets of futures contracts can be divided into two broad categories, i.e. specific assets and notional assets. Specific (also called “physical”) assets include the R153 bond, pork bellies, etc.,

while notional assets include the industrial index, the all share index, the gold index, etc.

10. ((7685 – 7535) x R10 x 5) – 50 = R7,450 .
11. “Short” sale means the sale of an instrument that the seller does not own. The seller borrows the instrument from an investor / lender for a fee and delivers it back to the lender when the short sale is unwound by the purchase of the instrument. A short sale is undertaken to profit opportunistically from an expected decline in price.
12. Members of the futures exchange are referred to by the generic term *broker-dealers*, because they may deal as principals or agents (in dual capacity). Some broker-dealers do not have clients and only deal as principals, and some broker-dealers deal only as agents with clients (both are called single capacity).
13. The purpose of the marking to market is to ensure that the *margin account is kept funded*. If the mark-to-market price is lower than the purchase price, i.e. if the holder of a future is making a loss, s/he has to top up the margin account to the proportionate level it was. This amount is called the *variation margin*. If a holder makes a profit, a credit to the margin account is made. The ultimate purpose is to ensure that the exchange, which has taken on the risk of guaranteeing the trades, is protected.
14. “Open interest” is the term for the *number of outstanding contracts*, i.e. contracts that are still open and obligated to be delivered (physical or cash settlement). Double counting is avoided in the number. If broker-dealer A takes a position in a future and B takes the opposite position, open interest is equal to 1.
15. 5375 x (1 + ((0.125 – 0.021) x 320/365)) = 5,865
16. FFR= ((1+(0.0870x273/365))/(1+(0.079x91/365)–1)x 365/(273 – 91)) x 100 = 8.92%p.a.
17. R307.50 (R2.50 per basis point).

18. 105.71077 (=A)
    + 1.99793 {A x {(rfr / 100) x [(ftd – fvd) / 365]}}
        - 6.79300 {(c / 2) x (1 + {(rfr / 100) x [(ftd – cd_2) / 365)]})}
    = 100.91570.

19. 11435 {11232 x {1 + [(0.085 – 0.035) x (132 / 365)]}}.
20. FVP = SP + B + (CC – B).

21. True.

3.25 USEFUL ACTIVITIES

Futures tutorials:

https://www.cmegroup.com/education/files/a-traders-guide-to-futures.pdf

https://www.cnbc.com/futures-now-tutorials/

CHAPTER 4

SWAPS

4.1 CHAPTER ORIENTATION

CHAPTERS OF “THE DERIVATIVES MARKET”	
Chapter 1	The derivatives market in context
Chapter 2	Forwards
Chapter 3	Futures
Chapter 4	Swaps
Chapter 5	Options
Chapter 6	Other derivative instruments

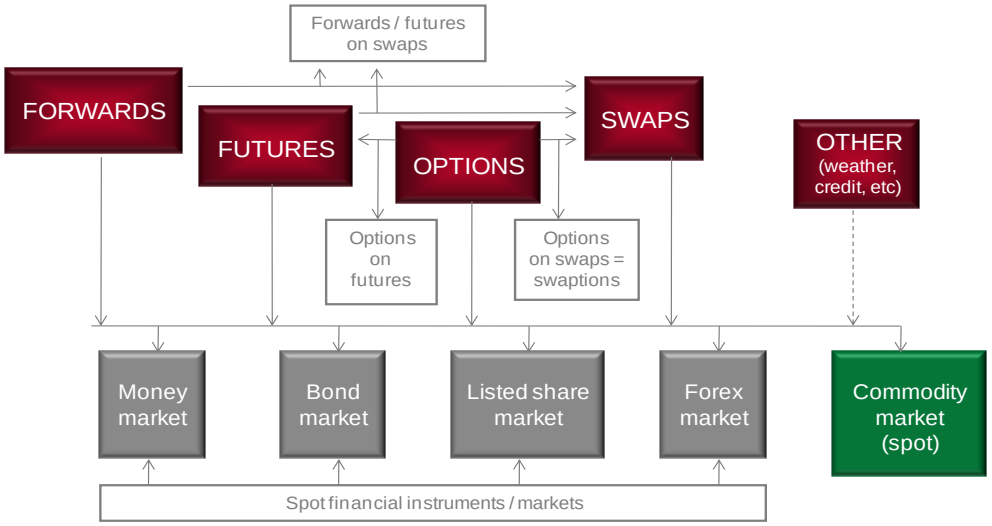
4.2 LEARNING OUTCOMES OF THIS CHAPTER

After studying this chapter, the learner should / should be able to:

- Define a swap.
- Know the different types of swaps.
- Understand the motivations underlying interest rate swaps.
- Understand how swaps are utilised in risk management.
- Know the variations on the main themes of swaps.

4.3 INTRODUCTION

Figure 4.1: derivatives & relationship with spot markets



Swaps emerged internationally in the early eighties, and the market has grown significantly. An attempt was made in the early eighties in South Africa to kick-start the interest rate swap market, but few money market benchmarks were available at that stage to underpin this new market. It was only in the middle nineties that the swap market emerged in South Africa, and this was made possible by the creation and development of acceptable benchmark money market rates.

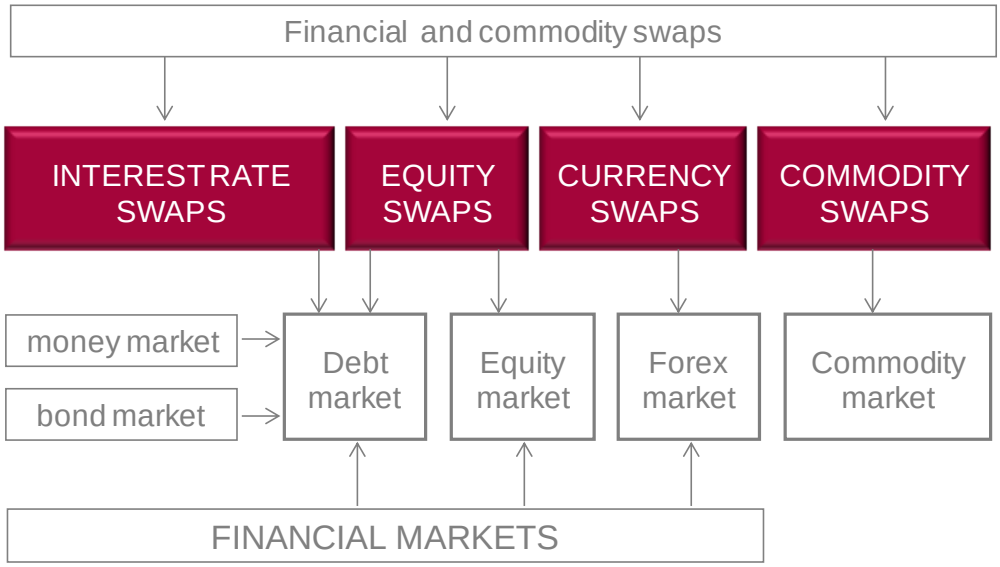
A reminder of where we are in this discussion is provided in Figure 4.1. We cover swaps before options because of the existence of *options on swaps*. This illustration shows that we find swaps in all the spot financial markets.

A swap may be defined as an agreement between counterparties (usually two but there can be more parties involved in some swaps) to *exchange specific periodic cash flows in the future based on specified prices / interest rates*. The cash flow calculations are made with reference to an agreed notional amount (i.e. an amount that is not exchanged). Swaps allow financial market participants to better manage risk in their relevant preferred habitat markets.

Swaps are a significant part of the financial markets and, as noted, are found in all the markets. The *interest rate swap* has a leg in the money market and a

leg in the bond market. *Equity swaps* have a leg in the equity market and the other in the bond market (and sometimes the money market). *Currency swaps* (not to be confused with foreign exchange swaps) have two legs in the foreign exchange market, but in different geographic markets. *Commodity swaps* involve the exchange of a fixed price on a commodity for the spot price (usually an average), and sometimes the transaction does not include the same commodity. The swap market may be depicted as in Figure 4.2.

Figure 4.2: swaps



To this list may be added the *credit risk swap*, but as the compensation for the "protection buyer" is contingent upon a "credit event", it is more akin to an insurance policy and will be discussed under the "other derivatives" section.

The various swaps undertaken in the five markets are covered briefly below. Interest rate swaps dominate and are given pole position, and we conclude with brief sections on the listed swaps in South Africa and the organisation of the swap market. The following are the headings:

- Interest rate swaps.
- Currency swaps.
- Equity swaps.
- Commodity swaps.

- Listed swaps.
- Organisation of the swap market.

4.4 INTEREST RATE SWAPS

4.4.1 Introduction

An interest rate swap entails the swapping of differing interest obligations in a single currency between two parties via a facilitator, usually a bank. It is an agreement between two parties to exchange a series of *fixed rate cash flows* for a series of *floating rate cash flows* in the *same currency*. These interest amounts are calculated with reference to a mutually agreed *notional amount*. The notional amount is not exchanged between the parties.

The most common interest rate swap is a coupon swap. The fixed rate payer is called the *buyer* and the party that undertakes to make *floating rate payments* is called the *seller*. When two floating rates are exchanged, they are called *basis swaps*. In fact, there are a variety of interest rate swaps, and these are mentioned at the close of this section. The following sections are covered here:

- Motivation for interest rate swaps.
- Coupon swap: transforming a liability.
- Coupon swap: transforming an asset.
- Organisation of the swap market.
- Variations on the theme.

4.4.2 Motivation for interest rate swaps

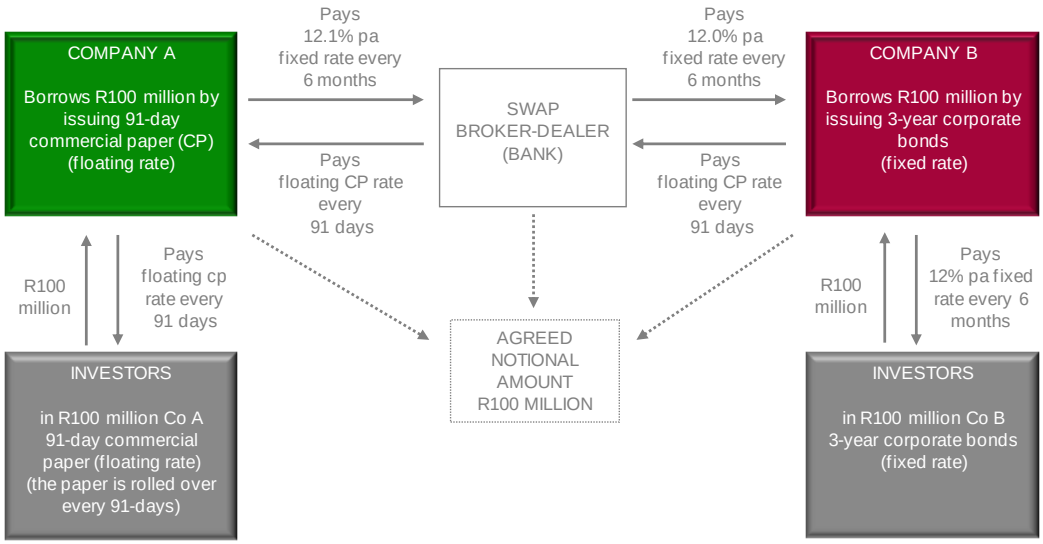
The circumstances that give rise to interest rate swaps (IRSs) usually involve interest rate risk. The following main IRS applications may be identified:

- Transforming a liability.
- Transforming an asset.
- Asset and Liability management in commercial banks

4.4.3 Coupon swap: transforming a liability

An example of an IRS that transforms a liability is shown in Figure 4.3.

Figure 4.3: interest rate swap example: transforming a liability



In this example Company A has borrowed R100 million through the issuing of 91-day commercial paper (which is re-priced every 91 days at the then prevailing rate), while Company B has borrowed R100 million by the issuing of corporate bonds at a fixed rate of 12% pa for a 3-year period. These borrowing habitats could reflect the following:

- Company A believes interest rates are going to move down or sideways. It therefore does not want to “lock in” a rate for a long period and wants to take advantage of rates declining if this does come about.
- Company B is of the view that rates are about to rise and wishes to lock in a rate now for the next three years.

Time passes and the two parties change their views. A sharp banker spots the changed views of the two companies and puts the following deals to them:

Company A

- Company A and the bank enter into an interest rate swap agreement.
- Company A agrees to pay to the bank a fixed rate of 12.1% for the next three years, interest payable six-monthly.

- The bank agrees to pay Company A the floating commercial paper rate every 91-days.
- The notional amount of the swap is R100 million.

Company B

- Company B and the bank enter into an interest rate swap agreement.
- Company B agrees to pay to the bank the commercial paper floating rate every 91 days.
- The bank agrees to pay to Company B paying a fixed rate of 12.0%, interest payable six-monthly.
- The notional amount of the swap is R100 million.

Because of their changed views, the deals are accepted by both companies. Company A's obligation to pay the 91-day commercial paper rate to the holders (which may be different in each rollover period) is matched by the bank's payment of the 91-day commercial paper rate to it. It is then left only with the obligation to pay the fixed rate of 12.1% pa to the bank.

Conversely, Company B's obligation to pay the fixed 12% pa to the investors in its paper is matched by the bank's obligation to pay the fixed 12% pa rate to it. Company B is thus left with the obligation to pay the 91-day commercial paper rate to the bank.

The interest obligations of the bank match, with the exception that the bank earns 0.1% on the fixed interest leg of the transaction (R100 000 per annum excluding compounding and present value calculations).

TABLE 4.1: FIXED FOR FLOATING INTEREST RATE SWAP
(FIXED RATE = 12.1% PA)

	Company A pays	Company B pays	Floating rate (% pa) assumed
Year 1 Day 0 Day 91 (91 days)	-	-	-

Day 182 (91 days)		2 966 849.32	11.9
Day 273 (91 days)	6 050 000	2 991 780.82	12.0
Day 365 (92 days)		3 066 575.34	12.3
Year 2	6 050 000	3 201 095.89	12.7
Day 91 (91 days)			
Day 182 (91 days)		3 241 095.89	13.0
Day 273 (91 days)	6 050 000	3 365 753.43	13.5
Day 365 (92 days)		3 490 410.96	14.0
Year 3	6 050 000	3 427 945.21	13.6
Day 91 (91 days)			
Day 182 (91 days)		3 340 821.92	13.4
Day 273 (91 days)	6 050 000	3 116 438.36	12.5
Day 365 (92 days)		2 991 780.82	12.0
	6 050 000	2 898 630.14	11.5
Total	36 300 000	38 099 178.08	

The mathematics of this deal is straightforward, and simply amounts to interest payments (i.e. cash flows) over the three-year period. The cash flows are shown in Table 4.1.

Company A's floating rate obligation is cancelled out by the matching payments from the bank, and Company B's fixed rate obligation is cancelled out by the payments from the bank. Company A thus over the period of 3 years paid out a total of R36.3 million in interest, compared with Company B's R38 032 876.73. Thus, Company A's amended interest rate view was correct, and it saved R1.7 million. Company B's treasurer should have stuck to his original view.

Counterparty risk

It is rare that counterparties in swap deals can find one another and do a deal to their mutual satisfaction. If they do, the *deal rests on the integrity of the two parties*, i.e. they are each exposed to counterparty risk. More generally, it is bankers that seek out these transactions.

The banks then interpose themselves between the clients (principals) and undertake to receive and pay the relevant interest amounts. Clearly, it is only

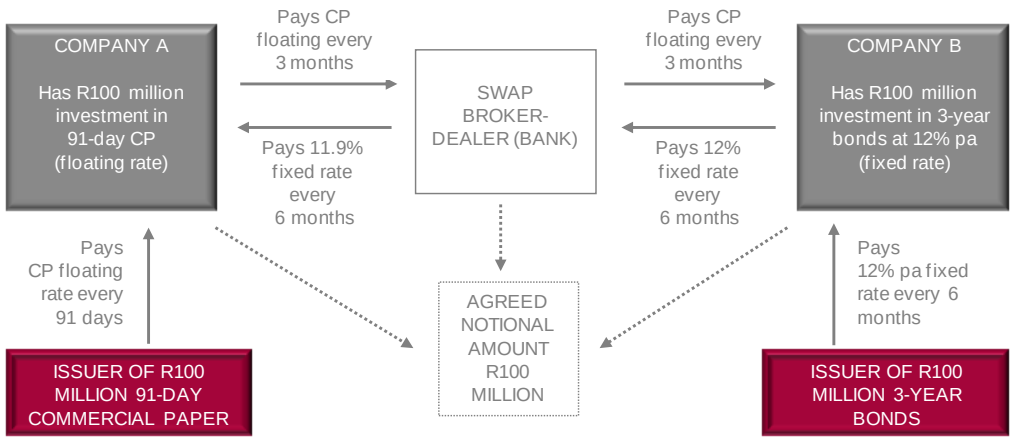
the large banks that can do these deals, because the counterparty of each principal is the intermediary bank (sometimes called the *swap agent*).

Fixed rates and floating rates

The above was an example of a plain vanilla swap. The floating rate used was the 91-day commercial paper rate. Most swaps in reality involve other well-known benchmark rates, such as the SONIA in the UK, the SOFR rate in the US, and the JIBAR rates in South Africa, and so on. The fixed leg is not benchmarked because it is an agreed number.

4.4.4 Coupon swap: transforming an asset

Figure 4.4: interest rate swap example: transforming an asset



4

In the example presented in Figure 4.4, Company A transforms its investment in 91-day commercial paper, which is repriced every 91-days, into an 11.9% fixed rate investment. Company B does the reverse. In this example the motivation for the deal was a change in interest rate views. It will be noted that there is a mismatch in the timing of the interest payments. This does not have to be the case.

4.4.5 Variations on the theme

There are many variations on the main IRS theme. A few examples are:

- *Basis swap:* A swap where two floating rates are swapped.

- *Amortising swap:* A swap with a notional value that reduces over the life of the swap in a predetermined way.
- *Accreting swap* (also called *step-up swap):* A swap in terms of which the notional amount increases in a predetermined manner during the term of the swap.
- *Roller-coaster swap:* A swap in terms of which the notional amount increases and decreases during the term of the swap.
- *Deferred swap* (also called *forward start swap*): A swap where the counterparties do not start exchanging interest payments until a future date.
- *Extendable swap*: A swap where one party has the option to extend the life of the swap beyond the term of the swap, according to predetermined conditions.
- *Constant maturity swap*: A swap where a floating rate (for example SOFR) is exchanged for a specific rate (for example the 10-year rate on government bonds).

4.5 CURRENCY SWAPS

4.5.1 Definition

A currency swap or cross-currency interest rate swap (CCIRS) – involves an exchange of cashflows, usually similar to a single currency interest rate swap, but in two different currencies. For example, a company has a borrowing in one currency and wishes to convert it into a borrowing in another currency. The transaction is the conversion of a stream of cashflows in one currency into a stream of cashflows in another currency.

It is possible to swap any combination of fixed and floating interest in two currencies:

- Fixed in one currency into fixed in another currency
- Fixed interest in one currency into floating in another currency (a ‘cross-currency interest rate swap or ‘currency and interest rate swap); or
- Floating interest in one currency to floating interest in another (a ‘cross-currency basis swap’)

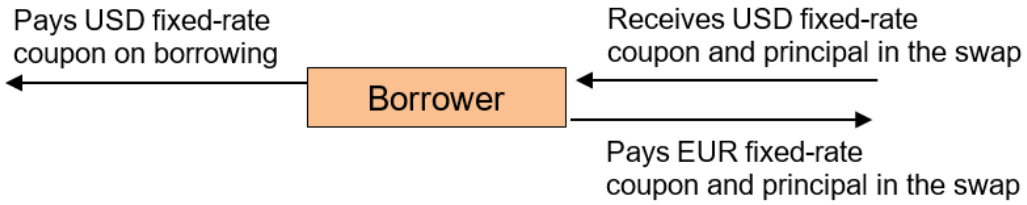
It is important to note that, unlike an interest rate swap, a currency swap which is based on a borrowing or an asset generally involves exchange of principal amounts as well as interest amounts. In a single currency interest rate swap, the principal amount is never subject to delivery.

An important point to note is the principal amounts are always exchanged at the end of the swap and are often also exchanged at the start of the swap using the same principal amounts. So, the same exchange rate at the start of the swap will be used at the end of the swap.

As a hedge, currency swaps are generally used for periods longer than one year to manage exchange rate risk.

Hedging exchange rate risk beyond one year using outright forward foreign exchange contracts is expensive because the market for outright forward exchange contracts beyond one year is very illiquid.

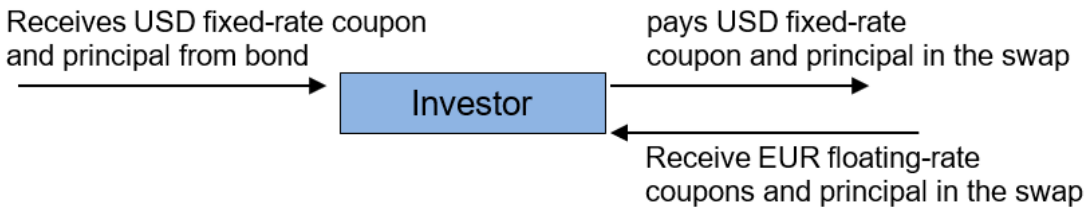
4.5.2 Liability swap converting a fixed-rate USD borrowing into a synthetic EUR fixed-rate borrowing



In the examples in diagram 4.5.2 and 4.5.3 The value of the two streams of cashflows at the start of the currency swap should be equal, converted at the spot exchange. For example, exchanging an amount of EUR 100 million using EUR/USD 1.1000 spot, the amount of USD would be 110 million. At maturity, the two amounts will be exchanged at the same spot rate of EUR/USD 1.1000.

The objective is to hedge the long-term currency risk on the principal amounts.

4.5.3 Asset swap converting a fixed-rate USD investment into a synthetic EUR floating-rate investment



4.5.4 Cross-currency basis swap

A cross-currency basis swap involves payment of cashflows based on a floating rate index in one currency and the receipt of cashflows based on a floating index in another currency. in the South African market, the flows are based on 3-month ZAR JIBAR and 3-month USD SOFR. In this case, the flows on the USD leg would be SOFR at a flat rate while the ZAR flows would be JIBAR plus a spread.

For example, 3-month SOFR flat against 3-month JIBAR+50 basis points (BP)

4.5.5 Cross-currency basis swap example

A listed South African construction company has received a 3-year overseas contract. The contract will pay drawdowns quarterly over the three-year period in US dollars. They need to borrow USD 10 million for the 3 years to fund the project. Even though the company does not have access to USD funding, they are able to issue a Floating Rate Note (FRN) in Rand for three years in the South African market to raise the equivalent amount of USD 10 million. At the current exchange of USD/ZAR 17.000

They issue the 3-year FRN in R170 million. The coupon on the FRN is 3-month JIBAR + 100 BP.

The company enters into a currency swap to switch the proceeds of the ZAR FRN into USD with their bankers with an agreement to exchange the principal amounts at the start and at the end of the swap. amounts at the start of the swap.

The rate at which the swap is concluded is 3-month SOFR flat against 3-month JIBAR+50 BP.

The Final result

- They pay 3-month JIBAR+100BP on the FRN
- They receive 3-month JIBAR+50BP on the Currency swap
- They pay USD SOFR flat on the Currency swap
- Cost of USD funding is 3-Month SOFR+50BP for 3 years.

At maturity of the currency swap they will pay USD 10 million to the bank and receive R170 million from the bank. They use the ZAR proceeds to repay the FRN at maturity.

The main purpose for the swap was to hedge the exchange rate risk on the principal amount.

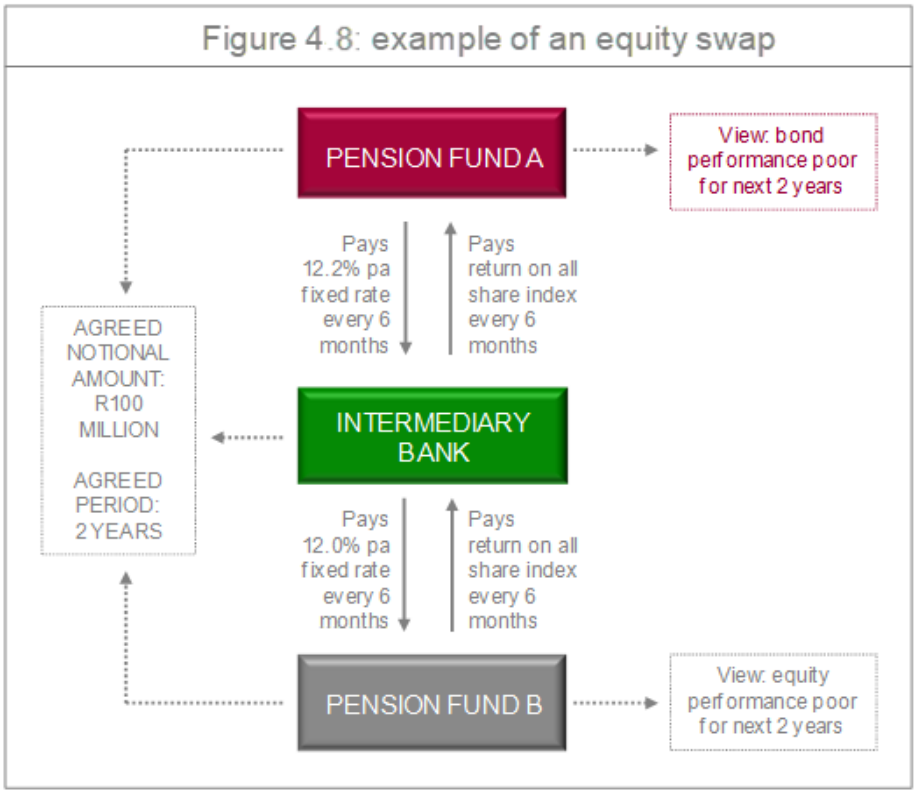
4.6 EQUITY SWAPS

4.6.1 Introduction

An equity swap is a *fixed-for-equity swap*. It is similar to the conventional interest rate swap in terms of a term to maturity, notional principal amount, specified payment intervals and dates, fixed rate and floating rate. The difference lies therein that the *floating rate is linked to the return on a specified share index* (usually total return, i.e. capital appreciation and dividend). The following are the sections covered here:

- Example of equity swap.
- Variations on the theme.

Figure 4.8: example of an equity swap



4.6.2 Example of equity swap

These swaps are a relatively new invention (first emerged in 1989), and are used for temporary desired changes to the income of a portfolio without having to sell the relevant instrument/s. For example (see Figure 4.8), a portfolio manager may believe that equities are to yield inferior returns for, say, two years, and that over this period bonds should perform well. An equity swap is an ideal instrument for this purpose, i.e. the equity return is swapped for a fixed rate of return for two years.

It will have been noted that the intermediary bank (who arranged the deal) profits by 0.2% pa on the fixed leg (R200 000 pa for 2 years). The two principals (pension funds) are not aware of this because they deal with the bank.

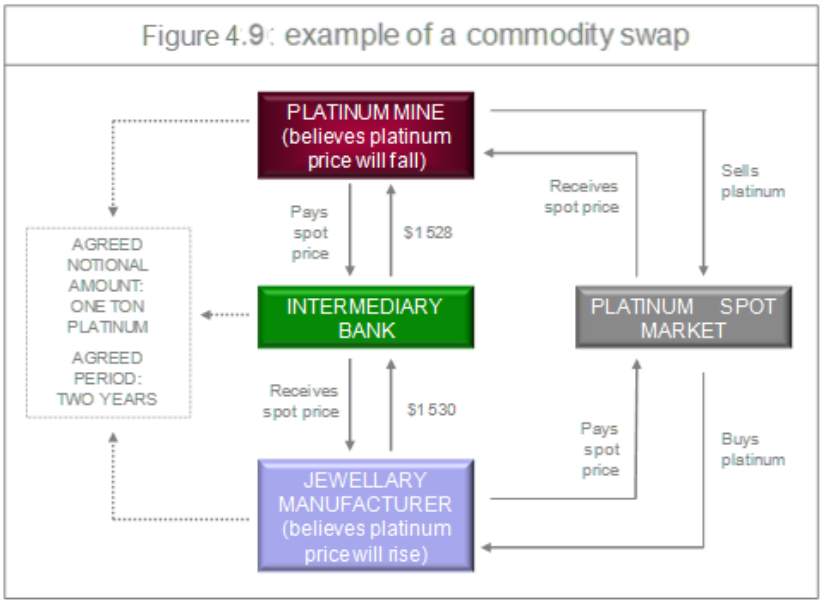
4.6.3 Variations on the theme

There are some variations to this plain vanilla equity swap:

- *Floating-for-equity equity swap*: An equity swap with one leg benchmarked against a floating rate of interest and the other leg benchmarked against an equity index.
- *Asset allocation equity swap*: An equity swap where the equity leg is benchmarked against the greater of two equity indices.
- *Quantro equity swap*: An equity swap with two equity legs, the return on one equity index is swapped for the return on another equity index.
- *Blended-index equity swap*: An equity swap where the floating leg is an average (weighted or otherwise) of two or more equity indices.
- *Rainbow-blended-index equity swap*: Same as the previous, but the indices are different foreign indices.

4.7 COMMODITY SWAPS

Figure 4.9: example of a commodity swap



Commodity swaps are where parties *exchange fixed for floating* ***prices*** *on a stipulated quantity of a commodity* (for example a 20 000 ounces of platinum). An example: a South African producer of platinum wishes to fix a price on part of its production (20 000 ounces), because it is of the opinion that the price of platinum is about to fall (wants to *receive fixed*, i.e. a fixed price, and *pay floating*, i.e. the spot rate).

On the other hand, a manufacturer of jewellery in Italy believes that the price of platinum is about to rise sharply (wants to *pay fixed*, i.e. fixed price, and *receive floating*, i.e. spot price).

An on-the-ball intermediary bank spots this difference of opinion and puts together the following deal (spot price at inception of the deal is USD 1 529 per ounce):

- The bank offers the mine a fixed price of USD 1 528 per ounce for the next 2 years, payable monthly, in exchange for monthly payments of the average spot rate for the preceding month.
- The bank offers the jewellery manufacturer monthly payments of the average spot rate for the preceding month, in exchange for a fixed price of USD 1 530 per ounce for the next 2 years, payable monthly.

Both parties cannot believe their good fortune and accept the deal. The banker is also pleased. It will be apparent that if the platinum price falls, the mine will be extremely pleased, because it receives the ever-declining price on the spot market and pays this to the intermediary bank. In exchange the miner receives the fixed price of USD 1 528 per ounce.

The jewellery manufacturer, on the other hand, will be smarting because it is paying floating in the spot market and receiving this same amount, while paying a fixed price that is increasingly higher than the spot price. The opposite case will be obvious. This swap deal is depicted in Figure 4.9.

4.8 LISTED SWAPS

Generally speaking the swap market is an OTC market “made” by the banks (see next section). However, in certain markets swaps are listed on financial exchanges.

4.9 ORGANISATIONAL STRUCTURE OF SWAP MARKET

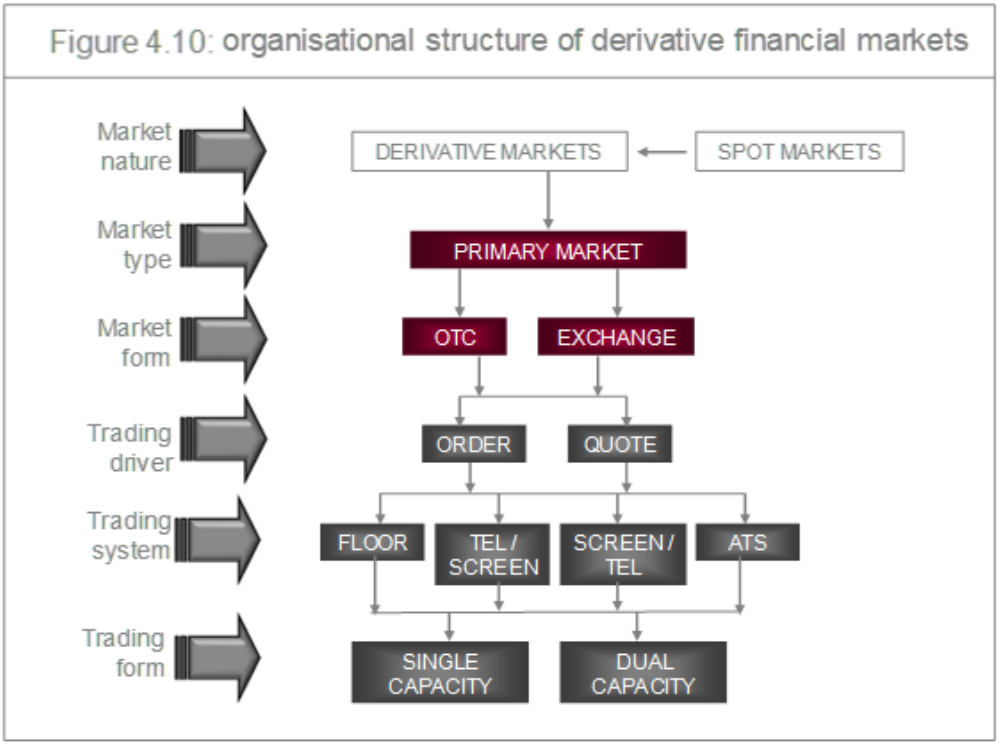
As noted, the swap market is largely an OTC market and it is dominated by the banks. As such, it is largely a primary market. As in the case of OTC forwards,

the OTC swaps are difficult to sell and “getting out” of them amounts to finding an equal and opposite OTC deal (which is not always easy to find).

This also applies to the listed swap market, but there is a major difference: the contracts are standardised, and exchange-traded, and trading “out” of them is easier. Another advantage is that the exchange guarantees the swap deals

in the OTC swap market the trading driver is “quote” (mainly done by the banks) whereas in the exchange-driven market participants place orders with their broker-dealers. The trading system in the OTC market is screen / telephone, i.e. firm prices are quoted on screen and confirmed on the telephone. In the exchange-driven markets it is a combination of ATS and screen-telephone.

Figure 4.10: organisational structure of derivative financial markets



4.10 REVIEW QUESTIONS AND ANSWERS

Review questions

1. The agreed notional amount in a swap is exchanged at the start of the swap and at the maturity of the swap. True or false?
2. The party that agrees to make *fixed interest rate* payments is called the *buyer* and the party that undertakes to make *floating rate payments* is called the *seller*. True or false?
3. The three main reasons for an interest rate swap are: transforming a liability, transforming an asset and Asset and Liability management. True or false?
4. The intermediary bank that arranges a swap transaction assumes the counterparty risk because it interposes itself between the clients (the two parties to the swap), and undertakes to receive and pay the relevant interest amounts. True or false?
5. Most swaps in reality involve well known benchmark rates, such as the SONIA in the UK, the Fedfunds rate in the US, the ROD or JIBAR rates in South Africa, and so on, which the fixed and floating rates in the swap are based in each payment period. True or false?
6. A basis swap is where two floating rates are swapped. True or false?
7. A currency swap in its simplest form involves the exchange of interest payments in one currency for interest payments in another currency. True or false?
8. Define a coupon swap.
9. What is a swap called when two floating rates are exchanged?
10. Define a cross currency liability swap.
11. Investor A has R100 million invested in government bonds at 9.6% pa, payable every six months, but would prefer to get a return on equity for the next two years. Investor B has got R100 million invested in equity, but would prefer a fixed return for the next two years. A bank arranges an equity swap at a commission of 0.2%. What will be the cash flows (in return terms, not in rand) to and from the bank for the two investors every six months?

12. A SA maize producer wishes to fix the price on 100 tons of the coming season's production. A SA mill wants to fix the price on 100 tons of maize that it will require in the coming season for its milling operations. What will be the price expectations of the two parties for a swap to be desirable?

4.10.2 Answers

1. False. The notional amount is not exchanged.
2. True.
3. True.
4. True.
5. False. The fixed leg is not benchmarked because it is an agreed number.
6. True.
7. False. A currency swap in its simplest form involves the exchange of principal and interest payments in one currency for principal and interest payments in another currency.
8. A coupon swap is a fixed for floating interest rate swap may be defined as an agreement between counterparties to *exchange specific periodic cash flows in the future based on underlying assets or prices*. The interest calculations are made with reference to an agreed notional amount.
9. Basis swap
10. A *cross currency liability swap* involves paying fixed in one currency in exchange for receiving a floating rate in another currency
11. Investor A:

Payment to bank: 9.6% pa fixed rate every six months

Payment by bank: return on all share index every six months.

Investor B:

Payment to bank: return on all share index every six months

Payment by bank: 9.4% pa fixed rate every six months.

12. The maize producer wishes to fix a price on its production (100 tons), because it is of the opinion that the price of maize is about to fall (wants to *receive fixed*, i.e. a fixed price, and *pay floating*, i.e. the spot rate). On the other hand, the miller who has to buy the maize believes that the price of maize is about to rise sharply (wants to *pay fixed*, i.e. fixed price, and *receive floating*, i.e. spot price).

CHAPTER 5

OPTIONS

5.1 CHAPTER ORIENTATION

CHAPTERS OF “THE DERIVATIVES MARKET”	
Chapter 1	The derivatives market in context
Chapter 2	Forwards
Chapter 3	Futures
Chapter 4	Swaps
Chapter 5	Options
Chapter 6	Other derivative instruments

5.2 LEARNING OUTCOMES OF THIS CHAPTER

After studying this chapter, the learner should / should be able to:

- Define an option.
- Understand the characteristics of an option.
- Know the different types of, and concepts relating to options.
- Understand the payoff profiles of the various option types.
- Comprehend intrinsic value and time value.
- Understand option pricing models.
- Understand put-call parity.
- Understand the motivation for undertaking (buying or writing) option contracts.
- Comprehend option strategies.
- Understand features and benefits of warrants.
- Understand delta hedging.
- Know the various exotic options.

5.3 INTRODUCTION

Our depiction of the derivatives markets and their relationship to the spot markets is shown here again for the purpose of orientation (see Figure 5.1). The figure shows that there exist *options on specific instruments* (called “physicals”) in the various financial markets and the commodities market, and *options on other derivatives*, i.e. futures, and swaps (with the exception of the category “other”). However, Figure 5.1 cannot demonstrate the detail of the options markets; this is portrayed in Figure 5.2.

Figure 5.2 shows that there exist options on the derivatives futures and swaps (called swaptions), and that there are options on specific instruments and indices in the various financial markets and the commodity markets.

These are covered in the following sections:

- The basics of options.
- Intrinsic value and time value.
- Option valuation and pricing.
- Organisation of options markets.
- Options on derivatives: futures.
- Options on derivatives: swaps.
- Options on debt market instruments.
- Options on equity market instruments.
- Options on foreign exchange.
- Options on commodities.
- Option strategies.
- Exotic options.

Figure 5.1: derivatives & relationship with spot markets

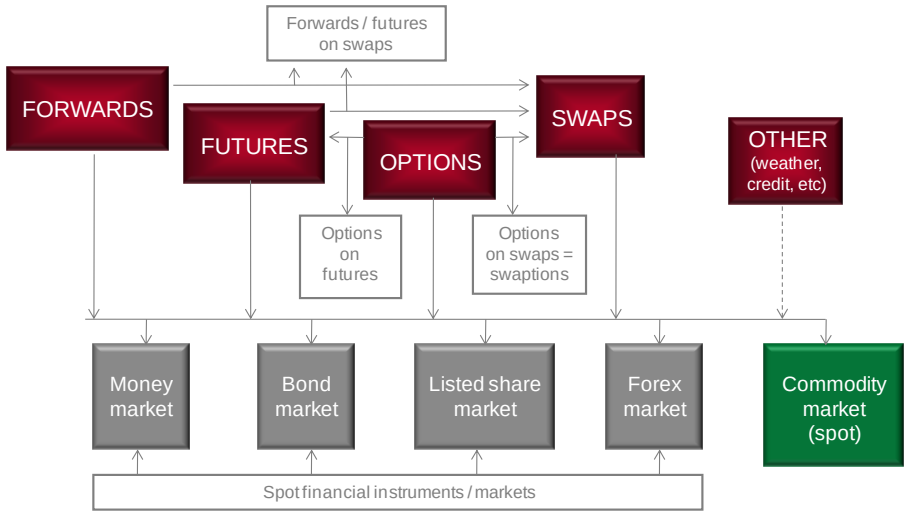
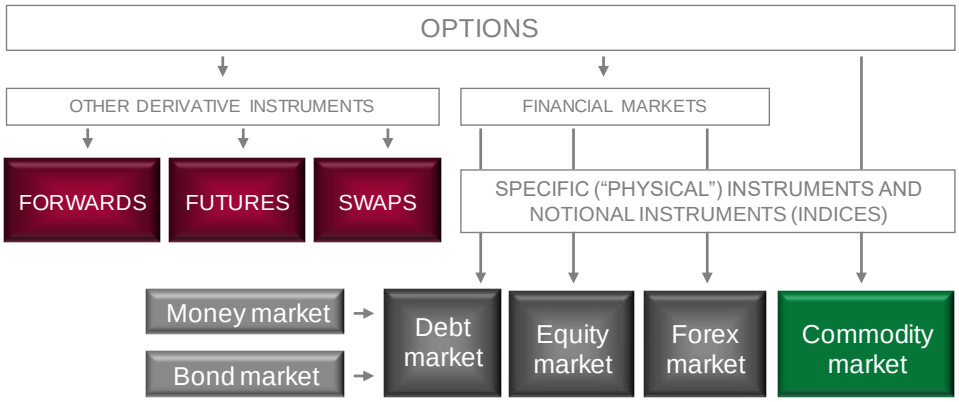


Figure 5.2: options



5.4 THE BASICS OF OPTIONS

5.4.1 Introduction and definitions

An option bestows upon the holder the right, but not the obligation, to buy or sell the asset underlying the option at a predetermined price during or at the end of a specified period. Holders exercise their options only if it is rewarding to do so, and their potential profit is not finite, while their potential loss is limited to the premium paid for the option.

There are *two parties* to each option: the writer and the owner or holder. The writer grants the rights that the option bestows on the owner.

There are three *brands* of options, i.e. American, European, Asian and Bermudan:

- An American option bestows the right upon the holder to exercise the option at any time before and on the expiry date of the option.
- A European option gives the holder to exercise the option only on the expiry date of the option.
- Asian Option: An Asian option is different from the American, European, and Bermudan options in that its payoff is determined by the average price of the underlying asset over a certain period, rather than the price at a specific point in time. Asian options can be beneficial for hedging purposes as they reduce the impact of volatility on the option's payoff. They are commonly used in markets where prices are highly volatile, and their premiums are often lower than those of American or European options due to the averaging feature.
- A Bermudan option is an option where early exercise is restricted to certain dates during the life of the option. It derives its name from the fact that its exercise characteristics are somewhere between those of the American (exercisable at any time during the life of the option) and the European (exercisable only at the expiration of the option) style of options.

Most options traded locally and internationally are American options. It is to be noted that the three option brands do not refer to geographic locations. American and Bermudan options exist in Europe and European and Bermudan options exist in America. While Asian options are utilised in various global markets.

Options are classified as *call* options and *put* options:

- The *call* option bestows upon the purchaser the right to *buy* (think “call for …”) the underlying asset at the pre-specified price or rate from the writer of the option.
- The *put* option gives the holder the option to *sell* the underlying asset at the pre-specified price or rate to the writer (think “put the writer with …”).

The buyer pays the writer of the option an amount of money called the *premium*. It is called this because an option is much like an insurance policy.

Thus, there are *two sides* to every option contract (in the primary market):

- The buyer who has taken a *long position*, i.e. he has *bought* the option and has the benefits of the option (the "option" to do something). The buyer pays the premium for the option to the seller.
- The seller who has taken a *short position*, i.e. he has *sold* the option and received the premium (the seller has "no options" but is contracted to do something if the buyer decides to exercise the option). The *seller* of an option is the *writer* of the option.

The terms *long position* and *short position* applies to both puts and calls, i.e. one can have a *long put* and a *long call* (see below). It will be apparent that the writer's "position" is the reverse of that of the buyer of the option. If the writer does not have an offsetting position in the underlying market, he is said to be *naked* or *uncovered*. If the writer does then he is *covered*.

Options are said to be *in-the-money* (ITM), *at-the-money* (ATM) and *out-the-money* (OTM) (obviously from the point of view of the holder) as follows (in the case of *call* options):

- ITM: Price of underlying asset > strike price.
- ATM: Price of underlying asset = strike price.
- OTM: Price of underlying asset < strike price.

Another few parts of the definition require further illumination:

- Underlying asset.
- Exercising.
- Exercise price.
- Expiration.
- Lapse.

Options are written on "something". This "something" is anything, i.e. options can be written on anything. As each house buyer and seller knows, the most

common option is an option to buy a house. The seller of the house gives (writes) the option to the potential buyer of the house to buy the house at a *specified price* (exercise or strike price) during a specified period.

The house option is usually written free of charge (i.e. no *premium* is payable) and has a fixed term of a day or two or three. The holder of the option can *exercise* the option at any time between the time of the writing of the option and the *expiration* of the option at the *strike* (or *exercise) price* (i.e. specified price). The option *lapses* if the holder decides to not *exercise* his rights under the option. If the buyer exercises the option, the seller is *obliged* to do the deal, i.e. deliver the *underlying asset* (the house).

As seen earlier, the *underlying assets* in the options markets of the world are *other derivatives* (futures and swaps), and *specific instruments* ("physicals") and *notional instruments* (indices) of the various markets.

5.4.2 Payoff profiles

There are 8 possibilities in terms of profit and/or losses when the price of the underlying asset changes (simple assumption: strike price = price of underlying). They are as shown in Table 5.1.

These payoff/loss profiles are depicted below, but first the details:

Underlying commodity = Mineral A
Contract = 100 ounces
Strike price = see diagrams below
Premium (option price) = USD 10 per ounce (i.e. total of USD 1 000)
Option type = European.

TABLE 5.1: PAYOFF PROFILES OF WRITER AND BUYER

Position	Change in price of underlying asset	Profit or loss
Call option – buy *(long call)*	Fall Rise	Loss: premium only Profit: unlimited

Call option – sell (write) *(short call)*	Fall Rise	Gain: premium only Loss: unlimited
Put option – buy *(long put)*	Fall Rise	Profit: unlimited Loss: premium only
Put option – sell (write) *(short put)*	Fall Rise	Loss: unlimited* Gain: premium only
Note: these profiles only apply if strike price = price of underlying on deal day. * = unlimited up to the point where the underlying has no value.		

Call option: buy (long call) at expiry

The long call option is depicted in Figure 5.3[35]. If the price of Mineral A remains at USD 450 (per ounce[36]) or falls below USD 450 for the term of the option contract, the buyer will not exercise the option, because it is not profitable to do so. The option will lapse, and the buyer loses the premium amount USD 10 per ounce, i.e. R1 000 (USD 10 x 100). He cannot lose more than this amount.

If the price moves upwards to say USD 455 at the end of the life of the option, the holder will exercise the option because he will recover part of the premium paid, i.e. USD 500 (USD 5 x 100). The total loss of the holder of the option will be half the premium, i.e. USD 500.

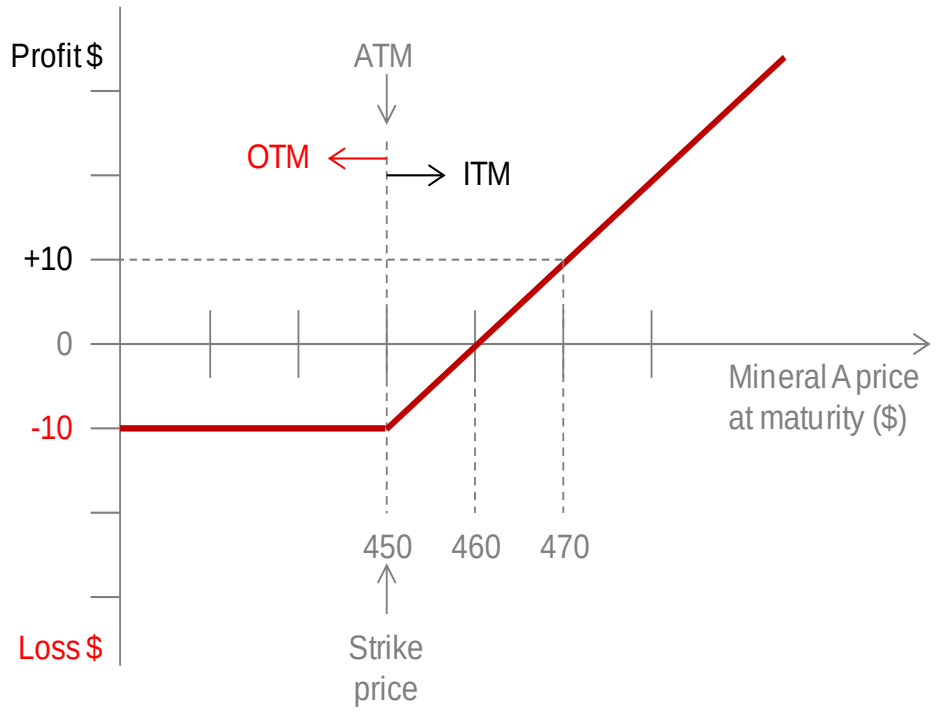
It should be clear that the exercising of the option means that the writer delivers 100 ounces of Mineral A to the buyer for which the buyer pays USD 450 x 100 = USD 45 000. The total cost to the buyer / holder of the option now is USD 46 000 (USD 45 000 plus the USD 1 000 premium). The buyer / holder of the Mineral A now sells the Mineral A in the spot market at the spot market price of USD 455 and receives USD 45 500 (USD 455 x 100). The total loss is USD

[35] Note that in the figures the platinum price is per ounce and therefore profits / losses are per ounce.

[36] All prices quoted hereafter are “per ounce”.

500 (USD 46 000 – USD 45 500). If the holder does not exercise the option the loss is R1 000 (the premium).

Figure 5.3: long call option



There are two other “options” for the buyer / holder in this regard:

- The holder could sell the option contract in the secondary market that exists for this paper. The value of the contract will be close to the market price of the underlying asset (pricing is discussed in some detail below).
- If the market is cash settled and the holder exercises, the writer pays the relevant amount to the holder (i.e. USD 500), and the writer’s profit is USD 500.

If the spot price of Mineral A moves to USD 460 (i.e. the strike price plus the premium) at the end of the life of the option, it also pays the holder to exercise the option because he will recover the premium paid. The option holder pays the writer USD 450 x 100 = USD 45 000 and sells the 100 ounces at the spot price of USD 460, i.e. for USD 460 x 100 = USD 46 000. The difference is USD 1 000 (USD 46 000 – USD 45 000), which is equal to the premium paid.

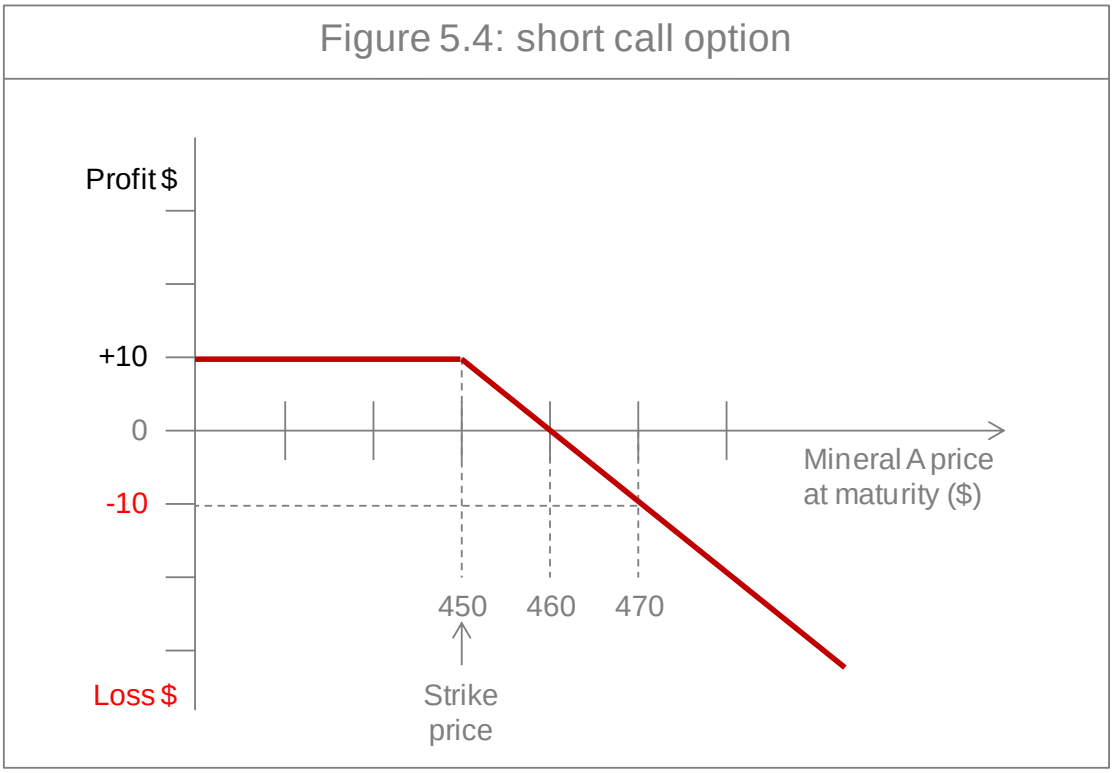
At any price above USD 460, there are 3 possibilities (that apply every day until expiry):

- Exercise the option.
- Sell the option.
- Keep the option (to expiry and exercise on expiry).

It will be apparent that the *profit potential of the holder is unlimited*. If say the Mineral A price moves to USD 600 and the holder exercises, the profit is:

Amount paid	= 100 x USD 450
	= USD 45 000
Premium paid	= 100 x USD 10
	= USD 1 000
Total cost	= USD 46 000
Amount sold for	= 100 x USD 600
	= USD 60 000
Profit	= USD 60 000 – USD 46 000
	= USD 14 000.

Figure 5.4: short call option



Call option: sell (write) (short call) at expiry

The short call option payoff profile is depicted in Figure 5.4.

The payoff profile of the seller/writer of the call option is the reverse of that of the buyer. The maximum the seller can earn is USD 1 000, and the loss potential is unlimited. Thus, if the price at expiry is USD 450 or lower, he makes a profit of USD 1 000. At USD 460, the writer makes nothing, and at any price above USD 460, the writer makes a loss.

Some of the jargon referred to earlier is pertinent here. An *uncovered* or *naked short call* is where the writer does not have a position in the underlying instrument, i.e. is not holding the underlying instrument in portfolio (in this case 100 ounces of Mineral A). Where the writer does have a matching position in the underlying asset, he is *covered*, i.e. has a *covered short call*.

Put option: buy (long put) at expiry

The long put option payoff profile is depicted in Figure 5.5. A put option is where the buyer has the right to "put" (sell to) the writer the underlying asset at a pre-specified price. In this example, the strike price is USD 470, and the buyer pays a premium of USD 1 000 (remember, USD 10 per ounce).

Figure 5.5: long put option

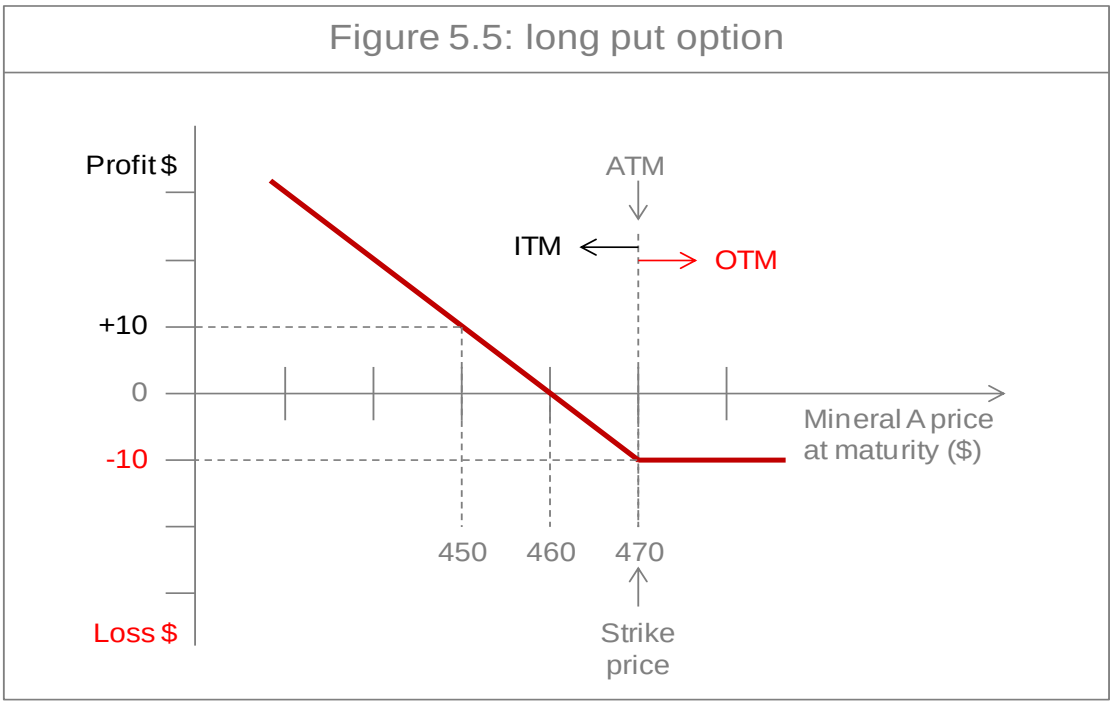
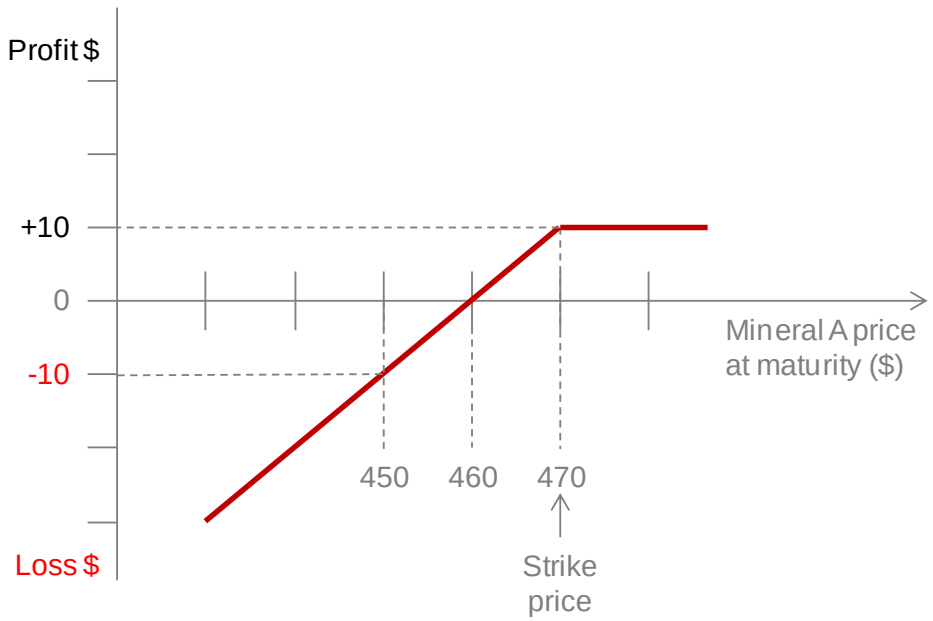


Figure 5.6: short put option



This is the mirror image of buying a call, i.e. the buyer is hoping for a fall in the price to make a profit. At a spot price of USD 470 or higher the buyer will allow the put option to lapse. At USD 460, the buyer breaks even and he will exercise the option before or at expiry to break even. At any price lower than USD 460 the buyer will make a profit.

Put option: sell (write) (short put) at expiry

The short put option payoff profile is depicted in Figure 5.6. At a Mineral A spot price of USD 470 or higher, the writer of a put option with a strike price of USD 470 will make a profit of USD 1 000 (i.e. the premium). At say USD 465 the profit will be halved because the buyer will exercise at expiry date). At any Mineral A price lower than USD 460, the writer's potential loss is unlimited (up to point where the Mineral A price = 0).

5.5 INTRINSIC VALUE AND TIME VALUE

5.5.1 Introduction

The *price or premium* (P) of an option has two parts, i.e.:

- Intrinsic value (IV)
- Time value (TV).

Therefore:

P = IV + TV.

5.5.2 Intrinsic value

The difference between the *spot price of the underlying asset* (SP) and the *exercise price of the option* (EP) is termed the *intrinsic value* (IV) of the option.

As seen, there are 3 categories in this regard:

- In-the-money (ITM) options (have an intrinsic value).
- At-the-money (ATM) options (have no intrinsic value).
- Out-the-money (OTM) options (have no intrinsic value).

ITM options are:

- Call options where: SP > EP.
- Put options where: SP < EP.

Clearly, the following options have no intrinsic value (OTM):

- Call options where: SP < EP.
- Put options where: SP > EP.
- Call options where: SP = EP.
- Put options where: SP = EP.

Thus:

IV = SP – EP (call options); positive when SP > EP.
IV = EP – SP (put options); positive when EP > SP.

A summary is provided in Table 5.2.

TABLE 5.2: PAYOFF PROFILES: ITM, ATM AND OTM OPTIONS				
ITM / ATM / OTM	Call options		Put options	
ITM	SP > EP	IV > 0	SP < EP	IV > 0
ATM	SP = EP	IV = 0	SP = EP	IV = 0
OTM	SP < EP	IV = 0	SP > EP	IV = 0

5.5.3 Time value

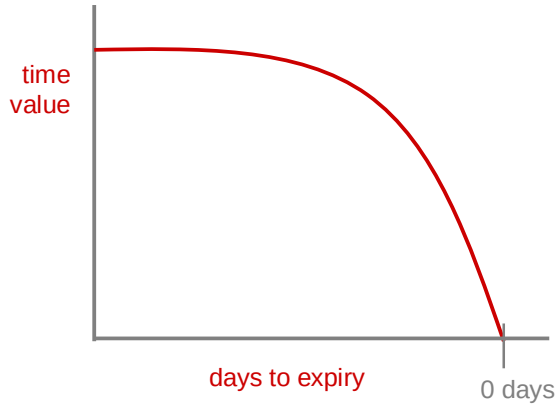
The *time value* (TV) of an option is the difference between the *premium* (P) of an option and its *intrinsic value* (IV):

P = IV + TV.
TV = P – IV.

An example is required:

Option = call option
Underlying asset = ABC share
Underlying asset spot market price (SP) = R70
Option exercise price (EP) = R60
Intrinsic value (IV) = SP – EP = IV
= R70 – R60 = R10
Premium (P) = R12
Time value (TV) = P – IV = TV
= R12 – R10 = R2.

Figure 5.7: time value of option



The option has *time value* of R2, and this indicates that there is a *probability that the intrinsic value could increase between the time of the purchase and the expiration date*. If the option is exercised now (i.e. at R60), the intrinsic value is gained, *but time value is forgone*. It will be apparent that as an option moves towards the expiration date, time value diminishes, and that at expiration time value is zero. This is portrayed in Figure 5.7.

5.6 OPTION VALUATION/PRICING

5.6.1 Introduction

There are two main option pricing / valuation models that are used by market participants:

- Black-Scholes model.
- Binomial model.

Below we also mention the other pricing models and define the so-called "Greeks". We also define the put-call parity concept.

5.6.2 Black-Scholes model

The Black-Scholes model was first published in 1973 and essentially holds that the fair option price (or premium) is a function of the probability distribution of the underlying asset price at expiry. It has as its main constituents the following (see the valuation formula below)[37]:

- Spot (current) price of underlying asset (assume share) (SP).
- Exercise (strike) price (EP).
- Time to expiration.
- Risk free rate (i.e. Treasury bill rate).
- Dividends expected on the underlying asset during the life of the option.
- Volatility of the underlying asset (share) price.

Each of these elements is covered briefly below.

Spot (current) price of underlying asset and exercise price

If a call option is exercised the *profit* is:

SP – EP (obviously if SP < EP, there is no profit).

Call options are therefore more valuable as the SP of the underlying asset *increases* (EP a given) and less valuable the higher EP is (SP a given). The opposite applies in the case of put options. The profit on a put option if exercised is:

EP – SP (obviously if EP < SP there is no profit).

Put options are therefore more valuable as the SP of the underlying asset *decreases* (EP a given) and less valuable the lower EP is (SP a given).

[37] This section relies heavily on Hull (2000: 250).

Time to expiration

The longer the time to expiration the more valuable both call and put options are. The holder of a short-term option has certain *exercise opportunities*. The holder of a similar long-term option also has these opportunities and more. Therefore, the long option must be at least equal in value to a short-term option with similar characteristics. As noted above, the longer the time to expiration the higher the probability that the price of the underlying assets will increase/decrease.

Risk free rate

The risk free rate (rfr) is the rate on government securities. The effect of the rfr on option prices is not as clear-cut as one would expect.

As the economy expands, rates tend to increase, but so does the expected rate of share price increases, because dividends increase. It is also known that the present value of future cash flows also decreases as rates increase.

These two effects tend to reduce the prices of put options, i.e. the value of put options decreases as the rfr increases. However, it has been shown that the value of call options increase as the rfr increases, as the former effect tends to dominate the latter effect.

Dividends

Dividends have the effect of reducing the share price on the ex-dividend date. This is positive for puts and negative for calls. The size of the expected dividend is important, and the value of call options is therefore negatively related to the size of the expected dividend. The opposite applies to put options.

Volatility

Of these factors, the only one that is *not observable* is *volatility*, i.e. the extent of variance in the underlying asset price. This is estimated (calculated) from data in the immediate past.

It will be clear that as volatility increases, so does the chance that the share will do well or badly. The investor in a share will not be affected because these two outcomes offset one another over time. However, in the case of an *option holder* the situation is different:

- The call option holder benefits as prices increase and has limited downside risk if prices fall.
- The put option holder benefits as prices decrease and has limited downside risk if prices rise.

Thus, both puts and calls increase in value as volatility increase.

The model (you will not be examined on this mathematics)

The Black-Scholes valuation model is as follows (European call option):

$P_c = N(d_1)S_0 – E(e^{-rt})N(d_2)$

where

P_c = price of European call option
S_0 = price of the underlying asset currently
E = exercise price of the option
E = base of the natural logarithm, or the exponential function
r = risk-free rate per annum with maturity at expiration date
N(d) = value of the cumulative normal distribution evaluated at d_1 and d_2
t = time to expiry in years (short-term = fraction of a year)
$d_1 = [\ln(S_0/E) + (r + \sigma^2/2)t] / \sigma \sqrt{t}$
$d_2 = d_1 - \sigma \sqrt{t}$
ln = natural logarithm
σ^2 = variance (of price of underlying asset on annual basis)
σ = standard deviation (of price of underlying asset on annual basis).

In the case of a European put option, the price formula changes to:

$P_p = – E(e^{-rt})N(–d_2) – N(–d_1)S_0.$

The one parameter of the model that cannot be directly observed is the *price volatility* of the underlying asset (standard deviation). It is a measure of the uncertainty in respect of returns on the asset. According to research, typically, volatility tends to be in the range of 20 – 40% pa. This can be estimated from the history of the assets. An alternative approach is *implied volatility*, which is the volatility implied by the option price observed in the market.[38]

Implied volatilities are used to gauge the opinion of market participants about the volatility of a particular underlying asset. Implied volatilities are derived from actively traded options and are used to make comparisons of option prices.

The Black-Scholes option pricing model is not the Midas formula, because it rests on several simplifying assumptions such as the underlying asset pays no interest or dividends during its life, the risk-free rate is fixed for the life of the option, the financial markets are efficient and transactions costs are zero, etc. However, it is very useful in the case of certain options (see section on binomial model after the following section). Next, we present an example.

5.6.3 Example of Black-Scholes option pricing

The underlying asset is a non-dividend-paying share of company XYZ the current share price of which is R100. The option is a European call, its exercise price is R100 and it has a year to expiry. The risk-free rate is 6.0% pa, historical volatility is 30% and the standard deviation of the share's returns is 0.1 per year. Thus:

S_0 = R100
E = R100
r = 0.06

[38] See Hull (2000: 255).

$t = 1$

$\sigma^2 = 0.01$

$\sigma = 0.1$

$d_1 = [\ln(S_0/E) + (r + \sigma^2/2)t] / \sigma\sqrt{t}$

$= [\ln(100/100) + (0.06 + 0.005)1] / 0.1\sqrt{1}$

$= 0.065 / 0.1$

$= 0.65.$

From the cumulative normal distribution table[39] one can establish the value of $N(d_1)$:

$N(d_1) = N(0.65) = 0.7422.$

Similarly, we find the value of $N(d_2)$:

$d_2 = d_1 - \sigma\sqrt{t}$

$= 0.65 – 0.1$

$= 0.55$

$N(d_2) = (0.55) = 0.7088$ (from table).

We are now able to complete the model:

$P_c = N(d_1)S_0 – E(e^{-rt})N(d_2)$

$= (0.7422 \times R100) – (R100 \times 2.718^{-0.06x1} \times 0.7088)$

$= R74.22 – (R100 \times 0.94177 \times 0.7088)$

$= R74.22 – R66.75$

$= R7.47.$

5.6.4 Binomial model

The Black-Scholes model is regarded as a good valuation model for certain options, particularly for European options on commodities. However, it is regarded as less accurate for dividend paying options and particularly so if the

[39] Not supplied here.

option is of the American variety. Also, it tends to undervalue deep-in-the-money options. Another problem is the assumption of log normality of future asset prices.

Where the Black-Scholes is regarded as weak, the binomial model is used. This model involves the construction of a *binomial tree*, i.e. a diagram representing different possible paths that may be followed by the underlying asset over the life of the option.

5.6.5 Other models

In addition to these two valuation models, there are:

- Monte Carlo simulation.
- Finite difference methods (implicit finite difference method and explicit finite difference method).

5.6.6 The Greeks

In the derivatives market reference is often made to the Greek letters, known as the "Greeks". The "Greeks" measure different dimensions of risk in option positions as follows:[40]

Delta

The *delta* is the rate of change of the option price with respect to the price of the underlying asset.

Theta

The *theta* of a portfolio of derivatives is the rate of change of the portfolio value with respect to the passage of time (*ceteris paribus* - when all else remains the same). It is often referred to as the *time decay* of the portfolio.

Gamma

---

[40] This section draws heavily from Hull (2000).

The *gamma* of a portfolio of derivatives on an underlying asset is the rate of change of the portfolio's *delta* with respect to the price of the underlying asset.

Vega

The *vega* of a portfolio of derivatives is the rate of change of the value of the portfolio with respect to the volatility of the underlying asset.

Rho

The *rho* of a portfolio of derivatives is the rate of change of the portfolio value with respect to the interest rate.

5.6.7 Put-call parity

Put-call parity.[41] defines a special relationship between the prices of European call and put options with the same strike price, nominal, and expiry date. This relationship can be used to synthesize long or short asset positions. Here's how it works:

- Buying a call option and selling a put option with the same strike price, same nominal, and same expiry creates a synthetic long asset position.Buying a put option and selling a call option with the same strike price, same nominal, and same expiry creates a synthetic short asset position.

Standard Put-Call Parity for European Options

For European options, there exists a standard relationship that ensures no arbitrage opportunities between the prices of calls and puts with the same strike price and expiration. This relationship is expressed by the following formula:

---

[41] **It was first discussed by HR Stoll in** *The relationship between put and call option prices* **in The Journal of Finance, volume 24, issue 5, December 1969.**

$$C + \frac{X}{(1+r)^T} = P + S$$

Where:

C = Call price
P = Put price
S = Underlying asset price (spot price)
X = Strike price
r = Risk-free interest rate
T = Time to maturity (in years)

This equation holds for European options that cannot be exercised before expiration. It helps to ensure that no arbitrage opportunities exist between the prices of put and call options with the same strike price and expiration date. The strike price is adjusted to its present value because these options are settled at expiration.

Put-Call Parity for Futures

There is also a specific relationship for futures markets derived from put-call parity, expressed as:Futures price = Strike + call premium – put premium

If a long or short asset position can be synthesised using options, then we can compare the implied futures price created through put-call parity with the actual futures price trading in the market. Any discrepancy in price results in arbitrage opportunity.

Using the following information to identify an arbitrage opportunity:

1-month option on futures strike 2100, call premium 50, put premium 20

Actual 1-month futures price 2200

Using put-call parity 2100 + 50 – 20 = 2130 which is the implied 1-month futures price created through options.

As the current futures price is higher than the put-call parity futures price arbitrage profit is possible.

- Buy the call and sell the put with the same strike of 2100. The net premium paid of 30 is a cost added to the strike giving us an implied futures price of 2130.
- Sell the futures at 2200
- 2200 – 2130 = 70 arbitrage profit. (no risk)

Selling futures will cause the price to fall. Buying calls will drive the premium up and selling puts will drive the premium down. Therefore, the effect of arbitrage trading drives the market prices back into line so that fair value is re-established.

Put-call parity plays a crucial role in maintaining balance between option and futures markets. By understanding this relationship, traders can identify arbitrage opportunities and synthesize long or short positions in a risk-free manner.

5.7 ORGANISATIONAL STRUCTURE OF OPTION MARKETS

One way of depicting the organisational structure of option markets is as in Figure 5.8.

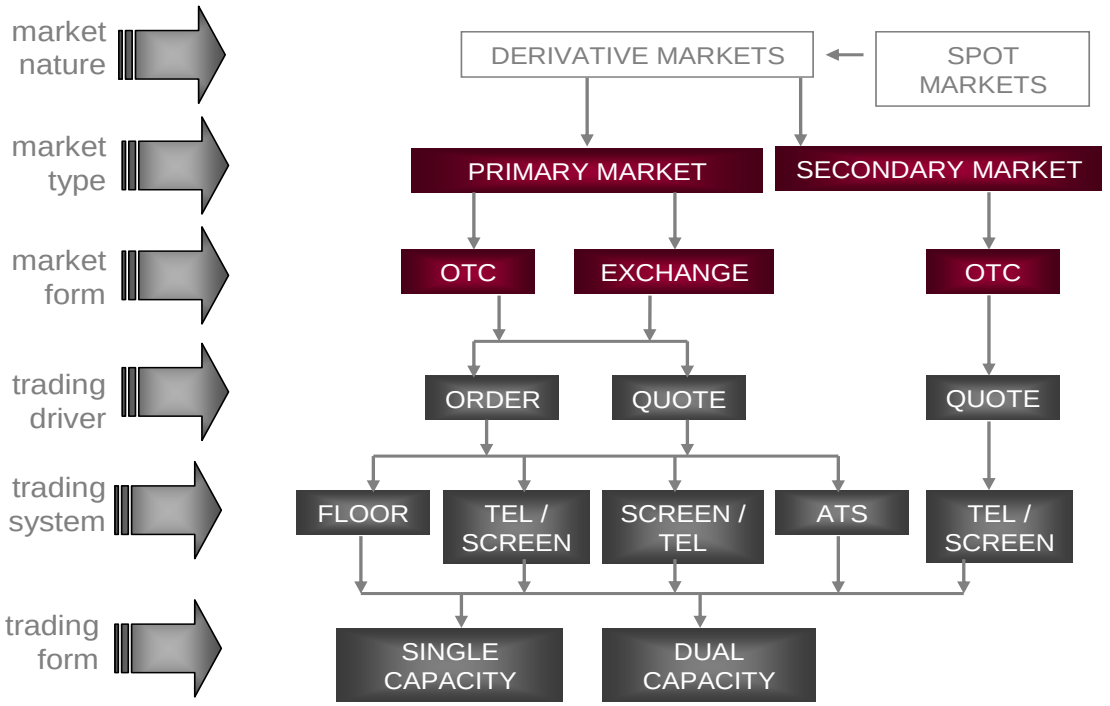
The *market form* of options is a mixture of *formal* in the shape of an exchange where options are listed, and *OTC*. There are many futures / options exchanges in the world, or futures / options divisions of exchanges as in the case of South Africa. There are also substantial OTC markets.

As to whether option markets are *primary markets* and/or *secondary markets*, the answer depends on whether they are OTC or exchange-traded. In the case of the OTC markets, there are primary markets in which options are issued and secondary markets in which existing options can be sold and bought. In the case of exchange-traded options the primary and secondary markets are “merged”. They are issued by the exchange (primary market) and can be “sold” (“closed out”) in the sense of dealing in the opposite direction. For example, if

a client has bought a call option, she can close out the position by selling the same call option.

However, the holder/ buyer of an option has other alternatives: exercise the option (if it is an American option and has value), or letting it expire worthless on expiration date.

Figure 5.8: organisation of options markets



The main advantage of exchange-traded options is that they are guaranteed by the exchange, they are standardised and they are (usually) liquid markets. The main advantage of the OTC market is that the options are customised. The differences between these two markets are as shown in Table 5.3.

The *trading-driver* process of *listed* options is the same as in the case of listed futures. The client telephones the broker and places an *order* to sell or buy a particular number of call or put options. She will of course also state the expiration date/s and strike price/s. The order placed is either a *market order* or a *limit order*. The former is an instruction to deal at the best available price, while the latter is an order to transact at a specific price.

In the case of the South African listed options market this information will be inputted into the *ATS system* and left there until a match is found (which in most markets is usually a few seconds or minutes because these markets are so liquid). In the case of an open outcry system of trading (as in certain overseas markets), the order is communicated to the trader in the pit. Traders form groups reflecting the various delivery dates. The order is "cried out" and another trader "cries out" if she has an opposite matching order. The trade is done with a floor broker, a market maker or a professional trader.

TABLE 5.3: COMPARISON OF OTC AND FORMALISED OPTIONS MARKETS		
	OTC	Exchange-traded
Regulation	None	Yes
Contracts	Usually not standardised (standardised in certain respects)	Standardised
Margin	Sometimes	Yes
Delivery dates	Customised (large range)	Standardised (limited range)
Delivery of underlying instrument	Almost always	Few settled by delivery
Instruments	Virtually all	Virtually all
Secondary market tradability	Limited	Liquid secondary markets
Participants	Large players only	Large and small players
Risk	Deal between counterparties – each faces risk	Contracts guaranteed by exchange
Market	Screen or telephone or both	Open outcry on exchange floor, or telephone or ATS

In OTC markets the *method of trading* is screen / telephone (as in the case of South Africa) or just telephone, and the *trading driver is quote*. Certain broker-dealers quote option buying and selling prices (premiums). Settlement takes place on T+1 or T+2.

It will be apparent that not just anyone is able to trade in the OTC market, and this is because each party is directly exposed to the other party in terms of risks such as settlement risk, risk of tainted scrip, default risk, etc. One needs credentials and a track record to deal in the OTC options markets.

5.8 OPTIONS ON DERIVATIVES: FUTURES

5.8.1 Introduction

The options market overview illustration is reproduced here for the sake of orientation (see Figure 5.9).

As noted, all futures markets are formalised markets. Options are available on virtually all futures, and most of these options are exchange-traded. The word "most" is used here because in some markets *OTC options on futures* also exist.

Figure 5.9: options

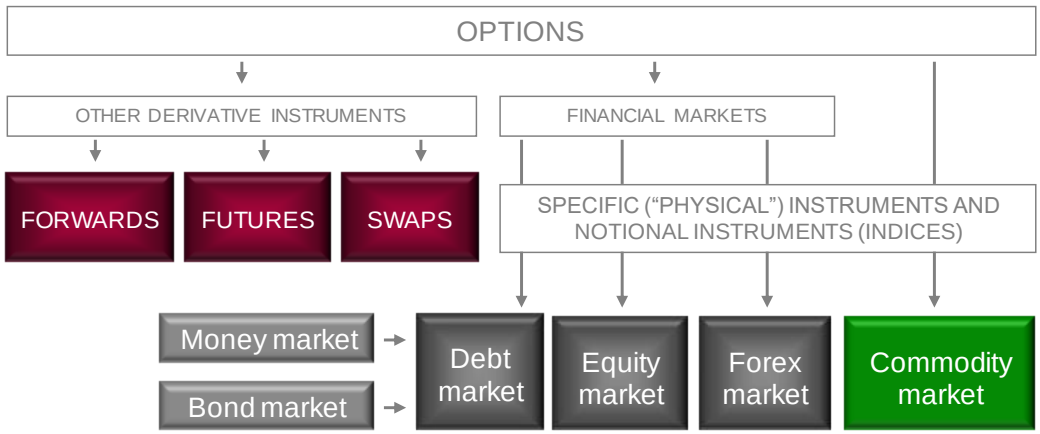


TABLE 5.4: EXAMPLES OF FUTURES CONTRACTS				
FINANCIAL			COMMODITIES	
Interest rate	Equity	Foreign currencies	Agricultural	Metals and energy

Physical Treasury bonds Treasury notes Treasury bills Federal funds Canadian govt bond Eurodollar Euroyen Eurobond Index (notional) Short sterling bond index Long sterling bond index Municipal bond index	Physical Various specific shares Index (notional) DJ Industrial S&P 500 NASDAQ 100 CAC-40 DAX-30 FTSE 100 Toronto 35 Nikkei 225 NYSE Comp.	Physical Japanese yen Euro British pound Swiss franc Canadian $ Australian $ Brazilian real Mexican peso Index (notional) US dollar index	**Grains and oilseeds** Wheat Soybeans Corn (maize) **Livestock and meat** Cattle – live Hogs – lean Pork bellies Food and fibre Cocoa Coffee Sugar Cotton Orange juice	Physical - Metals Gold Platinum Silver Copper Aluminium Palladium Physical - Energy Crude oil – light sweet Natural gas Brent crude Propane Index (notional) CRB index
Physical = the actual instrument, currency, commodity. Index = indices of exchanges, etc. CRB index = Commodity Research Bureau.				

With options on futures (also called “futures options”) the *underlying instrument is a futures contract* (not the underlying instrument of the future). The relevant price is therefore the price of the futures contract (and not the price of the underlying instrument or index).

The futures contract usually matures a short while after the expiration of the futures option. When the holder of a call futures option *exercises* the option, the *writer is obligated to deliver* to the holder of the *o*ption:

- A long position in the underlying futures contract.
- Plus, an amount that is equal to the difference between the last MTM[42] futures price and the exercise price (futures price - exercise price).

Conversely, when the holder of a put on a future *exercises* the option, the *writer is obligated to deliver* to the holder of the put:

- A short position in the underlying futures contract.
- Plus, an amount that is equal to the difference between the exercise price and the last MTM futures price (exercise price - futures price).

In practice, however, most options on futures are settled in cash.

It will be recalled that the futures market may be categorised (with examples included) as shown in Table 5.4

TABLE 5.5: SELECTION OF SOUTH AFRICAN FUTURES CONTRACTS				
FINANCIAL			COMMODITIES	
Interest rate	Equity	Foreign currencies	Agricultural	Metals and energy
Physical Futures on: R186 bond (10.5% 2026)	Physical Futures on: over 200 shares (called single stock	Physical USD/ZAR EUR/ZAR GBP/ZAR AUD/ZAR	Physical Local: White maize	Physical Local: None

[42] Last mark-to-market price. In this regard see Hull (2000:285).

3-month JIBAR interest rate Index (notional) Futures on: ALBI index GOVI index	futures – SSFs) Dividends (local & foreign) Index (notional) Futures on: FTSE/JSE Top 40 FTSE/JSE INDI 25 FTSE/JSE FINI 15 FTSE/JSE FNDI 30 FTSE/JSE RESI 20 FTSE/JSE Gold Mining	JPY/ZAR CAD/ZAR Index (notional) None	Yellow maize Soybeans Wheat Sunflower seed Beef Foreign (underlying = foreign futures): Chicago corn CBOT soybeans Index (notional) None	Foreign: (underlying = foreign futures) Gold Platinum Crude oil Index (notional) None

As noted, options are available on virtually all futures. In the US the most active options on futures contracts are the options on Treasury bond futures and Treasury note futures, options on the Eurodollar futures, and options on the futures contracts on corn, soybeans, and crude oil.

In South Africa, options are available on virtually all the futures contracts that are listed. Table 5.5 serves as a reminder.

It may be useful to provide an example of an option on futures deal:

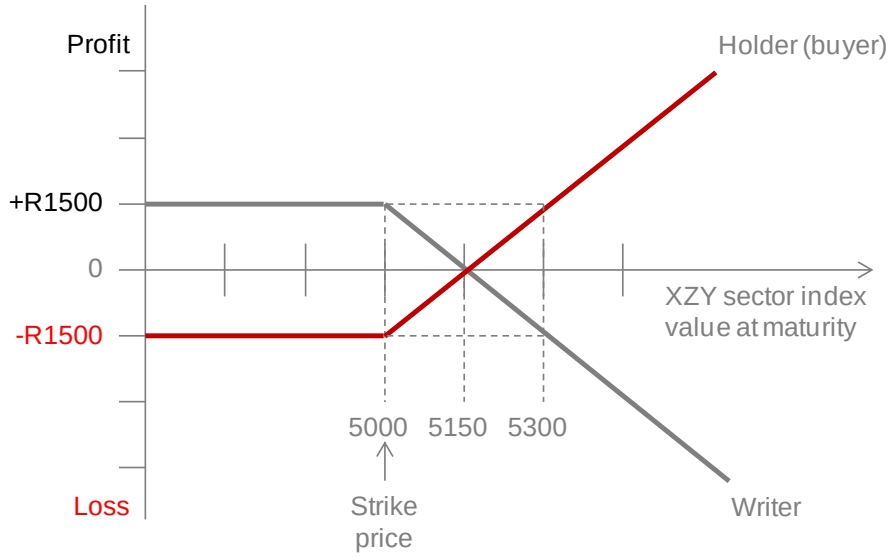
5.8.2 Example

An investor requiring equity exposure to the XYZ sector of the market to the extent of R1 million decides to acquire this exposure through the purchase of

call options on the *XYZ sector index future*. If the index is currently recorded at 5 000, she would require 20 call option contracts (20 x R10 x 5000 = R1 000 000) (one XYZ sector index futures contract is equal to R10 times the index value).

Because the investor is buying the *right* to purchase the future and has *no obligation* in this regard, she pays a premium to the writer. In this example we make the assumption that the premium is R1 500 per contract (R30 000 for 20 contracts). The investor is thus paying R30 000 for the right to purchase 20 XYZ sector index futures contracts at an exercise or strike price of 5000 on or before the expiry date of the options contract.

Figure 5.10: payoff profile of writer & holder of call option



It will be evident that the premium per contract of R1 500 translates into 150 points in the all share index (R1 500 / R10 per point). Thus, the investor's *breakeven price* is 5150 (5000 + 150). This can be depicted as the plum-coloured line in the payoff diagram shown in Figure 5.10.

Assuming that the buyer (investor) holds the contracts to expiry:

- If the price closes at or below 5000 she will not exercise. She incurs a loss equal to the premium paid, i.e. R1 500 per contract.

- If the price closes between 5000 and 5150 she will exercise the options and recover a portion of the premium.
- If the market closes at a price above 5150 she will exercise and make a profit. For example, if the price at expiry is 5400, her profit is R2 500 per contract [i.e. R10 x (5400 - 5150)].

The risk profile of the writer is exactly the reverse of that of the holder. As can be seen in Figure 5.10:

- The writer makes a profit of R1 500 (the premium) per contract if the price closes at or below 5000.
- The writer makes a profit of less than R1 500 per contract if the price closes at between 5000 and 5150. This is because the holder will exercise between these two prices to recover a portion of her premium.
- The writer makes a loss if the price rises above 5150. For example, if the price closes at 5600, the writer will make a loss of R4 500 [R10 x (5600 - 5150)] per contract.

It will be apparent that the investor gained her R1 million exposure with a monetary outlay of R30 000. Thus, she can invest the balance of R970 000 in the money market and receive the current interest rate. The money market rate (rfr) is thus an important input in the pricing of options (as seen above).

The buyer of a put option has a risk profile which is the converse of that represented by a call option (see Figure 5.11). For example, an investor wanting to hedge his R1 million XYZ sector equity exposure (i.e. anticipating that share prices will fall) would buy 20 put option contracts on the XYZ sector index future (assuming the strike price to be 5000). She is thus hedged to the extent of R10 x 20 x 5000 = R1 000 000. She thus has the right, but not the obligation, to sell to the writer (seller) 20 XYZ sector index futures contracts on or before the expiry date of the options contracts. Assuming that the premium paid is R1 500 per contract, her risk profile is as depicted in Figure 5.11.

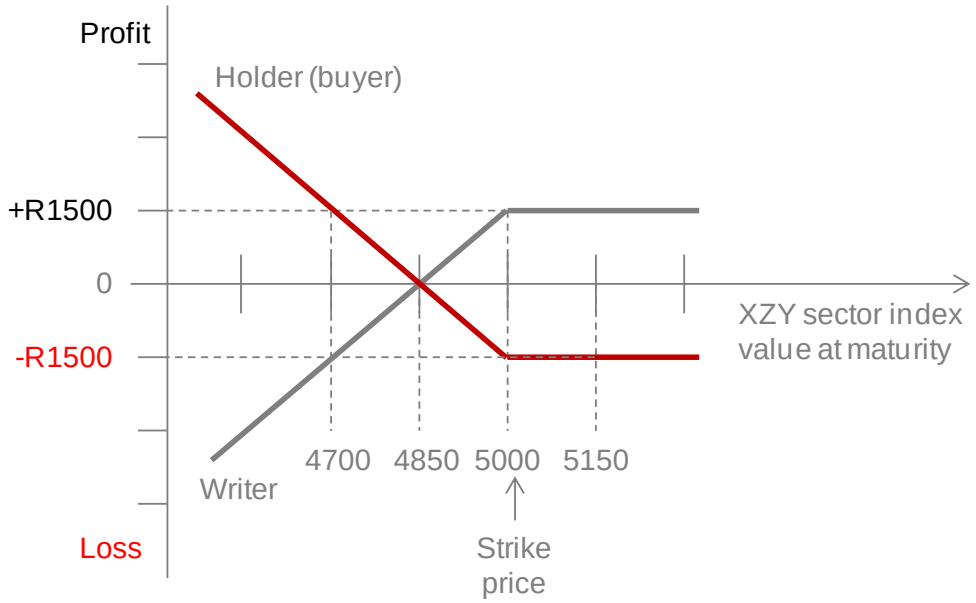
As far as the holder is concerned:

- If the price closes at 5000 or higher, she will not exercise and the loss is limited to R1 500 per contract.
- If the price closes at between 5000 and 4850, she will exercise and recover a portion of the premium.
- If the price falls below 4850 she makes a profit equal to R10 per point per contract.

Conversely, the writer of the put options will profit to the extent of R1 500 per contract if the price at close is 5000 or better, profit less than R1 500 at a price between 4850 and 5000 and incur a loss at a price below 4850 to the extent of R10 per point per contract.

Options on futures are also subject to margin requirements. These are the same as for the underlying futures.

Figure 5.11: payoff profile of writer & holder of put option



5.8.3 Option specifications

As will be understood, options contracts take on many of the features of the underlying instruments, i.e. the futures contracts. The below-mentioned option specifications should therefore be read together with the futures contract specifications (see Table 5.6).

The two basic uses of options on futures are to protect a future investment's return from falling interest rates / rising prices (call option), and to protect against rising interest rates / falling prices (put options).

TABLE 5.6: OPTION SPECIFICATIONS	
Expiry	The same time and date as the underlying futures contract
Style	American
Types	Both a call and a put at each strike (exercise)
Strike price units	Strike prices are specified in the units of quotation of the underlying futures contract
Strike price intervals	Strike prices are at fixed intervals.
Live strikes	Three strike prices are "live", i.e. are accommodated on the screens. The corresponding options are "at", "in" and "out" of the money, and are referred to as "strike 1", "strike 2" and "strike 3" on the screens. A separate screen gives the value of the strike price associated with each of the three.
Strike shifts	The live strikes are shifted, and new strikes introduced (if necessary) whenever the underlying financial instrument's price: • Moves beyond either of the away-from-the-money strikes or • Is consistently closer to an away-from-the-money strike than to the at-the-money strike for one trading day. Shifts are not normally more frequent than daily and are made overnight. All shifts are made at the exchange's discretion.
Free-format screens	Quotations for options whose strike prices are not live are entered onto one or more free-format screens
Contract size	Each option is on *one* contract of its underlying financial instrument
Standard lot size	(Number of options that quotations are good for). The same as the underlying financial instrument's standard lot size.
Quotations	Quotations are in whole rands per option
Settlement of premiums	Through the mark-to-market process over the life of the option
Mark-to-market	Daily according to the option's mark-to-market price (i.e. the same as for futures)

Determination of Mark-to-market prices	• Quoted doubles are used where available • Implied volatilities are calculated from available prices to value options (on the same underlying financial instrument) lacking quotes • Exchange has the discretion to override the former and to specify volatilities overriding the latter
Exercise	May be exercised at any time until expiry. A client's option is exercised through his member directly with the exchange
Settlement on exercise	Into the underlying financial instrument
Assignment	Options exercised will be randomly assigned to short positions in the same option. Assigned holders (or their members), and their clearing members, will be notified immediately. Assignment will be in standard lot sizes as far as possible.
Automatic exercise	All in-the-money options will be automatically exercised (into the underlying financial instrument) on expiry. This happens before the close out by the exchange of positions in futures contracts.
Margins	Option positions are subject to the same initial margin requirements as their underlying financial instruments. However, the potential profit/loss profile of options is recognised. Margins are also affected by volatility margin requirements.
Source: JSE.	

5.8.4 Can-do options

In 2006 the JSE (Equities Division)[43] launched a new type of option on equity futures: the *can-do option*. It is a hybrid of an exchange listed option and an OTC option in that it is listed but has the flexibility of an OTC option. It is therefore designed to, as stated by the JSE, "provide portfolio managers with a means to tailor derivatives to their particular exposures."

The following features distinguish it from other options on equities:

- Minimum contract size = R10 million (as such it is aimed at the professional investor).

[43] Mxhalisa, N, 2006. **The new derivative in the investor's armoury.** The Financial Markets Journal, No 4. Johannesburg: SAIFM.

- Contract size = any amount over R10 million.
- Underlying instruments = futures on shares / baskets of shares can be specified by the investor.
- Expiry date = specified by the investor.
- Settlement = cash or physical at the option of the investor.

Subsequent to the launch of the equity futures can-do options in 2006, other can-do options have been launched, including currency futures can-do options.

5.9 OPTIONS ON DERIVATIVES: SWAPS

Figure 5.12: options

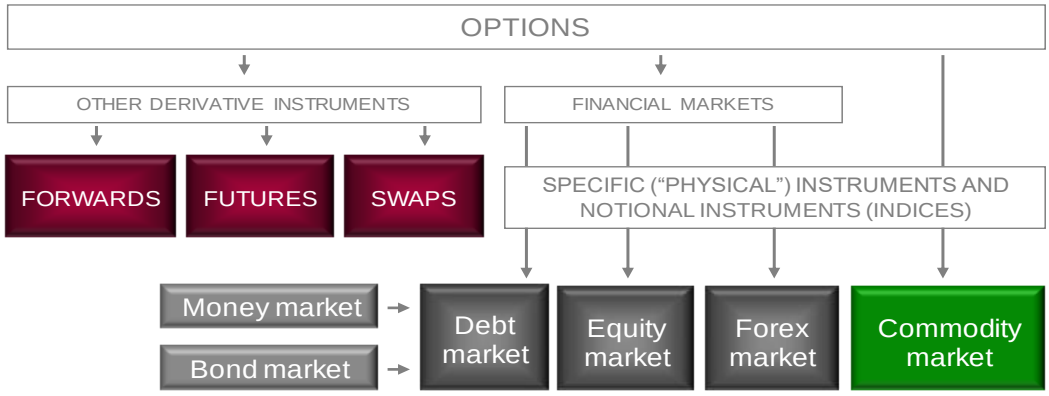
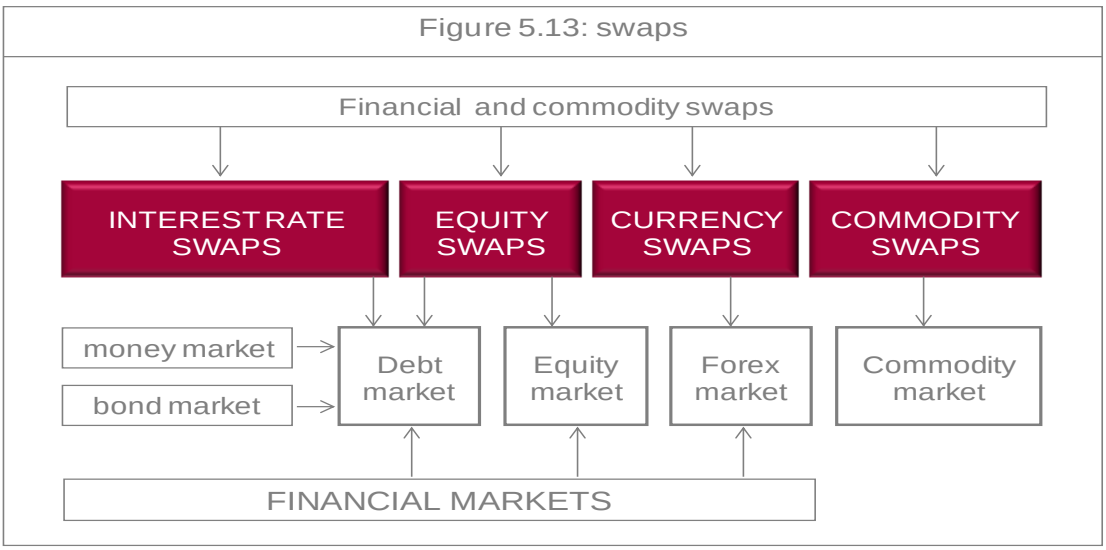


Figure 5.12 is presented here for the sake of orientation. We discussed *swaps* in some detail in the previous chapter. An option on this derivative is the *option on the swap*, called the *swaption*.

Figure 5.13: swaps



We saw earlier that there are four types of swaps that relate to the financial markets and the commodity market (see Figure 5.13). We also saw that there exists a *forward swap* (or deferred swap) (it is mentioned here again because it is touched upon below).

Although options can be traded on any swaps, the term *swaption* generally refers to an option on the *interest rate swap* (the largest swap market), and it will be evident that a *swaption* is a *combination of an interest rate swap and an option*. As elucidated above, in interest rate swaps, fixed-rate obligations (cash flows) are swapped for floating rate obligations. In swaptions, the underlying instrument is the *fixed-rate* obligation. Thus, a *call swaption imparts the right to the holder to receive the fixed rate in exchange for the floating rate, while in put swaptions, the holder has the right to pay fixed and receive floating.*

An example may be useful.[44] A company knows that in six months' time it is to enter into a five-year floating rate loan (i.e. borrowing) agreement at 3-month JIBAR and wants to swap the floating rate payments into fixed rate payments, i.e. to convert the loan into a fixed rate loan (because the company believes that rates are about to rise).

For a premium, the company can buy a (put) swaption from a broker-dealer in this type of paper. The swaption gives the company the right to receive the 3-month JIBAR rate on a notional amount that is equal to its loan, and to pay a fixed rate of interest every three months at 14% pa (assumed) for the next five years, starting in six months' time.

The "options" the company has are clear:

- If in six months' time the fixed rate on a normal 5-year swap is lower than 14%, the company will allow the swaption to lapse (remember the company wants to pay fixed)
- The company will then undertake a normal interest rate swap at the lower fixed rate (the floating rate will probably still be 3-month JIBAR)

[44] With assistance from Hull (2000:.543).

- If the fixed rate on normal swaps is higher than 14%, the holder will exercise the swap and take up the swap.

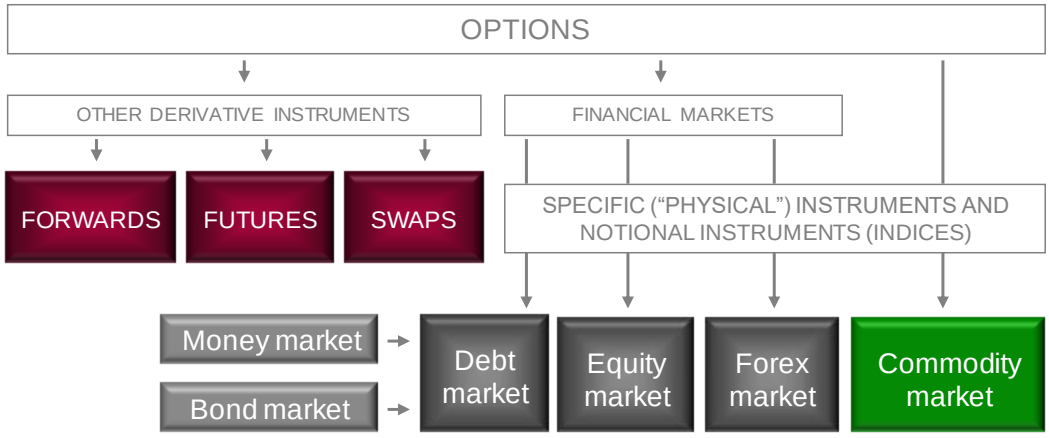
The company is guaranteed that the fixed rate it will pay on the future will not exceed an agreed fixed rate. Thus, the company has protection against rates moving up, while retaining the option to benefit from lower rates in the future.

The swaption is an *alternative* to the *forward swap*. The latter obliges the holder to enter into a swap after a stipulated period, but the holder pays no premium for it. In the case of the swaption, the holder is not obligated and can allow the swaption to lapse, i.e. it allows the holder to benefit from favourable interest rate movements.[45]

5.10 OPTIONS ON DEBT MARKET INSTRUMENTS

5.10.1 Introduction

Figure 5.14: options



The options market illustration presented here again is designed to orientate the reader in terms of the place of the market being discussed (see Figure 5.14).

[45] The swaption-swap differences are similar to the differences between an option on forex and a forex forward. See Hull (2000: 543).

The term “debt market instruments” in respect of options encompasses money and bond market *specific instruments* (“physicals”) (or rather some of them) and *notional instruments* (indices) (or some of them). They may be classified as follows:

- Money market options:
    - Options on specific money market instruments
    - Interest rate caps and floors.
- Bond market options:
    - Options on specific bonds
    - Options on bond indices
    - Bond warrants (retail options)
    - Bond warrants (call options)
    - Callable and puttable bonds (bonds with embedded options)
    - Convertible bonds.

Money market options are comprised of options on specific money market instruments (and this includes ordinary deposits) and caps and floors (these are *option-like* instruments). As seen in the list, there are several bond option varieties. The first three mentioned above are full-blooded bond options, while the latter three may be termed *option-like securities* in the bond market. We discuss all these a little later. Options on *bond futures* are obviously not discussed in this section (they were discussed under “options on derivatives”).

5.10.2 Options on specific money market instruments

TABLE 5.8: EXAMPLE OF OPTION ON MONEY MARKET INSTRUMENT						
LIFFE SHORT STERLING OPTION GBP 500 000, POINTS OF 100%						
Strike price	Calls			Puts		
	Dec	Mar	Jun	Dec	Mar	Jun
9350	0.11	0.08	0.09	0.06	0.33	0.66
9375	0.01	0.02	0.04	0.21	0.52	0.86
9400	0.00	0.01	0.02	0.45	0.76	1.09

Money market options are options that are written on specific money market instruments, such as commercial paper, NCDs, deposits, etc. Not many

countries have specific asset money market options, because of the existence of the active markets in other money market derivatives (swaps, swaptions, repos, caps and floors, FRAs, and interest rate futures).

Some countries, however, have options on *notional* money market instruments. A UK example is presented in Table 5.8.[46]

Let us focus in on the June call option at a strike (exercise) price of 9350, and a premium of 0.09. What do these numbers mean? The holder of the option has the right to make a deposit of GBP 500 000 on the expiry date in June (the date is specified) at an interest rate of 6.5% (100 – 93.50) for 3 months. Each tick movement on the contract, which is equivalent to one basis point, is worth the value of the contract (GBP 500 000) multiplied by 1 basis point (0.01% or 0.0001) and a quarter of a year (0.25), i.e.:

GBP 500 000 x 0.0001 x 0.25 = GBP 12.50.

The cost of the call option (i.e. the premium), is therefore 9 x GBP 12.50 = GBP 112.50.

If by the expiry date the contract strike price rises to 9450 (interest rates have fallen to 5.5%) the holder is entitled to a gain of 100 basis points, and the profit is 100 x GBP 12.50 = GBP 1 250.00 less the premium of GBP 112.50 = GBP 1 137.50.

On the other hand, if interest rates have risen (to 7% pa) so that the contract is trading at 9300, the contract will not be exercised and the holder will forego the premium of GBP 112.50.

5.10.3 Caps and floors

Description

[46] Example (slightly) adapted from Pilbeam, 1998.

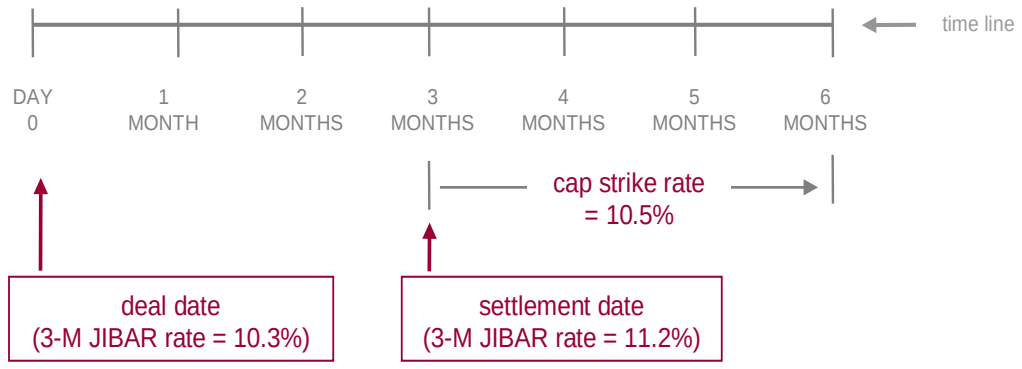
Caps and *floors* (a combination of which is termed a *collar*) are akin to options. In fact, they are so similar to options that they could be termed *cap options* and *floor options.* Because of their option-like attributes, they are placed in this chapter on options.

A *cap* purchased makes it possible for a company with a *borrowing requirement* to hedge itself against *rising interest rates*. The cap contract establishes a ceiling, but the company *retains the right to benefit from falling interest rates*. On the other hand, a *floor* contract allows a company with an *investment requirement* (surplus funds) to shield itself against *declining interest rates* by determining a specified floor upfront, while it *retains the right to profit from rising interest rates*.

On the *exercise date* of the cap or floor contract, the specified *strike rate* is evaluated against the *standard reference rate* (i.e. usually the equivalent-term JIBAR rate). The interest differential is then applied to the *notional principal amount* that is specified in the contract, and the *difference is paid* by the seller/writer to the buyer/holder. The buyer of a floor or cap pays a *premium* for the contract, as in the case of an option or insurance policy.

Caps

Figure 5.15: example of T3-month – T6-month cap



It is perhaps best to elucidate a cap with the assistance of an example: *borrowing company buys a T3-month – T6-month cap* (see Figure 5.15).

A company needs to borrow R20 million in 3 months' time for a period of 3 months and is *concerned that interest rates are about to rise sharply*. The present 3-month market rate (JIBAR rate = market rate) is 10.3% pa. The company is quoted a T3-month – T6-month (T3m-T6m) cap by the dealing bank at 10.5%, i.e. the 3-month JIBAR borrowing rate for the company is fixed 3-months ahead. The company accepts the quote and pays the premium of R25 000 to the dealing bank. The number of days of the period for which the rate is fixed is 91.

If the JIBAR rate (= market rate on commercial paper, the borrower's borrowing habitat) in 3-months' time (i.e. settlement date), is 9.3%, the company will allow the cap to lapse (i.e. will *not exercise the cap*) and instead will borrow in the market at this rate by issuing 91-day commercial paper. The total cost to the company will be the 9.3% interest *plus the premium paid* for the cap:

Cost to company = (C x ir x t) + P

where

C = consideration (amount borrowed)
Ir = interest rate (expressed as a unit of 1)
t = term, expressed as number of days / 365
P = premium

Cost to company = (C x ir x t) + P
= R20 000 000 x 0.093 x 91 / 365) + R25 000
= R463 726.03 + R25 000
= R488 726.03.

It will be apparent that the interest rate actually paid by the company (ignoring the fact that the premium is paid upfront) is:

Total interest rate paid = R488 726.03 / R20 000 000 x 365 / 91
= 0.0244363 x 4.010989
= 0.09801
= 9.80% pa.

If the JIBAR rate on the settlement date is say 11.2% pa, settlement will take place with the dealing bank according to the following formula:

SA = NA x [(rr – csr) x t]

where

SA = settlement amount

NA = notional amount

Rr = reference rate

Csr = cap strike rate

t = term, expressed as number of days / 365

SA = R20 000 000 x [(0.112 – 0.105) x 91 / 365]
= R20 000 000 x (0.007 x 91 / 365)
= R34 904.11.

The financial benefit to the company is equal to the settlement amount minus the premium:

Financial benefit = SA – P
= R34 904.11 – R25 000
= R9 901.11.

The company thus borrows at the market rate of 11.2%, but this rate is reduced by the amount paid by the bank to the company less the premium paid to the bank:

Cost to company = (C x ir x t) – (SA – P)
= (R20 000 000 x 0.112 x 91 / 365) – (R9 901.11)
= R558 465.75 – R9 901.11
= R548 564.64

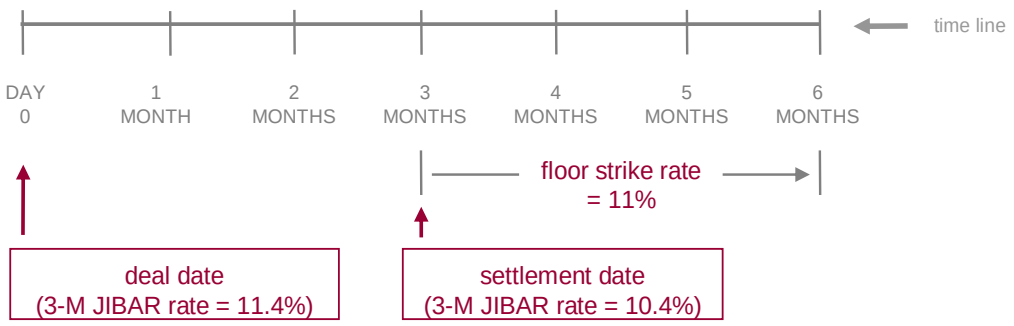
Total interest rate paid = (R548 564.64 / R20 000 000) x (365 / 91)
= 0.0274282 x 4.010989
= 0.110001
= 11.00% pa.

This of course ignores the fact that the premium is paid up front.

Floors

It is useful to elucidate floors with the use of a specific example: *investing company buys a T3-month – T6-month floor* (see Figure 5.16).

Figure 5.16: example of T3-month – T6-month floor



An investor expects to receive R20 million in 3 months' time, and these funds will be free for 3 months before it is required for a project. The investor *expects rates to fall* and would like to lock in a 3-month rate now for the 3-month period (assume 91 days) in three months' time. He approaches a dealing bank and receives a quote for a T3m-T6m floor at 11.0% on a day when the 3-month market (JIBAR) rate is 11.4%. He verifies this rate with other dealing banks and decides to deal. The premium payable is R19 000.

Three months later (on the settlement date) the JIBAR 3-month rate is 10.4% pa. The investor was correct in his view and the bank not, and the bank coughs up the following (fsr = floor strike rate):

SA = NA x [(fsr – rr) x t]
= R20 000 000 x [(0.11 – 0.104) x 91 / 365]
= R20 000 000 x (0.006 x 91 / 365)
= R20 000 000 x 0.00149589
= R29 917.81.

The financial benefit to the company is:

Financial benefit = SA – P
= R29 917.81 – R19 000
= R10 917.81

The company thus *invests* at the 3-month *cash (spot) market rate* of 10.4% pa on the settlement date, and its earnings are boosted by the settlement amount less the premium paid to the bank:

Earning on investment = (C x ir x t) + (SA – P)
= [R20 000 000 x (0.104 x 91 / 365)] + R10 917.81
= (R20 000 000 x 0.025929)
= R10 917.81
= R518 575.34 + R10 917.81
= R529 493.15.

Thus, the *actual rate* (ignoring the fact that the premium is paid upfront) earned by the company is:

Total interest rate earned = (R529 493.15 / R20 000 000) x (365 / 91)
= 0.0264747 x 4.010989
= 0.1061897
= 10.62% pa.

It will be evident that if the spot market rate is say 11.5%, the treasurer of the investing company *will let the floor contract lapse* (ie *not exercise*). He will invest at 11.5% for the 3-month period, but this return is eroded by the premium paid for the floor. The following are the relevant numbers:

Earnings on investment = (C x ir x t) - P
= (R20 000 000 x 0.115 x 91 / 365) - R19 000
= R573 424.66 - R19 000
= R554 424.66.

It will be apparent that the interest rate actually earned by the company (ignoring the fact that the premium is paid upfront) is:

Total interest rate earned = (R554 424.66 / R20 000 000) x (365 / 91)
= 0.0277212 x 4.010989
= 0.1118943
= 11.12% pa.

Thus, the investor would have been *worse off* if he had exercised the floor.

5.10.4 Options on specific bonds

Introduction

An option on a specific bond, also called a bond option, may be defined as *an option to buy (call) or sell (put) a specific bond on or before an expiry date at a pre-specified price or rate.* "Price or rate" is mentioned because some markets deal on price and some on rate; South Africa deals on a rate (ytm) basis.

Bond option markets are OTC and/or exchange-driven markets.

OTC bond options

In the OTC options markets, the contracts are generally standardised (in most respects). Options are written on the most marketable short- and long-term bonds, which are the high-capitalisation bonds.

The OTC bond options written and traded are of the standardised and American variety. European options are also written from time to time, and there are also non-standardised options. The latter, which include "overnighters" (i.e. contracts written to expire the following day) are usually written to suit particular hedging strategies. They differ from the standardised contracts in terms of expiration date and strike rate level.

The characteristics of standardised bond options are shown in Table 5.9.

TABLE 5.9: CHARACTERISTICS OF STANDARDISED BOND OPTIONS	
Size of contract	R1 million (nominal value), but the standard trading amount is R10 million or multiples of this amount
Underlying instruments	Various government and public enterprise bonds
Market price/rate	Yield to maturity
Strike rate intervals	0.25%, for example 8.00%, 8.25%, 8.50%, 8.75%
Expiry dates	12 noon on the first Thursday of February, May, August and November

Commission	As there are no fixed commission rates, the commission is included in the premium paid by the purchaser

Listed bond options

Options on specific bonds were listed on the Bond Exchange of South Africa (BESA, now part of the JSE Debt Market Division) in the past. They were European style options (call and put) on the most tradable bonds and they were physically settled. The product specifications as they are shown in Table 5.10.

BESA provided an example in the past as follows:

“Consider a BOR194 Dec04C call option contract. This will trade on implied volatility and a strike price corresponding to a yield level which will be specified by both parties involved in the trade.

“If on the maturity date, the option is in the money, physical delivery of the underlying will occur at the strike level (or closed out for cash). Suppose a trade occurs for a single contract at a strike level of 9% and at an implied volatility of 20%. The holder of the long position pays an amount of cash (in the form of an upfront premium) corresponding to the volatility level of the contract. On expiry, if the spot yield of the [bond] is lower than the strike level, the holder of the option will be delivered R1 million [of the bond] at a price corresponding to the strike level.”

TABLE 5.10: SPECIFICATIONS OF LISTED BOND OPTIONS	
Contract code	BO-Instrument-expiry-put\call (e.g. BOR194 Dec04P)
Underlying instrument	Various (e.g. R194, R157)
Contract size	Notional amount agreed by counterparties
Contract months	1st Thursday of February, May, August and November
Expiry date and time	1st Thursday of February, May, August and November at 12h00
Quotations	Implied volatility

Minimum price movement	4th decimal place (0.0001%)
Standard quote size	R1 million
Expiry price valuation method	As per BESA MTM process
Settlement	Physically settled by reporting the bond transaction through the exchange or cash settled
Margin requirements	Agreed bi-laterally between the parties

5.10.5 Options on bond indices

A bond index option is an option to buy (call) or sell (put) a specific bond index on or before an expiry date at a pre-specified price (not rate because an index is a number; rate applies to options on specific bonds).

The size of an index option is established by a multiplier applied to the strike index value (SIV). For example, the size of an option on an All Bond Index can be the SIV x R500. If the SIV = 1500, then the size of the contract = 1500 x R500 = R750 000. Profits / losses are cash settled because the index cannot be delivered.

As we have seen, in South Africa there are three so-called *Total Return Indices* (TRIs): the *All Bond Index* (ALBI), the *Government Bond Index* (GOVI), and the *Other Bond Index* (OTHI). The indices change as the market rates of the components of the indices change, and they enable investors to measure the performance of bond portfolios. Options on these indices allow investors to hedge against expected changes in them.

5.10.6 Bond warrants (call options)

There are two types of bond warrants:

- Bond warrants (retail options).
- Bond warrants (call options).

The term “bond warrant” internationally generally refers to *call* options on specific bonds but with a difference: when a bond warrant (call option) is exercised, this leads to the issuer issuing *new bonds*.

In the case of the ordinary bond options, the issuer is not involved - the writer of a call that is exercised sells existing bonds to the holder of the option.

The term to expiry of bond warrants (call options), unlike normal options, is long, sometimes running for many years. The underlying bond also has a long term to maturity, usually 10 years or longer.

This warrant-type does not exist in South Africa.

5.10.7 Bond warrants (retail options)

In South Africa, however, the term “bond warrant” refers to ordinary options on specific bonds, but they are *retail options*, i.e. the denominations are small. Calls and puts are written and traded and a call does *not lead to the issue of new bonds*.

The issuer of bond warrants is an entity, usually a bank, which is not associated with the issuer of the underlying bond (which in the main is government bonds). The issuer of the warrant is the writer, and the holder therefore has the right to exercise it against the issuer. As such the warrant holder assumes counterparty risk, i.e. the credit risk associated with the issuer.

Bond warrants enable investors / speculators to profit from expected movements in interest rates on specific bonds. Call warrants are bought to profit from an expected increase in the bond price (decrease in ytm), and bond put warrants are bought to profit from an expected decrease in the bond price (increase in the ytm).

There are two types of bond warrants: American or European. They are listed on the JSE and are traded and settled with members of the JSE (therefore settlement is guaranteed by the JSE). The issuers of warrants make a market in them by quoting bid and always offer prices simultaneously. The buyer pays the premium quoted by the market-maker. Bond warrants are cash settled.

The advantages of warrants and the risks associated with warrants are covered under equity warrants below, as this is the largest warrants market in South Africa.

5.10.8 Callable and puttable bonds (bonds with embedded options)

Bonds with embedded options are bonds that are issued with *provisions* that allow the *issuer to repurchase* (callable bond) the bond, or the *holder to sell back to the issuer* (puttable bond) the bond at a pre-specified price/rate at certain dates in the future.

The *callable bond* means that the buyer of the bond has sold to the issuer a call option to repurchase the bond. The strike price/rate (also called the *call price*) is the pre-determined price/rate that the issuer is obliged to pay to the bondholder.

It is usual that callable bonds are not callable for some years after issue. For example, a 15-year bond may not be callable for 10 years, and a price is set for each year after 10 years. A portion of the bond or the full amount may be callable. The fact that the buyer has “sold” to the issuer a call option means that these bonds are issued at a lower price (higher rate) than equivalent term and rated “ordinary” bonds.

Puttable bonds, i.e. bonds with embedded put options, are also issued in some markets. As noted, such bonds have provisions that allow the holder to sell the bond back to the issuer at pre-specified prices/rates on pre-determined dates. This means that the holder of the bond has bought a put option from the issuer. These bonds are issued and trade at lower yields (higher price) than equivalent term and rated bonds without such options attached.

5.10.9 Convertible bonds

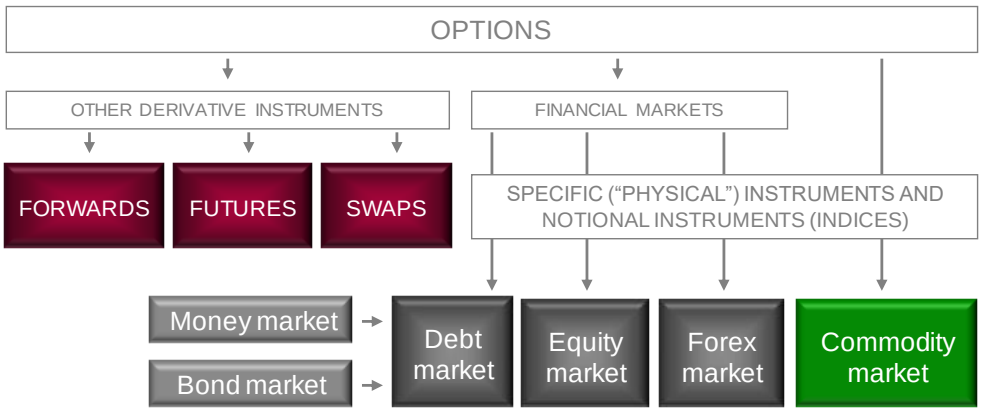
Convertible bonds are bonds that are *convertible into shares* (ordinary or preference) at the *option of the holder* on pre-specified terms (e.g. number of shares per nominal value).

5.11 OPTIONS ON EQUITY MARKET INSTRUMENTS

5.11.1 Introduction

We repeat our illustration on options introduced earlier for the sake of orientation (see Figure 5.17).

Figure 5.17: options



Options on equities may be divided into the following categories:

- Options on specific equities.
- Options on equity indices.
- Equity warrants (call options).
- Equity warrants (retail options).
- Redeemable preference shares.

Examples of the options in the first two categories are shown in Table 5.11 for the US market. The many different exchanges involved in these markets will be noted. It is obvious that these markets are exchange-traded, but it should be pointed out that there is also an OTC market in shares and these and other indices.

TABLE 5.11: EXAMPLES OF US MARKET OPTIONS ON EQUITIES		
Type	Exchange	Share / index
Options on shares ("stocks" in the US)	CBOE AM PB PC NY	Many specific shares (stocks) Many specific shares (stocks) Many specific shares (stocks) Many specific shares (stocks) Many specific shares (stocks)
Options on share ("stock" in the US) indices	CBOE CBOE CBOE AM PB PB PB	Dow Jones Industrial Average NASDAQ 100 S&P 100 index Major market index Gold Oil service index Utility index
CBE = Chicago Board of Trade. CME = Chicago Mercantile Exchange. LIFFE = London International Financial Futures Exchange. CBOE = Chicago Board of Option Exchange. AM = American Exchange. PB = Philadelphia Exchange. PC = Pacific Stock Exchange. NY = New York Stock Exchange.		

5.11.2 Options on specific equities

There are many exchanges in the US and the UK (and other markets including the JSE) that list and trade options on specific equities. Such options are usually written on the shares that have a large market capitalisation and are well traded (i.e. liquid). An example is required (see Table 5.12).[47]

[47] Example from Pilbeam, 1998.

TABLE 5.12: LLOYDS TSB EQUITY OPTIONS (QUOTED ON LIFFE) (CURRENT PRICE **384** PENCE)						
Strike price	Calls			Puts		
	Dec	Mar	Jun	Dec	Mar	Jun
360	27.0	33.0	38.5	0.5	7.5	12.5
390	6.5	14.5	22.0	10.0	22.0	27.0

In this example there are two strike prices, i.e. 360 pence and 390 pence at a time when the share in trading at 384 pence. The limited number of strike rates and contract maturity dates ensure that there is liquidity in the option contracts.

There are two sets of prices quoted, i.e. one for call options and one for put options. For example, the June call price at a strike price of 390 is 22.0 pence. This means that a buyer of this call option will pay 22 pence per share. The minimum contract size is 100 shares; thus, the option contract will cost the buyer GBP 220 (i.e. the premium). The buyer of the call has the right but not the obligation to buy 100 Lloyds shares at a price of 390 pence and the cost of the option is GBP 220. Alternatively, a June put option at a strike price of 390 will cost GBP 270, and this will bestow upon the buyer the right to sell 100 Lloyds shares at a price of 390 pence at any stage up to the expiry date of the option in June.

The markets in options on individual shares are large, and they are usually exchange-traded. There are also OTC markets in options on individual shares. In South Africa, options are written on single-stock (i.e. single-share) futures (SSFs), but not on individual shares.

5.11.3 Options on equity indices

The options on indices markets of the world are also large and active. Examples of indices are the FTSE 100 in the UK, the DJIA and the S&P 500 in the US,

the ALSI and the INDI in South Africa. They are mostly exchange-traded, but an OTC market also exists.

An option on a share index allows the holder to take a position in the index (short or long) for the price of the premium quoted. This means that the buyer of a share index is buying the right to “invest” in a diversified portfolio (of the shares that make up the index) at a pre-specified price.

The size of index options is established by a multiplier applied to an index, i.e. the size of a share index option is equal to the index value (specifically the strike index value / price - SIV) times the multiplier. For example, the size of an option on the S&P 500 index is = SIV x USD 500. In the case of the DJIAA index it is SIV x USD 100. If for example the SIV on the S&P 500 = 1635, the size / exposure of the option = 1635 x USD 500 = USD 817 500. These options are *settled in cash*, obviously because the index cannot be delivered.

An example may be constructive here:[48] An investor has a portfolio that he set up to replicate the S&P 500 share index. He is concerned that monetary policy is about to be tightened and that share prices are about to fall sharply, but he does not want to sell because it is expensive to sell and to reconstruct this portfolio again after the fall (because of brokerage, taxes, etc.). The value of his portfolio is USD 2.8 million and the S&P 500 SIV of a 3-month put option = 1400. The size of each option is thus 1400 x USD 500 = USD 700 000. The investor will buy four 3-month put options on the S&P index. Thus, the investor is hedging his USD 2.8 million portfolio with four put options = USD 2 800 000 (4 x USD 500 x 1400).

We assume that the investor is right in his view and the index over three months falls to 1120 (i.e. by 280 points or 20%). The value of the investor’s portfolio will be USD 2.24 million (remember he replicated the S&P 500 index with “physical”

[48] With some assistance from Saunders and Cornett, 2001. They also assisted with the currency option example.

shares), i.e. he incurs a loss of USD 560 000[49]. However, the investor exercises the four put options on expiry date, and makes a profit of:

(1400 – 1120) x USD 500 x 4 = USD 560 000,

which = the loss on his portfolio.

5.11.4 Equity warrants (call options)

As in the case of bond warrants, internationally equity warrants bestow the right (option) on the holder of the warrant to take up *new shares* of the relevant company. These call options are usually long term in duration.

5.11.5 Equity warrants (retail options)[50]

The South African equity (or share) warrants' (retail options) market had its genesis in 1967 and has since grown rapidly. They comprise call and put options on specific shares and on certain indices. They are of the American and European varieties and are listed on the JSE. As such they are traded and settled via a stockbroking broker-dealer firm (on the JSE trading and settlement systems). The issuers make a market in their equity warrants, ie quote bid (holder sells to the issuer) and offer (holder buys from the issuer) prices simultaneously, for example, bid: 12 cents / offer: 13 cents (these prices are called premiums).

The advantages of warrants are many. One of the issuers and market-makers (Standard Bank) lists eight as follows[51]:

1. Warrants enable investors to trade on the JSE Limited with the same ease as trading ordinary shares.
2. Warrants offer a low cost entry into blue chip shares.

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[49] This is approximate because the market index could have differed from the SIV.

[50] See www.jse.co.za

[51] https://securities.standardbank.co.za/ost/nsp/BrochureWarepublic/Ost/products/warrants.html

3. There is potential to leverage or gear up your investment.
4. Your risk is limited to the initial premium (price of the warrant) paid.
5. Warrants have the transparency of a listed instrument.
6. Small investors can short the market or hedge their portfolios using put warrants and so profit from falls in the market.
7. The warrants market is extremely liquid, as the issuer is required to provide both bids and offers.
8. Warrants are an extremely cheap instrument to trade with no STT tax and brokerage of a flat R50 plus taxes and fees.

The risks associated with warrants are price risk and credit risk. However, as shown above, price risk is limited to the premium which is a fraction of the value of the relevant share; i.e. there is limited downside risk and marked upside profit opportunity. While settlement is guaranteed by the JSE, the holder takes on credit risk because the counterparty to the deal is the issuer. As seen, these are the larger banks; as such credit risk is deemed to be small.

As noted, warrants are written on specific shares and on certain indices. The most popular shares on which warrants are written are Anglo, Gold Fields, Sasol, Harmony, Didata, Iscor, Bidvest, Remgro, and SABMiller. The indices on which warrants are written are the *All Share Index* and the *Industrial Index* (ALSI and INDI).

In addition to the “ordinary” equity warrants mentioned above, there are several variations on the theme, such as reset warrants and knockout warrants.

5.11.6 Redeemable preference shares

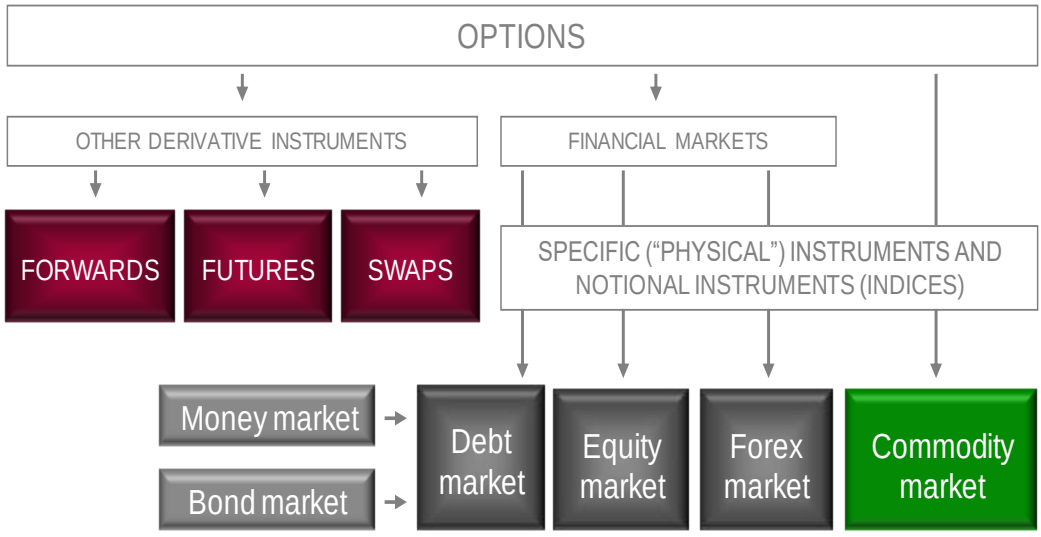
Preference shares (“preferred stock” in other countries) in many countries are like perpetual bonds. In South Africa, they are required to be redeemable or redeemable at the *option* of the issuer (section 98 of the Companies Act, 61 of 1973).

5.12 OPTIONS ON FOREIGN EXCHANGE

5.12.1 Introduction

We repeat our illustration on options introduced earlier for the sake of orientation (see Figure 5.18).

Figure 5.18: options



As in the case of bonds and shares, the options market in foreign currency can be divided into the wholesale and retail markets as follows:

- Options on foreign exchange (wholesale).
- Options on foreign exchange (retail: warrants).

5.12.2 Options on foreign exchange (wholesale)

Options on foreign exchange (also called *currency options*) are traded the world over, and the most tradable contracts are those written on EUR/USD (example: EUR 62 500 on the PHLX), USD/JPY (example: JPY 12 500 000 on the PHLX), GBP/USD (example GBP 31,250 on the PHLX), USD/CAD (example: CAD 50,000 on the PHLX), AUD/USD (example: AUD 50,000 on the PHLX). In the US, the Philadelphia Options Exchange (PHLX) is particularly active in currency options.

The underlying asset in a currency option is an exchange rate. A call option on the GBP for example will give the buyer the right to buy GBP for a given price in dollars (i.e. the strike price).

TABLE 5.13: PHILADELPHIA OPTIONS EXCHANGE GBP / USD OPTIONS GBP 31,250 (CENTS PER POUND) (SPOT PRICE: GBP/USD 1.6383)						
Strike price	Calls			Puts		
	June	July	August	June	July	August
1.63	1.5	2.4	2.9	1.1	1.55	2.23
1.64	1.3	1.84	2.35	1.5	2.01	2.62
1.65	0.94	1.43	1.89	1.05	2.55	3.21

An example is always useful (see Table 5.13). The GBP/USD spot price is GBP/USD 1.6383. The face value of currency option contracts is fixed at an amount of currency; in this example it is GBP 31 250). A US investor purchases a June GBP *call* option at an exercise / strike price of 1.6300 (this of course means GBP / USD 1.6300). The face value of the contract is GBP 31 250.

At the end of the life of the option the GBP increases in value relative to the USD. We assume GBP/USD 1.7600. The investor exercises the option and receives GBP 31,250 for which he pays USD 50,937.50 (1.6300 x GBP 31 250). The investor sells the GBP in the spot forex market at the spot exchange rate of GBP / USD 1.7600 and receives USD 55,000 (1.76 x GBP 31,250). The profit made is USD 4,062.50 (USD 55,000 - USD 50,937.50) less the premium paid for the option.

The *premium* is quoted in US cents per GBP. In the above example the premium is 1.5 US cents per GBP, i.e. the premium amount is 31 250 x 1.5/100 = USD 468.75. Total net profit is USD 3,593.75 (USD 4,062.50 – USD 468.75).

5.12.3 Options on foreign exchange (retail: warrants)

In addition to the wholesale market, there exists a market in retail options on foreign currencies. In South Africa, these are called *currency reference*

warrants (CRWs).[52] CRWs are of the European variety, are available as call and put warrants, are listed on the JSE, and are cash settled.

CRWs enable investors to hedge themselves against unexpected movements in the ZAR. Call warrants enable investors to buy a foreign currency (i.e. to sell the ZAR) when they believe the ZAR will weaken (read: pay more ZAR for one unit of the foreign currency). On the other hand, put warrants enable investors to sell a foreign currency (i.e. to buy the ZAR) when they believe the ZAR will strengthen (read: less ZAR for one unit of the foreign currency).

5.13 OPTIONS ON COMMODITIES

The commodities options markets are also large markets internationally, but they fade into the background when compared with the options on financial instruments markets. Options are written on all the larger commodities, such as gold, oil, wheat, maize, soybean, and certain commodity indices such as the AMEX oil index. The commodity options markets are both formalised and OTC.

In addition to the wholesale options on commodities market, there exists a retail market: warrants on commodities.[53] These are called *commodity reference warrant* (CoRWs) in South Africa. The underlying assets of CoRWs are commodities such as gold, platinum, and oil, expressed in ZAR. They are available in puts and calls.

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[52] See https://www.warrants.standardbank.co.za/proxy/warrants/docs/ProductBrochures/CRW%20Brochure-Final.pd

[53] See: https://securities.standardbank.co.za/ost/nsp/BrochureWarepublic/Ost/products/warrants.html (Accessed 12 01 2012).

5.14 OPTION STRATEGIES

5.14.1 Introduction

There are no fundamental dissimilarities between operations in the futures and options markets, i.e. dealings in the options market can be divided into the four types:

- Speculative.
- Hedging.
- Arbitrage.
- Investment.

However, we know that a hedger, speculator or investor has the choice between futures and options, and the essential difference between them is that in the case of the options the buyer has limited downside risk. We also know that there are several payoff situations for buyers are sellers of options. In addition, a virtually unlimited variety of payoff patterns may be attained by the *combination* of calls and puts with various exercise prices. Here we consider only two of the combinations of options, the straddle and the strangle.[54]

[54] Example from Pilbeam, 1998.

5.14.2 Straddle

TABLE 5.14: PROFIT / LOSS PROFILE OF A LONG STRADDLE			
Underlying price of share at expiry	Profit / loss on call option	Profit / loss on put option	Net profit / loss on straddle
440	-10	+31	+21
445	-10	+26	+16
450	-10	+21	+11
455	-10	+16	+6
460	-10	+11	+1
465	-10	+6	-4
470	-10	+1	-9
475	-10	-4	-14
480	-10	-9	-19
485	-5	-9	-14
490	0	-9	-9
495	+5	-9	-4
500	+10	-9	+1
505	+15	-9	+6
510	+20	-9	+11
515	+25	-9	+16
520	+30	-9	+21

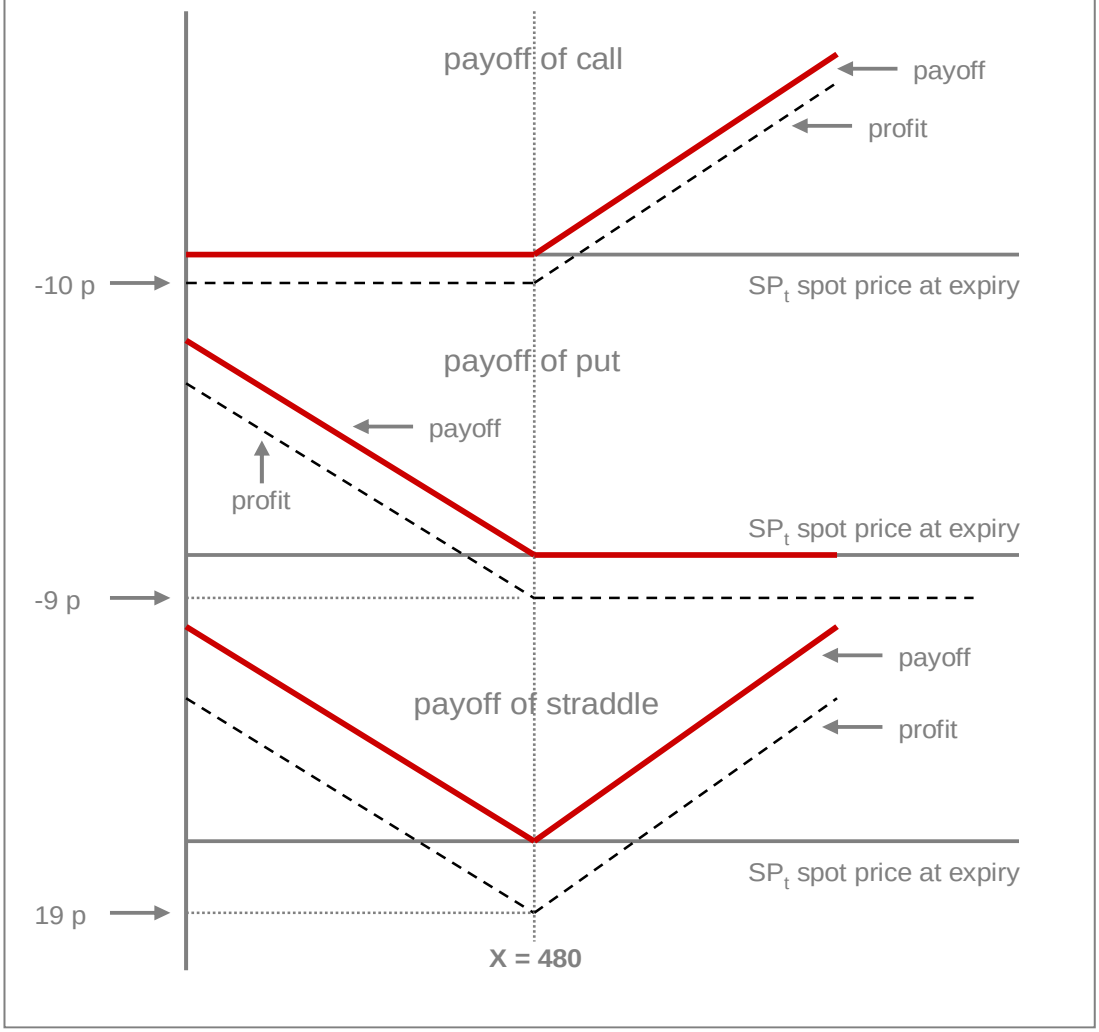
The straddle is generally put into place when an investor believes that the price of the underlying is about to “run” but she is uncertain of the direction. The straddle involves the purchasing of a call and a put at the same strike price and expiration date.

The share price of Company ABC is trading at 480 pence currently. The price of a call at a strike of 480 pence is 10 pence and the price of a put at the same strike is 9 pence. The position is held to maturity (six months from purchase). Table 5.14 and Figure 5.19 set out the profit and loss profile.

TABLE 5.15: VALUE OF STRADDLE AT EXPIRY		
	$SP_t < X$	$SP_t \geq X$
Payoff of call	0	$SP_t - X$
+ Payoff of put	$X - SP_t$	0
= Total	$X - SP_t$	$SP_t - X$

The solid line in the lowest part of the chart shows the payoff condition of the straddle. At $X = SP_t$ the payoff is equal to zero. It is only at this point that the payoff is zero; at all other points the straddle has a positive payoff. One may then ask why these combinations are not more popular. The answer is that if prices are not volatile the holder may lose heavily because she is paying a *much higher premium* than is usually the case.

Figure 5.19: profit / loss profile of a long straddle



The dotted line in the chart represents the profit of the straddle. It is below the solid line by the cost of the straddle, i.e. the premium, in this case 19 pence. This is the maximum that can be lost.

The dotted line in the chart represents the profit of the straddle. It is below the solid line by the cost of the straddle, i.e. the premium, in this case 19 pence. This is the maximum that can be lost.

5.14.3 Strangle

A strangle is the same as the straddle except that the exercise prices differ. An example is shown in Table 5.16.[55]

The share price of Company ABC is trading at 480 pence. The price of a call option at strike 460 is 25 pence, and the price of the put at strike 480 is 9 pence. The table shows the payoff profile. It will be clear that there is a range where maximum losses are made and this is between the two strike prices. The loss is capped at 14 pence. Beyond this range the losses are reduced or profits rise and they do so in a symmetrical fashion.

TABLE 5.16: PROFIT / LOSS PROFILE OF A LONG STRANGLE

Underlying price of share at expiry	Profit / loss on call option	Profit / loss on put option	Net profit / loss on straddle
440	-25	+31	+6
445	-25	+26	+1
450	-25	+21	-4
455	-25	+16	-9
460 (call strike)	-25 (call premium)	+11	-14
465	-20	+6	-14
470	-15	+1	-14
475	-10	-4	-14
480 (put strike)	-5	-9 (put premium)	-14

[55] Example from Pilbeam, 1998.

485	0	-9	-9
490	+5	-9	-4
495	+10	-9	+1
500	+15	-9	+6
505	+20	-9	+11
510	+25	-9	+16
515	+30	-9	+21
520	+35	-9	+26

5.14.4 Delta hedging

In normal hedging strategies (for example, holding of an asset and buying a put with the asset as the underlying when it is expected that its price will decline), some hidden risks lurk, requiring an appreciation of the "Greeks": delta, theta, gamma, vega and rho. We covered them briefly earlier. Here we discuss the most prominent one, delta, and specifically delta hedging, in a little more detail.

It will be recalled that *delta* is the rate of change of the option price with respect to the price of the underlying asset. If a call option has a delta of +1 it means that when the value of the underlying increases, the value of the option changes by the same amount. If the delta of a call option is +0.5, it means that when the price of the underlying increases by a number, the price of the option changes by 50% of that number. (It will be clear that the delta of a put option is negative.) When the delta of an option is removed from +1 or -1 (ie closer to 0), it constitutes risk in a hedge. The delta can also change over time due to changes in the underlying price, volatility or a shortening of the time to expiration (referred to as *delta-variable*).

A *delta-neutral* position is obtained when an options / underlying instrument position is constructed so that it is insensitive to small price movements in the underlying instrument. Thus, if an investor has a long position in shares, she can hedge the position against losses by buying puts (long put position) or selling calls (short call position) to the extent of the *inverse of the delta*. If the delta of a put option is 0.75, the *hedge ratio* is 1/0.75 = 1.33. This means that

1.33 put options are required to offset one unit of the long position in shares. With this in place the investor has a *delta-neutral hedge.*

An example: if an investor holds 30 000 ABC shares, she will need to buy put options (with a delta of 0.75) to the extent of 30 000/0.75 = 40,000 (assuming a put option on 1 share could be bought). If the put option contract size is 1,000 shares, then 40 contracts are required [30 000/(0.75x1,000)] to achieve a *delta-neutral hedge.*

As noted above, the delta values of options contracts do change over time; therefore, the position needs to be rebalanced every so often to maintain a hedge ratio of h = -1. This is called *dynamic hedging*.

5.15 EXOTIC OPTIONS[56]

Securities broker-dealers and investment banks have over the years developed many so-called exotic options. Many of them cross the various markets. The following may be mentioned as examples:

As you like it options (AYLIO)

The AYLIO is an option that allows the holder to convert from one type of option to another at a certain pre-specified point prior to expiration. This is usually from a call to a put or vice versa. This option type is also called “call or put option” or “chooser option”.

Average rate options (ARO)

The ARO is an option on which settlement is based on the difference between strike price and the average of the share or index on certain given dates. The “average” attribute of the ARO renders this option less volatile and thus cheaper than a conventional “spot price option”. The ARO is also called an “Asian Option”.

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[56] See Pilbeam, 1998 and Hull, 2000.

Barrier options (BAO)

There are many types of barrier options. Their payoff is dependent on the price of the underlying asset and on whether the asset reaches a pre-determined barrier at any time in the life of the option. There are, for example, knock-in options and knock-out options. The former is activated when the price of the underlying asset reaches a pre-determined level. The latter option is “killed” if the price of the underlying reaches a pre-determined level.

Compound options (CO)

A CO is an option on an option. The buyer has the right to buy a specific option at a pre-set date at a pre-set price.

Lookback options (LO)

A LO is an option where the pay-out is determined by using the highest intrinsic value of the underlying security or index over its life. For a lookback call the highest price is used, whereas the lowest price is used in a lookback put.

Quantro options (QO)

A QO is a currency option in terms of which the foreign exchange risks in an underlying security have been eliminated.

Package options (PO)

A PO is a portfolio consisting of standard European calls, standard European puts, forward contracts, cash and the underlying asset itself. An example is a range forward contract.

Forward start options (FSO)

FSOs are options that start their life at some stage in the future. They are used in employee incentive schemes.

Binary options (BIO)

BIOs are options with discontinuous payoffs. An example is a cash-or-nothing call. This pays off nothing if the share price ends up below the strike price at some time in the future and pays a fixed amount if it ends up above the strike price.

Shout options (SO)

SOs are European options where the holder can “shout” to the writer at one time during its life. At the end of the life of the option the holder receives either the usual payoff from a European option or the intrinsic value at the time of the shout whichever is greater.

Other options

There are also other options such as options to exchange one asset for another (*exchange options*), options involving several assets (*rainbow options*), basket options, etc.

5.16 REVIEW QUESTIONS AND ANSWERS

Review questions

1. Writers exercise their options only if it is rewarding to do so, and their potential loss is finite, while their potential profit is limited to the premium received for the option. True or false?
2. Call and put options both give the holder the right to decide whether to exercise the option. In the former case the writer is obliged to sell the underlying asset if the option is exercised, whilst in the latter case the writer is obliged to buy the underlying asset if the option is exercised. True or false?
3. The buyer of a call option takes a long option position and the buyer of a put option takes short option position. True or false?
4. The strike (or exercise) price on a put option is R500 and the premium paid was R10. On the expiration date the spot price is R495. The holder will not exercise the option because the spot price plus the premium is more than the strike price. True or false?
5. An option that is at-the-money (ATM) has no intrinsic value because SP = EP but does have time value because it has not yet reached its expiry date. True or false?
6. Call options are more valuable as the SP of the underlying asset *increases*, and put options are more valuable as the SP of the underlying asset *decreases*.
7. The longer the time to expiration the more valuable both call and put options are because the accrued interest calculated at the risk-free rate will be more the longer the period until maturity. True or false?
8. The Black-Scholes option pricing model is referred to as the Midas formula, because it allows the investor to avoid all risk and obtain a true risk-free investment. True or false?
9. Define an option.
10. What are the types of underlying assets in the financial markets on which options can be acquired?

11. What will be the profit or loss payoff of the writer of a call option if the spot price should fall below the strike (or exercise) price and if the spot price should rise above the strike price?
12. What will be the profit or loss payoff of the holder of a put option if the spot price should fall below the strike (or exercise) price and if the spot price should rise above the strike price?
13. For each of the following options, state whether it is a horizontal flip image (left flips to right and vice versa), or vertical flip image (top goes to bottom, etc.), or both a horizontal and vertical flip image of the payoff profile of call option from the perspective of the holder of a call option; writer of a call option; holder of a put option; and writer of a put option.
14. You are given the following information about a put option:
    - Underlying asset = a share listed on the JSE
    - Underlying asset spot market price (SP) = R243
    - Option exercise price (EP) = R251
    - Premium (P) = R12.

    What is the time value on this option?

15. What variable in the Black-Scholes model is the key determinant of the probability distribution of the underlying asset price?
16. Why do the values of both puts and calls increase as volatility (of the underlying asset price) increases?
17. An investor requiring a general equity exposure to the extent of R1 million decides to acquire this exposure through the purchase of call options on the *ALSI future*. The index is currently recorded at 12 500. Assume that the premium is R1 700 per contract. How many option contracts would the investor require? What is the investor's breakeven price?
18. The premium on a 3-month JIBAR September future, with a price of R94.60, is 8.5% in June. An investor buys a call option on this future in June for a nominal value of R1 000 000. By the expiry date interest rates have fallen to 5.2%. Will the holder exercise the option and what is the profit or loss on the option?

19. An investor has a portfolio that can be compared with the JSE's ALSI share index. The value of his portfolio is R5.5475 million and the ALSI index is presently standing at 15 850. The value of a share index option is ten times the index value. How many put options will the investor require to hedge the value of his portfolio?
20. What is the delta of an option?

Answers

1. False. Writers do not exercise their options; holders have the right, granted to them by the writers, to exercise their options, which they will only do if it is rewarding to do so. The potential loss to the writer is not finite, while their potential profit is limited to the premium paid for the option.
2. True.
3. False. The buyer of an option (call or put) takes a *long position*, i.e. s/he has *bought* the option and has the benefits of the option (the “option” to do something). The seller of an option (call or put) has taken a *short position*, i.e. s/he has *sold* the option and received the premium.
4. False. The holder will exercise the option because doing so will reduce the net loss from R10 (the premium) to R5. The option is bought at the spot price of R495 and sold at the strike price of R500. That gives a profit of R5 that reduces the cost of the premium of R10 by R5, leaving a net loss of R5.
5. True.
6. True.
7. False. The longer the time to expiration the more valuable both call and put options are because the holder of a short-term option has certain *exercise opportunities*, whereas the holder of a similar long-term option also has these opportunities and more. Therefore, the long option must be at least equal in value to a short-term option with similar characteristics. As noted above, the longer the time to expiration the higher the probability that the price of the underlying assets will increase/decrease because it is probable that the fluctuation of the price

can produce a spot rate that will make a bigger profit possible in future (but before expiration) than can be made today.

8. The Black-Scholes option pricing model is not the Midas formula, because it rests on several simplifying assumptions such as the underlying asset pays no interest or dividends during its life, the risk-free rate is fixed for the life of the option, the financial markets are efficient and transactions costs are zero, etc. However, it is very useful in the case of certain options.
9. An option bestows upon the holder the right, but not the obligation, to buy or sell the asset underlying the option at a predetermined price during or at the end of a specified period.
10. The *underlying assets* in the options markets of the world are *other derivatives* (futures and swaps), and *specific instruments* (“physicals”) and *notional instruments* (indices) of the various markets.
11. If the spot price falls below the strike price: the writer will make a profit equal to the premium. If the spot price rises above the strike price: the writer will make a loss that is unlimited in the sense that it will rise in proportion to the rise of the spot price above the strike price.
12. If the spot price falls below the strike price: the holder will make a profit that is unlimited in the sense that it will rise in proportion to the fall of the spot price below the strike price. If the spot price rises above the strike price: the holder will make a loss that is equal to the premium paid on the option.
13. Payoff profile of the writer of a call option: a vertical flip image of the payoff profile of the holder of a call option.

    Payoff profile of the holder of a put option: a horizontal flip image of the payoff profile of the holder of a call option.

    Payoff profile of the writer of a put option: a horizontal and vertical flip image of the payoff profile of the holder of a call option.

14. R4 {12 – (251 – 243)}.
15. The volatility of the underlying asset is the key variable in the Black-Scholes model that determines the probability distribution of the underlying asset price.

16. As volatility increases, so does the chance that the underlying asset will do well or badly. The direct investor in such an asset will not be affected because these two outcomes offset one another over time. However, in the case of an *option holder* the situation is different:
    - The call option holder benefits as prices increase and has limited downsize risk if prices fall;
    - The put option holder benefits as prices decrease and has limited downsize risk if prices rise.

    Thus, both puts and calls increase in value as volatility increases.

17. An investor requiring a general equity exposure to the extent of R1 million decides to acquire this exposure through the purchase of call options on the *ALSI future*. The index is currently recorded at 12 500, s/he would require 8 call option contracts (8 x R10 x 12500 = R1 000 000) (remember that one ALSI futures contract is equal to R10 times the index value).

Because the investor is buying the *right* to purchase the future and has *no obligation* in this regard, s/he pays a premium to the writer. The premium is R1 700 per contract (R13 600 for 8 contracts).

The investor is thus paying R13 600 for the right to purchase 8 ALSI futures contracts at an exercise or strike price of 12500 on or before the expiry date of the options contract. It will be evident that the premium per contract of R1 700 translates into 170 points in the all share index (R1 700 / R10 per point). Thus, the investor's *breakeven price* is 12670 (12500 + 170).

18. The holder of the option has the right to make a deposit of R1 000 000 on the expiry date in September (the date is specified) at an interest rate of 5.4% (100 – 94.60) for 3 months.

    Each tick movement on the contract, which is equivalent to one basis point, is worth the value of the contract (R1 000 000) multiplied by 1 basis point (0.01% or 0.0001) and a quarter of a year (0.25), i.e.: R1 000 000 x 0.0001 x 0.25 = R 25.00.

    The cost of the call option (i.e. the premium), is therefore 8.5 x R25.00 = R212.50.

If by the expiry date the contract strike price rises to R94.80% (interest rates have fallen to 5.2%) the holder is entitled to a gain of 20 basis points, and the profit is 20 x R25.00 = R500.00 less the premium of R212.50 = R287.50.

The holder will therefore exercise the option to make a profit of R287.50.

19. The value of his portfolio is R5,547,500 and the ALSI index is presently trading at 15,850. The value of a share index option is ten times the index value. The nominal value of each option is thus 15,850 x R10 = R158,500. The investor will buy 35 put options on the ALSI index (5,547,500/158,500 = 35).
20. *Delta* is the rate of change of the option price with respect to the price of the underlying asset

5.17 USEFUL ACTIVITIES

Options listed on the JSE:

http://www.jse.co.za

Options tutorial:

http://www.investopedia.com/university/all/options-and-futures/

Examples of SA exotic options:

https://www.jse.co.za/content/JSEBrochureItems/55%20-%20JSE%20Can%20Do%20Exotic%20Options%20-%20April%202014.pdf

Warrants:

https://www.warrants.standardbank.co.za/proxy/warrants/

General glossary:

http://www.mfdf.org/images/DirResPDFs/GlossaryofCommonDerivativesTerms.pdf

CHAPTER 6

OTHER DERIVATIVE INSTRUMENTS

6.1 CHAPTER ORIENTATION

CHAPTERS OF “THE DERIVATIVES MARKET”	
Chapter 1	The derivatives market in context
Chapter 2	Forwards
Chapter 3	Futures
Chapter 4	Swaps
Chapter 5	Options
Chapter 6	Other derivative instruments

6.2 LEARNING OUTCOMES OF THIS CHAPTER

After studying this chapter, the learner should:

- Comprehend the existence of derivatives that are not classified under the traditional derivatives (forwards, futures, swaps and options).
- Define products of securitisation.
- Understand credit derivatives.
- Describe weather derivatives.
- Elucidate carbon credit derivatives.
- Describe freight (or shipping) derivatives.
- Explain energy derivatives.
- Understand the development of the crypto currency derivatives

6.3 INTRODUCTION

The mainstream derivatives were discussed above. As stated before, derivatives are instruments that cannot exist without their underlying instruments and their value depends on the value of these underlying instruments; and the traditional underlying instruments are share prices, share indices, interest rates, commodity prices, exchange rates, etc.

Over the past decades, and in some cases over the past few years, other derivatives have been developed: insurance derivatives, catastrophe derivatives, weather derivatives, credit derivatives, and so on. We discuss the main ones here:

- Products of securitisation.
- Credit derivatives.
- Weather derivatives.
- Carbon credit derivatives.
- Freight (or shipping) derivatives.
- Energy derivatives.
- Crypto currency derivatives

6.4 SECURITISATION

The products of securitisation *may also be seen as "derivatives"* because they and their prices are derived from debt or other securities that are placed in a legal vehicle such as a company or a trust. Some analysts will insist that these products are *not derivatives*. However, the jury is still out in this respect.

Securitisation amounts to the pooling of certain non-marketable assets that have a regular cash flow in a legal vehicle created for this purpose (called a special purpose vehicle or SPV) and the issuing by the SPV of marketable securities to finance the pool of assets. The regular cash flow generated by the assets in the SPV is used to service the interest payable on the securities issued by the SPV.

There are many assets (representing debt) that may be securitised, and the list includes the following:

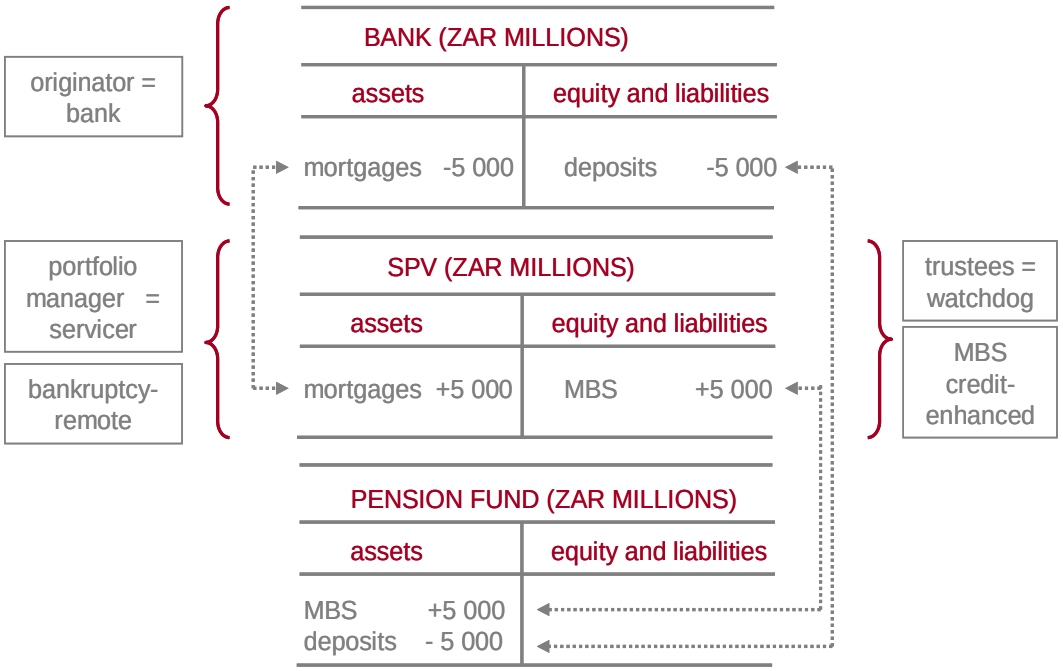
- Residential mortgages.
- Commercial mortgages.
- Debtors' books.
- Credit card receivables.
- Motor vehicle leases.
- Certain securities with a high yield.
- Equipment leases.
- Department store card debit balances (example: Edgars card).

For the banks, securitisation amounts to the taking of assets off balance sheet and freeing up capital[57]. For companies, securitisation presents an alternative to the traditional forms of finance. An example of the latter is the securitisation of company's debtors' book.

A typical securitisation (of mortgages) may be illustrated as in Figure 6.1. In this example, the bank decides to securitise part of its mortgage book, to free up the capital allocated to this asset. It places R5 billion of mortgages into a SPV, and the SPV issues R5 billion of mortgage-backed securities (MBS) at a floating rate benchmarked to the 3-month JIBAR to finance these assets. A portfolio manager manages the SPV, and trustees appointed in terms of the scheme monitor the process on behalf of the investors (in this case assumed to be pension funds) in the MBS.

[57] Not always though; it depends on credit enhancement facilities.

Figure 6.1: simplified example of bank securitisation of mortgages



It should be noted that the details of the above securitisation have been ignored, in the interests of understanding the basic principles of the transaction. In real life, the scheme is extremely lawyer-friendly, and the MBS issued are rated AAA by the rating agency/agencies to attract investors. This is achieved by the credit-enhancement process, by which is meant that the SPV is properly "capitalised". The latter in turn is achieved by the SPV issuing 3 streams of MBS in the following manner (this is an example)[58]:

- AAA rated MBS: 90% of the total (i.e. R4 500 billion).
- BBB rated MBS (called mezzanine debt): 7% of the total (i.e. R350 million).
- Unrated MBS (called subordinated debt): 3% of the total (i.e. R150 million).

[58] There are other requirements as well, such as a liquidity requirement.

The AAA rated paper, as noted, is sold to the market, while the BBB paper is usually purchased by one of the sponsors at an excellent rate of interest.[59] The management company usually holds the unrated paper in portfolio, and a mixture of equity and debt finances this company.

The variable rate of interest paid on the underlying assets (and the cost of the credit enhancement) determines the rate payable on the three streams of paper created by the SPV.

6.5 CREDIT DERIVATIVES

6.5.1 Introduction

Credit derivatives emerged in the 1990s, and the market and the range of products have grown significantly since then. A credit derivative may be defined as "… a contract where the payoffs depend partly upon the creditworthiness of one or more commercial or sovereign entities."[60] There are a number of credit derivative contracts, such as *total return swaps* (e.g. where the return from one asset is swapped for the return on another asset), *credit spread options* (e.g. an option on the spread between the yields on two assets; the payoff depends on a change in the spread) and *credit default swaps*. The latter is the most utilised credit derivative[61], and we focus on this one below.

6.5.2 Example of credit default swap

A credit default swap is a bilateral contract between a *protection purchaser* and a *protection seller* that compensates the *purchaser* upon the occurrence of a *credit event* during the life of the contract. For this protection the protection purchaser makes periodic payments to the protection seller. The *credit event* is

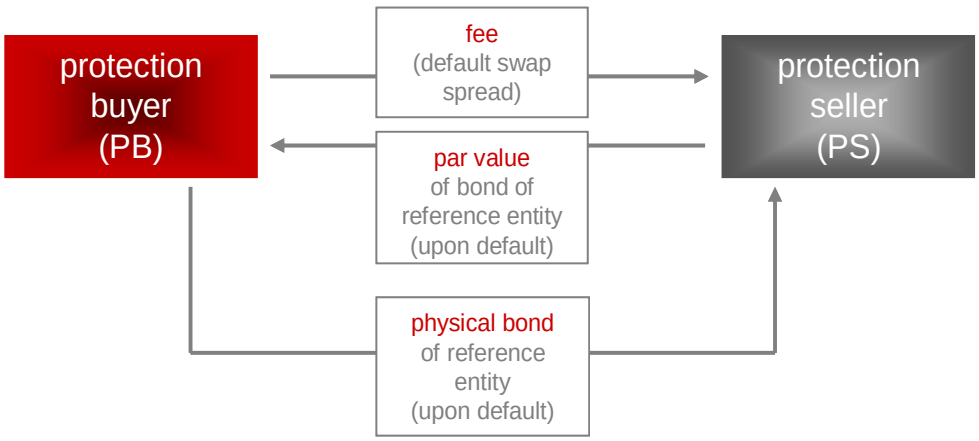
[59] As high as 400 basis points above the AAA-rated paper (i.e. + 4%).

[60] Definition from Hull (2000: 644)

[61] Estimated by the British Bankers' Association at close to 40% of the market (in 1999).

objective and observable, and examples are default, bankruptcy, ratings downgrade and fall in market price.

Figure 6.2: example of a credit default swap



An example is required (default by an issuer of a bond): a credit default swap contract in terms of which INVESTCO Limited (an investor; called the *protection buyer*) has the right to sell a bond[62] issued by DEFCO Limited (a bond issuer; called the *reference entity*) to INSURECO Limited (an insurer; called the *protection seller*) in the event of DEFCO defaulting on its bond issue (the specified *credit event*). In this event the bond is sold at face value (100%).

In exchange for the protection, the protection buyer undertakes to settle an amount of money (or fee) in the form of *regular payments* to the protection seller until the maturity date of the contract or until default. The fee is called the *default swap spread*. This contract may be illustrated as in Figure 6.2.[63]

As noted, the fee is payable until maturity of the bond or until default. If default takes place, the protection buyer has the right to sell the bond to the protection seller at par value. It is then up to the protection seller to attempt to recover any

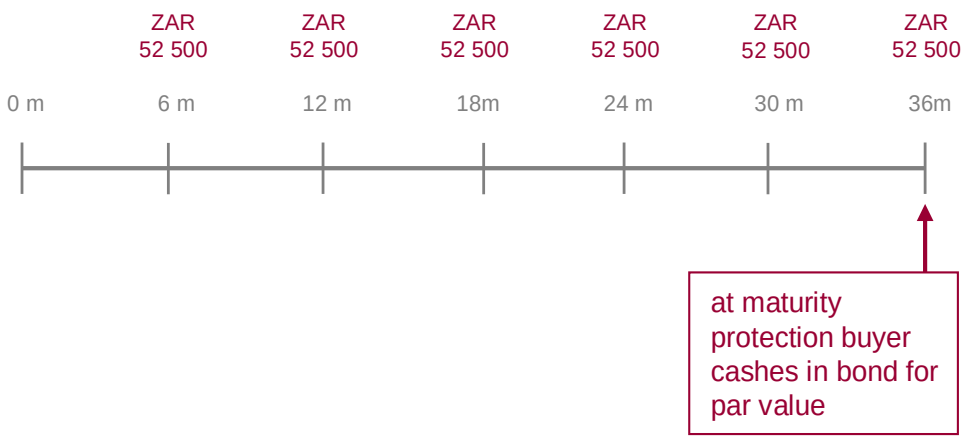
[62] Some contracts are also settled in cash.

[63] Example much adapted from Lehman Brothers International (Europe), 2001.

funds from the defaulting bond issuer. The following are the details of the contract:[64]

Protection buyer	= INVESTCO Limited
Protection seller	= INSURECO Limited
Reference entity (issuer)	= DEFCO Limited
Currency of bond	= ZAR
Maturity of bond	= 3 years
Face value	= ZAR 30 million
Default swap spread	= 35 basis points pa
Frequency	= Six monthly
Payoff upon default	= Physical delivery of bond for par value
Credit event	= Default by DEFCO Limited on bond.

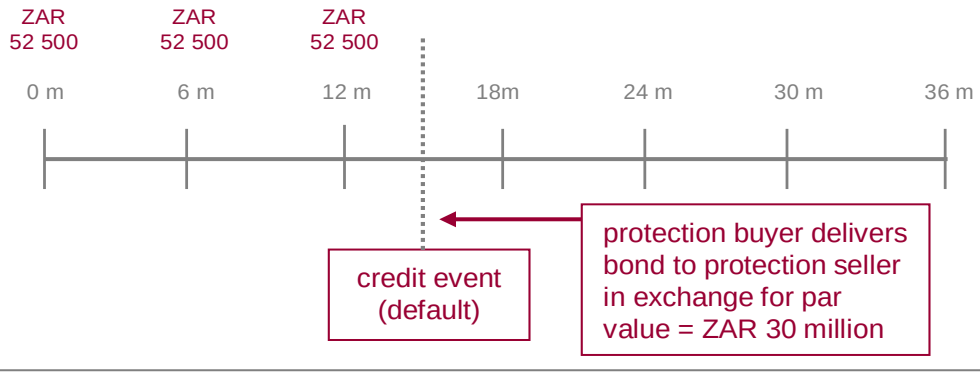
Figure 6.3: cash flows with no default (to protection seller)



The cash flows in the event of no default and default are as shown in Figure 6.3 and Figure 6.4.

[64] Ibid.

Figure 6.4: cash flows in event of default



6.5.3 Pricing

The pricing of credit derivatives is straightforward. The fee payable on the swap, i.e. the default swap spread (DSP), should be equal to the risk premium (RP) that exists *over* the risk-free rate (rfr = rate on equivalent term government bonds). In other words, the DSP should be equal to the RP which is equal to the yield to maturity (ytm) on the DEFCO bond less the rfr:

DSP = RP = ytm – rfr.

This is so if the credit default swap is priced correctly. If this is not the case, arbitrage opportunities arise. For example, if rfr = 10.0% pa and RP = 5.0% pa then ytm = 15.0% pa. If the market rate (ytm) of the reference bond is 17.0% pa, and DSP = 5.0% pa, it will pay an investor (protection buyer) to buy the bond at 17.0% pa and do the credit swap (cost = 5% pa) because he is getting a 200bp better return than the rfr (10% pa) on a synthetic risk-free security.

Conversely, if the ytm of the reference bond is 13.0% pa, and DSP = 5.0% pa, it pays the protection seller to short the reference bond and enter into the swap. This means that the protection seller is borrowing money at 13% pa (the ytm at which the reference bond is sold), and investing at the rfr (10.0% pa) and earning the DSP of 5.0% pa, i.e. a profit of 200 bp.

Clearly these examples point to the fact that arbitrage will ensure that in an approximate sense DSP = RP.

The main participants in the credit derivatives market are the banks (63% of protection buyers and 47% of protection sellers), securities firms (18% of protection buyers and 16% of protection sellers) and insurers (7% of protection buyers and 23% of protection sellers).[65]

The other participants are the hedge funds, mutual funds, pension funds, companies, government, and export credit agencies.

6.6 WEATHER DERIVATIVES

The weather derivative is a relatively new instrument, but it is growing in popularity because many businesses depend on or are affected by the weather. Examples are:

- Retailers in London (example: loss of sales in bad weather).
- Agricultural concerns (example: loss of crops).
- Insurers of agricultural concerns (example: claims for hail damage)
- Construction enterprises (example: loss of time spent on a contract as a result of inclement weather).
- Football stadiums (example: lower turnstile takings as a result of bad weather).
- Large landlords (example: additional heating costs in cold periods).

According to Applied Derivatives Trading Magazine[66], 75% of the profits of enterprises rise and fall as a result of changes in the weather. The magazine also reported that in the first 18 months since weather derivatives were introduced some 1 000 contracts were signed.

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[65] Estimates by the British Bankers' Association in 1999.

[66] See Applied Derivatives Trading Magazine (November 1998).

Weather derivative contracts are usually structured as futures, options (caps, floors, collars) and swaps, and are settled in the same way as these. The contracts have several parameters as follows[67]:

- Contract type (cap, floor, swap).
- Contract duration.
- Official weather station (often weather service data stations located at major airports).
- Definition of underlying weather index (temperature, rainfall, snow, frost).
- Strike for options or index for swap.
- Tick for linear pay-out or fixed payment for binary payment scheme.

As seen, weather hedges can be based on temperature, rainfall, etc. The most common is contracts based on temperature. The underlying “instrument” or “value” in the case of temperature-related weather derivatives is Celsius-scale temperature as measured by “degree days” (DD). A DD is the absolute value of the difference between the average daily temperature and 18^{o}C. The winter measure of average daily temperature below 18^{o}C is called heating degree days (HDDs), and the summer measure of average daily temperature above 18^{o}C is termed cooling degree days (CDDs). If for example the mean temperature of a day in December were 3^{o}C, the HDD would be 15. The number for the month is the total of the daily HDDs (negatives are ignored).

Examples of temperature contracts:

- Caps (also known as call options) establish a DD ceiling. The holder is compensated for every DD above the ceiling up to a maximum amount.
- Floors (also known as put options) establish a DD minimum. The holder is compensated for every DD below the floor up to a maximum amount.
- Collars or swaps establish a DD ceiling and a DD floor. The holder is compensated for every DD above the ceiling or below the floor.

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[67] http://financialmarketsjournal.co.za/oldsite/1stedition/printedarticles/printweatherderivatives.htm

An example is required[68]. A London retailer reviews historical weather and revenue data to uncover the correlation between temperature and sales. They find that 225 HDDs in December is the point below which *winter apparel sales* start to fall. Each DD below 225 corresponds to a potential GBP 10 000 in lost sales. The retailer decides to buy a weather floor for December of 225 HDDs, with a pay-out of GBP 10 000 per DD and a maximum of GBP 1 million. The weather index used is the weather station at London Weather Centre. The premium is GBP 85 000.

December passes and the data is available on 3 January. The December cumulative number of HDDs is 200 (i.e. 25 below the floor of 225), i.e. it was warmer and winter apparel sales were indeed down. The seller of the hedge pays out:

GBP 10 000 x 25 = GBP 250 000,

and the total income of the retailer is:

GBP 250 000 – GBP 85 000 (the premium paid) = GBP 165 000.

6.7 CARBON CREDIT DERIVATIVES

To comprehend carbon credits, some background information is required. In 1979 an international climate conference took place. This led to the formation in 1992 (at the Rio Earth Summit) of the *United Nations Framework Convention on Climate Change* (UNFCCC), which became operational in 1994. The countries which ratified the UNFCCC (now close to 200) are called *Parties to the Convention* and their frequent meetings are called *Convention of the Parties* (COP). Each meeting is given a COP-number and a name, for example, the *Kyoto Protocol* (COP3), and the 2011 *Durban Platform for Enhanced Action* (COP17).

[68] Clemmons, L and Mooney, N (1999)

The ultimate objective on the UNFCCC is to stabilise greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic (human induced) interference with the climate system." It further states that "such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner."[69]

According to the UNFCCC, by 1995 “countries realized that emission reductions provisions in the Convention were inadequate. They launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed countries to emission reduction targets. The Protocol’s first commitment period started in 2008 and ends in 2012.”[70] In essence, the Kyoto Protocol sets binding emission reduction targets for 37 industrialised countries and the European Community. On average the target is an emissions-reduction of 5% compared to 1990 levels over the period 2008-2012.[71]

At the latest Convention, COP17 in 2011, the parties agreed on a pathway to a legally binding instrument that will compel all countries to take action to slow the pace of global warming. It is to be agreed by 2015 and implemented by 2020) The parties also agreed to a second commitment period of the Kyoto Protocol starting in 2013.

What is a carbon credit? Unfortunately, the answer is not a short one. In terms of the Kyoto Protocol[72] the *developed* countries are assigned *quotas* (aka *caps*) for greenhouse gas (GHG) emissions, termed *assigned amounts*. The initial assigned amounts are made up of units termed *assigned amount units* (AAUs).

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[69] See: http://unfccc.int/essential_background/convention/items/6036.php

[70] See: http://unfccc.int/essential_background/items/6031.php

[71] See: http://unfccc.int/essential_background/kyoto_protocol/items/6034.php

[72] See: http://unfccc.int/resource/docs/publications/08_unfccc_kp_ref_manual.pdf

Each AAU is an *allowance* to emit one metric ton of CO_2 (or CO_2 equivalent GHGs), and each developed country has a National Registry of its AAUs. The AAUs are known as carbon credits (and they can also be created – see below).

The developed countries, in turn, set quotas for the GHG emissions of local private and public enterprises (called operators), managed through their National Registries (and required to be validated and monitored for compliance by the UNFCCC). Thus, each operator has an *allowance* of carbon credit units, and each carbon credit unit represents the right to emit one ton of CO_2 (or other equivalent GHGs).[73]

In addition to the AAUs, another tradable carbon credit exists (created under the *Clean Development Mechanism* (CDM) of the Kyoto Protocol): an *offset of emissions*, termed *certified emission reductions* (CERs), when approved by the UNFCCC. A developed country can fund a GHG reduction project in a developing country (which has ratified the Kyoto Protocol), and the developed country would be allocated credits for meeting its emission reduction targets.

Operators that are about to exceed their quotas can buy carbon credits (AAUs and / or CERs) from operators that have not used up their quotas. This can be done on the open market or privately. Each transfer is reported to and authorised by the UNFCCC.

In addition to the UN-regulated market a voluntary market exists, elucidated by Nadaa Taiyab as follows: “Parallel with the CDM market, there has emerged a voluntary market for carbon offsets. The voluntary market consists of companies, governments, organisations, organisers of international events, and individuals, taking responsibility for their carbon emissions by voluntarily purchasing carbon offsets. These voluntary offsets are often bought from retailers or organisations that invest in a portfolio of offset projects and sell slices of the resulting emissions reductions to customers in relatively small quantities. As retailers generally sell to the voluntary market, the projects in

[73] See: http://en.wikipedia.org/wiki/Carbon_credit

which they invest do not necessarily have to follow the CDM process. Free of the stringent guidelines, lengthy paperwork, and high transaction costs, project developers have more freedom to invest in small-scale community based projects. The co-benefits of these projects, in terms of, for example, local economic development or biodiversity, are often a key selling point."

There are several exchanges that trade in carbon credits: European Climate Exchange, PowerNext, NASDAQ OMX Commodities Europe, Commodity Exchange Bratislava and the European Energy Exchange.[74] There are spot markets and futures and options markets. The trading unit is one allowance / carbon credit.

In regard to this market, the UK Financial Conduct Authority (FCA) warned in February 2015[75]: "… many investors have told us they are not able to sell or trade the carbon credits they have bought. None of these investors reported making a profit. This supports our view that there is not a viable secondary market for ordinary investors to sell or trade carbon credits, despite claims and promises made by many firms, advisers and brokers promoting and selling them as an investment. We have also received reports that an increasing number of firms are using dubious, high-pressure sales tactics to sell carbon credits to investors."

6.8 FREIGHT (OR SHIPPING) DERIVATIVES

At times the volatility of rates in the freight markets is high, i.e. a high level of risk exists for commodity producers and traders, ship owners, ship operators and other participants in freight. This led to the creation of forward freight agreements (FFAs) in the early nineties.76 A FFA is a contract between two parties, which stipulates an agreed future freight rate for carrying commodities

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[74] See: http://en.wikipedia.org/wiki/Carbon_credit

[75] Source: http://www.fca.org.uk

[76] See: http://www.olympicvessels.com/derivatives.php

(wet and dry) at sea. The contract does not involve any actual freight or any actual ships. It is a financial agreement which is cash settled.

The underlying asset is a freight rate (the contract rate) for a specified route (the contract route) over a specified period (the contract period). The rates on the routes are "assessed"[77] daily and published by the Baltic Exchange (there are also other smaller publishers of rates, such as Platt's). The rates are published as indices [e.g. the Baltic Exchange Panamax Index (BPI)] or rates. Thus, FFAs have four main terms:

- The agreed route.
- The settlement/expiry date.
- The contract size.
- The contract rate at which differences will be settled.

FFAs are OTC products made on a principal-to-principal basis. As such they are flexible and are not traded on an exchange. Brokers are involved in deals but:

- Settlement is between the principals (in cash usually within a few days after the settlement date).
- Commissions are agreed between the principal and the broker.
- The broker acts as an intermediary only and is therefore not responsible for the performance of the contract.[78]

There are two types of FFAs: OTC swaps and OTC "futures". The latter are actually forwards, but are called "futures" by market participants, because they enjoy clearing facilities [by the London Clearing House (LCH), the Norwegian Futures and Options Clearinghouse (NOS), the Singapore Exchange (SGX) and the Chicago Mercantile Exchange (CME)].

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[77] An estimated mid-price of the bids and offers of brokers at 17.30. See: https://www.balticexchange.com/ffa/ (Accessed 06 10 2017).

[78] Source: http://www.balticexchange.com (Accessed 06 10 2017).

In essence FFAs are cash-settled, privately negotiated (via non-principal brokers) bespoke financial contracts between two parties in terms of which one party agrees to pay the other party an amount equal to the difference between the contract price of the underlying index / rate of a specified route and the settlement price of the index / rate of the route.

The participants in the freight derivatives market are the abovementioned commodity producers and traders, ship owners, ship operators, etc. (i.e. those that wish to shed risk / hedge), as well as the speculators in the freight market (those that take on risk), including investment banks and hedge funds.

Variations of FFAs have emerged, including container-freight derivatives[79], options and spread dealing.

6.9 ENERGY DERIVATIVES

Energy derivatives is the term for forwards, futures, swaps and options on energy products, that is, the underlying assets of these derivatives are energy products, including oil, natural gas and electricity. The derivatives trade either on exchanges or OTC. We touched on the derivatives on commodities in the body of this text and present this section merely for the sake of completeness.

6.10 CRYPTO CURRENCY DERIVATIVES

Derivatives are part of any mature financial system and therefore play a crucial role in developing the cryptocurrency industry as a recognized asset class. Crypto derivatives are essential to the crypto market because their functions extend far beyond an individual trader's investment portfolio.

6.10.1 What are the Benefits of Crypto Derivatives?

Crypto derivatives facilitate market liquidity, making it easy for traders to open or close positions. In a liquid market, there is typically less risk because there is always someone willing to take the other side of a position. When a market

[79] See: http://www.economist.com/node/16846627 (Accessed 06 10 2017).

is liquid, it attracts more investors and traders because transaction costs are lower and closing a position is possible without price slippage.

Derivatives can protect a portfolio from unexpected risk owing to high volatility in terms of crypto-asset prices. A strong derivatives market helps to attract professional traders and institutional investors to the crypto industry.

Trading in cryptocurrency derivatives can be done on specialized cryptocurrency exchanges or on traditional financial exchanges that have added cryptocurrency trading to their offerings.

Why are crypto derivatives important?

Derivatives also predict risk, especially in uncertain market conditions wherein options prices are typically overbought. Forewarned by risk-averse sentiments, traders will make it a point to buy options in a bid to protect their portfolios.

Portfolio diversification

Derivatives allow traders more options to diversify their investment portfolios. They can expand across multiple crypto assets, and master advanced trading strategies. Some examples of the more sophisticated trading strategies are arbitrage, pairs trading, short-selling and the like.

Crypto Futures

Futures involve an agreement between a buyer and a seller to sell an asset in the future. The specific date and amount are also agreed on ahead of time. Contract details may vary, but the terms are usually similar.

Futures are a popular type of crypto derivative commonly used by institutional investors. Data from futures are typically used to predict future price movements and market sentiment.

Traders may either gain or lose depending on future price changes. For example, if the current price of Bitcoin is at $30,000, an investor may either buy or sell futures contracts in anticipation of either a price decline or an increase.

In any case, if a buyer purchases a futures contract worth one Bitcoin ($30,000) and it increases to $50,000 by the time the contract closes, the buyer will have realized $20,000 in profit. On the contrary, if the price drops to $20,000 by the time the contract closes, the buyer will have incurred a loss of $10,000.

More specifically, Bitcoin futures are agreements between a buyer and a seller to buy and sell Bitcoin at a given price at a specific date in the future. The contract is usually settled in USD or any other currency agreed upon by both parties.

Crypto Options

Options on a crypto currency contract gives a trader the right but not the obligation to buy or sell the crypto currency at a set price on a future date.

The nature of crypto options is no different to the options we already covered in Chapter 5. The buyer of the option pays premium and has the right but not the obligation to exercise at expiry. The contracts can either be exercised into an actual physical position in the underlying coin, or it can be settled in cash.

Risks of Trading Cryptocurrency Derivatives

While trading cryptocurrency derivatives can provide investors with an opportunity to profit from the volatile cryptocurrency market, it also carries risks. Let's take a closer look at some of the risks that come with trading cryptocurrency derivatives.

- Volatility in the Market - Cryptocurrencies are extremely volatile, with prices fluctuating rapidly. Because of this volatility, derivatives trading can be extremely risky, as investors may be unable to accurately predict future price movements.
- If the underlying asset experiences sharp price movements, derivatives trading can magnify the losses.
- Counterparty Danger - Counterparties, or the parties on the other side of the trade, are frequently involved in cryptocurrency derivatives

trading. The risk that a counterparty will not fulfil its contractual obligations, which is known as counterparty risk.

For instance, if an investor enters into a Bitcoin futures contract over the counter and the counterparty fails to deliver the Bitcoin on the agreed-upon date, the investor may incur losses. This risk can be mitigated when trading on a recognised futures Exchange like the CME or ICE Exchange described below.

- Leverage - Many cryptocurrency derivatives enable investors to use leverage, or the ability to control a large position with a small amount of capital.

While leverage can increase profits, it can also increase losses. If the market moves against the investor, they may be required to deposit more money to cover its losses.

- Regulatory Concerns - Because many countries are still developing regulations for cryptocurrency trading, trading in cryptocurrency derivatives is fraught with regulatory risks. Regulatory changes can have an impact on the value of cryptocurrencies and their derivatives, resulting in unexpected price movements.
- Risk of Liquidity - The trading of cryptocurrency derivatives can be illiquid, which means that there may not be enough buyers or sellers to match an investor's desired trade. This can make it difficult to execute trades and force investors to accept unfavourable prices.
- Operational Dangers - Trading cryptocurrency derivatives necessitates a complex technical infrastructure, and operational risks can arise as a result of system failures, cyber-attacks, and other unforeseeable events. These dangers can lead to financial losses, reputational harm, and regulatory fines.

Advantages of Trading Crypto Derivatives

The advantages of trading these types of derivatives are:

- **Achieving higher leverage-** derivatives trading is an activity well-known for its use of leverage. This means that one can theoretically increase his or her profits without having to put up a significant amount of capital upfront.
- **Transaction costs are low**- derivatives in general are known to reduce market transaction costs.
- **Efficiency on the back of arbitrage**- in what concerns market efficiency, crypto derivatives trading practices arbitrage, meaning that it has a role in achieving stability in the market given how it ensures that their underlying assets' prices are accurate.
- **Effective risk management**- as crypto derivative contracts' values are pegged to their respective underlying assets, they can be used as a clever way of mitigating the risks for which the underlying assets have been associated with (usually by offsetting losses with derivative-related gains).
- **Helping to determine the underlying asset's price while attaining higher liquidity**- given the high level of demand, the derivatives trading markets are highly liquid. Crypto derivative contracts in a way can thus help define the prices of their respective underlying assets.
- **Diversifying-** Derivatives can be effectively used as a way of minimizing one's portfolio risks.

The Formalising of Crypto Currency Derivatives on Futures Exchanges

Counterparty default on a forward, future, or option contract, can be mitigated when trading is conducted on a large internationally recognised like the Intercontinental Exchange (ICE) or the Chicago Mercantile Exchange (CME). Recently both have established contracts for Crypto futures and options.

Bakkt® Bitcoin Futures contracts

The launch of Bakkt® Bitcoin Futures contracts on ICE Futures U.S. represents the first futures contracts with CFTC-regulated on-exchange price discovery and physical delivery. This means that for the first time, price discovery and settlement will be set without reference to unregulated spot market.

Bakkt launched the first regulated options contract for bitcoin futures, traded at ICE Futures U.S. A cash settled futures contract is also available for trading at ICE Futures Singapore. Referencing the price of the physically delivered Bakkt® Bitcoin (USD) Monthly Futures, the cash settled contract offers a cost-efficient tool for hedging or gaining exposure to bitcoin without the need for physical delivery or reliance on the unregulated bitcoin spot market.

Chicago Mercantile Exchange Bitcoin Futures

CME’s Bitcoin futures contract, ticker symbol BTC, is a USD cash-settled contract based on the CME CF Bitcoin Reference Rate (BRR), which serves as a once-a-day reference rate of the U.S. dollar price of bitcoin. The BRR aggregates the trade flow of major bitcoin spot exchanges during a one-hour calculation window into the U.S. dollar price of one bitcoin as of 4 p.m. London Time.

The Bitcoin futures contract trades Sunday through Friday, from 5 p.m. to 4 p.m. Central Time (CT).

A single BTC contract has a value of five times the value of the BRR Index and is quoted in U.S. dollars per one bitcoin. The tick increments are quoted in multiples of $5 per bitcoin, meaning a one-tick move of the BTC future is equal to $25.

BTC futures are block trade eligible with a minimum quantity threshold of five contracts.

BTC futures expire the last Friday of the month and are listed on the nearest six consecutive monthly contracts, inclusive of the nearest two December contracts.

6.11 THE JSE VOLUNTARY CARBON MARKET

The JSE Voluntary Carbon Market (VCM) is part of the Johannesburg Stock Exchange's initiative to create a transparent, liquid, and accessible marketplace for the trading of carbon credits. The carbon credits are certificates representing a reduction in greenhouse gas emissions, which companies can buy to offset their own emissions. By trading these credits, businesses that are unable to fully reduce their emissions can still contribute to environmental sustainability efforts.

6.11.1 Key Features of the JSE VCM:

- It allows participants to buy and sell carbon credits, which represent the reduction or removal of one tonne of carbon dioxide or its equivalent.
- It is voluntary, allowing businesses that wish to offset their carbon footprint beyond regulatory requirements to participate in carbon trading.
- By offering a formal market for these credits, the JSE ensures transparent pricing and regulated transactions, improving trust and encouraging participation.
- ensures a more liquid market for carbon credits, as it allows organisations of different sizes and sectors to participate. This improves the efficiency and pricing mechanisms of carbon credits.
- aligns with global efforts to fight climate change, enabling South African companies to participate in the global carbon market, ensuring that the traded credits meet international standards of environmental integrity.

6.11.2 Why It Matters in Derivatives

Carbon markets are gaining importance globally as part of environmental finance, and the JSE’s initiative ties into a larger movement toward sustainable finance. Derivatives, including carbon credits, allow for risk management in financial markets and can play a critical role in meeting environmental goals. As carbon credit trading grows, it becomes a valuable derivative product for both voluntary and compliance markets.

6.12 SUMMARY OF DERIVATIVE INSTRUMENTS

We present a summary of the derivatives covered (excluding the exotic options) in Table 6.1.

TABLE 6.1: SPOT MARKETS AND DERIVATIVE INSTRUMENTS				
	SPOT MARKETS			
Derivatives	Debt market	Equity market	Forex market	Commodity market
Forwards				
Forward interest rate contracts	Yes			
Repurchase agreements	Yes			
Forward rate agreements	Yes			
Outright forwards	Yes	Yes	Yes	Yes
Foreign exchange swaps			Yes	
Forward forwards			Yes	
Time options (obliged to exercise)			Yes	
Forwards on commodities				Yes
Forwards on swaps[1]	Yes			
Futures				
On specific instruments (“physicals”)	Yes	Yes	Yes	Yes
On notional instruments (indices)	Yes	Yes	Yes	Yes
Swaps	Yes[2]	Yes[3]	Yes[4]	Yes[5]
Options				
Options on futures	Yes	Yes	Yes	Yes
Options on swaps	Yes			
Options on specific instruments	Yes	Yes	Yes	Yes
Options on notional instruments	Yes	Yes	Yes	Yes
Interest rate caps and floors	Yes			
Warrants (retail options)	Yes	Yes	Yes	Yes
Warrants (call options)	Yes	Yes		
Callable and puttable bonds	Yes			
Convertible bonds	Yes			
Other				
Products of securitisation	Yes			

Credit derivatives	Yes			
Weather derivatives				
Carbon credit derivatives				
Freight derivatives				
Energy derivatives				
Crypto Currency derivatives				
1. On interest rate swaps. 2 = Interest rate swaps. 3 = Equity swaps. 4 = Currency swaps. 5 = Commodity swaps.				

6.13 REVIEW QUESTIONS AND ANSWERS

Questions

1. There is general agreement that securitisation instruments are also derivatives. True or false?
2. A credit derivative may be defined as "… a contract where the payoffs depend partly upon the creditworthiness of one or more commercial or sovereign entities. True or false?
3. A credit default swap offers a *protection purchaser* protection against the occurrence of a *credit event* during the life of the contract. For this protection the protection purchaser makes a premium payment to the protection seller on the contract date when the swap is entered into. True or false?
4. The primary objective of weather derivatives is to hedge the risk of the price of a commodity changing adversely as a result of the weather. True or false?
5. Define securitisation.
6. The SPV created for the purpose of a securitisation issues 3 streams of MBS in the following manner:
    - AAA rated MBS: 90% of the total
    - BBB rated MBS: 7% of the total
    - Unrated MBS: 3% of the total.

    How is each stream generally financed? What does the descriptive name given to each stream indicate about the risk profile of each stream?

7. The pricing of credit derivatives is determined with the equation:
    DSP = RP = ytm – rfr.

    What is the meaning of each term in this equation?

8. The relevant information on a credit default swap is:

- The risk free rate – rfr – is 8.9% pa on a synthetic risk-free security.
- The ytm of the reference bond is 12.2% pa.
- The DSP = 3.2% pa.

Will it pay the protection seller to short the reference bond and enter into the swap?

9. What is the underlying instrument for a weather derivative?
10. Which exchange offers a cash settled Bitcoin futures contract?

Answers

1. False. The products of securitisation may also be seen as “derivatives” because they and their prices are derived from debt or other securities that are placed in a legal vehicle such as a company or a trust. Some analysts will insist that these products are *not derivatives*. However, the jury is still out in this respect.
2. True.
3. False. A credit default swap is a bilateral contract between a *protection purchaser* and a *protection seller* that compensates the *purchaser* upon the occurrence of a *credit event* during the life of the contract. For this protection the protection purchaser makes periodic payments to the protection seller.
4. False. The primary objective of weather derivatives is to hedge volume risks, rather than price risks, that result from a change in the demand for goods due to a change in weather.
5. Securitisation amounts to the pooling of certain non-marketable assets that have a regular cash flow in a legal vehicle created for this purpose (called a special purpose vehicle or SPV) and the issuing by the SPV of marketable securities to finance the pool of assets. The regular cash flow generated by the assets in the SPV is used to service the interest payable on the securities issued by the SPV.
6. The AAA rated paper is usually sold to the market at a rate commensurate with its risk rating, while the BBB paper is usually purchased by one of the sponsors at an attractive rate of interest. The management company usually holds the unrated paper in portfolio, and a mixture of equity and debt finance is used to finance this company.
   The AAA rated paper is referred to as senior debt because it will be paid back before the other two streams.

The BBB rated paper is referred to as mezzanine debt as it is given an "in-between" position as far as pay back is concerned. It will be paid back before the unrated paper but only after the AAA paper has been paid back.

The unrated paper is referred to as subordinated debt as it is last in the queue when it comes to being paid back.

7. The terms in the credit default swap equation have the following meaning:

- DSP: The fee payable on the swap, i.e. the default swap spread.
- RP: The risk premium.
- ytm: the yield to maturity – the current market return on a reference bond.
- rfr: The risk-free rate – rate on equivalent term government bonds.

8. It does not pay the protection seller to short the reference bond and enter into the swap. Doing so means that the protection seller is borrowing money at 12.2% pa (the ytm at which the reference bond is sold), and investing at the rfr (8.9% pa) and earning the DSP of 3.2% pa, i.e. a loss of 100 bp.
9. The underlying “instrument” or “value” in the case of temperature-related weather derivatives is Celsius-scale temperature as measured by “degree days” (DD). A DD is the absolute value of the difference between the average daily temperature and 18^{o}C. The winter measure of average daily temperature below 18^{o}C is called heating degree days (HDDs), and the summer measure of average daily temperature above 18^{o}C is termed cooling degree days (CDDs).
10. Chicago Mercantile Exchange - CME.

GLOSSARY OF TERMS[80]

Arbitrage

Trading strategies designed to profit from price differences for the same or similar goods in different markets.

Call option

See options.

Clearing

The settlement of a transaction, often involving exchange of payments and/or documentation.

Clearing house

An institution that acts as the buyer to every seller and the seller to every buyer of exchange traded contracts and thus guarantees the performance of the contract. It can incur the enormous credit risks that this involves as a result of a system of deposits known as margins.

Derivative

Forwards, futures, swaps and options (and other such as weather derivatives) whose value depends, at least in part, upon the value of an underlying asset or liability.

Equity derivative

A generic term for derivatives involving stocks/shares - whether in terms of those in individual companies, or baskets or indices of these.

[80] From www.jse.co.za with some amendments.

Equity option

An option involving a stock/share, or a basket or index of these.

Exchange traded

The generic term used to describe shares, bonds, futures, options and other derivative instruments traded on an organised exchange.

Exercise

The act by which the buyer/holder of an option takes up his rights to buy or sell the underlying at the strike price.

Exercise price

See strike price.

Expiry, expiration date, maturity date

The date and time when a transaction matures. Most commonly used to describe when the buyer / holder of an option ceases to have any rights under the contract, or when a futures contract month ceases trading.

Forward

Any transaction in which the price is fixed today, but settlement is not due to take place until a future date.

Future

An agreement to buy/sell, a standard quantity of a specific commodity or financial instrument, at a standard future date at a price agreed between parties to the contract. Futures contracts are traded on organised exchanges.

Greek letters

In the derivatives market reference is made to the Greek letters:

Delta:	change in option price per USD (ZAR etc.) increase in underlying asset
Gamma:	change in delta per USD (ZAR etc.) increase in underlying asset
Vega:	change in option price per 1% increase in volatility (e.g. from 19% to 20%)

Rho: change in option price per 1% increase in interest rate (e.g. from 4% to 5%)

Theta: change in option price per calendar day passing.[81]

Hedging

Dealing in such a manner as to reduce risk by taking a position that offsets an existing or anticipated exposure to a change in market prices. You are therefore attempting to lock in the profit/loss on the position at the current level.

Initial margin

A relatively small deposit (in comparison to the nominal value of the contract) which both the buyer and the seller must lodge with the clearing house as security. In very volatile markets, the initial margin required can vary several times during the course of a single day.

Long position

The result of a trader having bought more than he has sold in any particular market/commodity/instrument/contract.

Margin

Those involved in exchange traded derivatives have to pay margins to the clearing house, either directly, if they are members, or via their broker. These are posted as a “good faith” performance guarantee designed to ensure that all parties can fulfil their obligations to one another. Margin accounts are adjusted daily to reflect current market price on the positions held. If a profit has been made it is paid to the account holder daily, likewise, if a loss has been made the account holder is asked to reimburse the amount lost daily.

Margin call

A demand from the clearing house to one of its members, or a broker (normally a member) to one of its customers, for a margin payment.

Mark-to-market

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[81] Adapted from Hull (2000).

The revaluation of a futures or options position at its current market price/rate. All positions are marked to market by the clearing house, at least once a day. The profit/loss that is revealed by the re-valuation is received/paid to the clearing house (known as variation margin).

Maturity

The date when a transaction is due to end, or the period of time until that date is reached.

Open Interest

The total number of purchased or sold lots in a particular type of exchange traded contract that have not yet been offset, i.e. sold off or bought back.

Option

Contracts which give the buyer/seller the contractual right, but not the obligation, to buy/sell a specified quantity of a given underlying asset at a fixed price on the designated future date. A ***call option*** confers the buyer/holder the right to buy the underlying commodity/instrument at the strike price. A ***put option*****,** on the other hand, confers to the buyer/holder the right to sell the underlying commodity/instrument. The holder of a long call position will profit from a rise in the price of the underlying asset, while the holder of a long put position will profit from a fall in the price of the underlying asset.

Over the counter (OTC)

The term “over the counter” is used to describe trading in financial instruments off organised exchanges with the effect that performance risk by the counterparties is not guaranteed by the exchange

Position

The difference between the quantities bought and sold in any particular market / commodity / instrument / contract.

Premium

The consideration paid by the buyer/holder to the seller/writer for an option.

Put option

See option

Risk management

The science of identifying, assessing, monitoring and controlling risks to keep them within acceptable bounds.

Seat

The right which confers membership of the exchange on the registered holder or lessee thereof.

Short position

The result of a trader having sold more than he has bought in any particular market/ commodity / instrument / contract.

Spot (or cash market)

A transaction involving immediate settlement, or the soonest standard settlement in that market. For example, the spot date in the foreign exchange market, is normally two business days after the date of the deal.

Strike price

The price at which the buyer/holder of an option has the right to buy/sell the underlying.

Underlying

The commodity / asset / financial instrument on which a derivative is based. For example, in the case of an option, the product which the buyer/holder has the right to buy / sell.

Variation margin

See mark-to-market.

Volatility

A measure of the degree of movements in the price of the underlying around their statistical mean.

Writer

The original seller of an option. The writer is required to fulfil the terms of the option at the choice of the holder.

MULTIPLE CHOICE QUESTIONS

1. What is the primary difference between the spot market and the derivatives market?
   A. The spot market settles transactions immediately, while the derivatives market settles at future dates.
   B. The derivatives market deals with equity instruments, while the spot market deals with debt instruments.
   C. The spot market only deals with non-marketable securities.
   D. The spot market requires collateral, while the derivatives market does not.

2. What is the repo rate in the context of South Africa's money market?
   A. The rate at which banks lend money to each other
   B. The rate at which the central bank lends to commercial banks
   C. The interest rate charged on corporate bonds
   D. The rate at which equity prices are determined

3. Which of the following are the characteristics of a forward market?
   (i) Flexibility with regard to delivery dates.
   (ii) Standardized contract terms and sizes.
   (iii) Flexibility with regard to size of contract.
   (iv) Centralized trading through an exchange
   A. (i) and (ii) only
   B. (i) and (iii) only
   C. (ii) and (iii) only
   D. (ii) and (iv) only

4. In forward markets, who usually bears the risks associated with this contract?
   A. The exchange
   B. The buyer only
   C. The seller only
   D. Both parties involved

5. If the spot price of an asset is R500, the interest rate is 6%, and the cost of carry is 1%, what is the fair value price of a futures contract maturing in one year?
   A. R506
   B. R530
   C. R535
   D. R540

6. Which of the following factors are needed to calculate the fair value of a futures contract?
   (i) Spot price of the underlying asset
   (ii) Risk-free rate
   (iii) Dividend yield
   (iv) Expected price of the underlying asset at maturity
   A. (i) and (ii) only
   B. (ii) and (iv) only
   C. (i), (ii), and (iii) only
   D. (iii) and (iv) only

7. Which of the following are key motivations for entering into an interest rate swap?
   (i) To convert floating-rate debt to fixed-rate debt
   (ii) To hedge against fluctuations in interest rates
   (iii) To benefit from speculative movements in interest rates
   (iv) To reduce exposure to exchange rate risk
   A. (i) and (ii) only
   B. (ii) and (iv) only
   C. (i), (ii), and (iii) only
   D. (i), (ii), and (iv) only

8. Calculate the holder's break-even price if she purchases 20 call option contracts on the ABC index future. The current index level is 5000, and the premium for each call option contract is R1500. Assume each contract represents a standard number of index points.
   A. Break-even Price: 5100, Total Cost: R30,000
   B. Break-even Price: 5050, Total Cost: R30,000
   C. Break-even Price: 5150, Total Cost: R30,000
   D. Break-even Price: 5050, Total Cost: R15,000

9. Which ONE of the following is true about Forward Freight Agreements (FFAs)?
   A. FFAs are traded on major exchanges like the New York Stock Exchange
   B. Brokers are responsible for the performance of the FFA contracts they broker
   C. FFAs are standardized contracts traded globally
   D. FFAs are OTC products made on a principal-to-principal basis

10. Which of the following are the advantages of trading cryptocurrency derivatives?
   (i) Higher leverage opportunities
   (ii) Increased counterparty risk
   (iii) Effective risk management
   (iv) Low transaction costs
   A. (i) and (ii) only
   B. (i), (iii), and (iv)
   C. (iii) and (iv) only
   D. (ii), (iii), and (iv)

ANSWERS

Question 1: **A. The spot market settles transactions immediately, while the derivatives market settles at future dates.**

Question 2: **B. The rate at which the central bank lends to commercial banks**

Question 3: **B. (i) and (iii) only**

Question 4: **D. Both parties involved**

Question 5: **C R535**

Question 6: **C. (i), (ii) and (iii) only**

Question 7: **C. (i), (ii) and (iii) only**

Question 8: **A. Break-even Price: 5100, Total Cost: R30,000**

Question 9: **D. FFAs are OTC products made on a principal-to-principal basis**

Question 10: **B. (i), (iii) and (iv) only**

BIBLIOGRAPHY

1. Applied Derivatives Trading Magazine, 1998. November.
2. Bodie, Z, Kane, A, Marcus, AJ, 1999. **Investments**. Boston: McGraw-Hill/Irwin.
3. Clemmons, L and Mooney, N, 1999. How weather hedging can keep you cool. **The Southern African Treasurer**. 11, December.
4. Collings, BAC, 1993. The economic impact of an efficient financial futures market on the South African economy. Unpublished MEcon thesis, University of Stellenbosch, December.
5. Falkena, HB, et al., 1989. **The futures market.** Halfway House: Southern Book Publishers (Pty) Limited.
6. Falkena, HB, et al., 1991. **The options market.** Halfway House: Southern Book Publishers (Pty) Limited.
7. Faure, AP, 2005. **The financial system**. Cape Town: QUOIN Institute (Pty) Limited.
8. Hull, JC, 2000. **Options, futures, & other derivatives** (4e). London Prentice-Hall International, Inc.
9. JSE Limited, 2010. [Online]. Available: www.jse.co.za [Accessed various times].
10. Lehman Brothers International (Europe), 2001. Credit derivatives explained: markets, products and regulations. March.
11. Mxhalisa, N, 2006. **The new derivative in the investor's armoury.** The Financial Markets Journal, No 4. Johannesburg: SAIFM.
12. McInish, TH, 2000. **Capital markets: A global perspective**. Massachusetts, USA: Blackwell Publishers Inc.
13. Mishkin, FS and Eakins, SG, 2000. **Financial markets and institutions** (3e). Reading, Massachusetts: Addison-Wesley.
14. National Treasury, 2001. Separate trading of registered interest and principal of South African government securities. Draft paper. 2 October.
15. Rose, PS, 2000. **Money and capital markets** (international edition). New York: McGraw-Hill Higher Education.
16. Saunders, A, 2001. **Financial markets and institutions** (international edition) New York: McGraw-Hill Higher Education.

17. Santomero, AM and Babbel, DF, 2001. **Financial markets, instruments and institutions** (2e). Boston:.McGraw-Hill/Irwin.

18. Spangenberg, P, 2000. Forward rate agreements. **The Southern African Treasurer.** 14. September.
19. Spangenberg, P, 1999. The mechanics of option-styled interest rate derivatives – caps and floors. **The Southern African Treasurer**. 11. December.
20. Standard Bank., 2004. [Online]. Available: www.warrants.co.za. [Accessed June].
21. Steiner, R, 1998. **Mastering financial calculations.** London: Financial Times Management.
22. Taiyab, N, 2006. Exploring the market for voluntary carbon offsets. http://pubs.iied.org/pdfs/G00268.pdf (Accessed 23 January 2012).
23. The Chicago Mercantile Exchange cmegroup.com/bitcoinfutures.

Appendix A: Formula sheet

RPE students will be issued with this formula sheet during the RPE Derivatives Market examinations

Formula 1	FP = SP x [1 + (ir x t)]
Formula 2	IFR = $\{[1 + (ir_L \times t_L)] / [1 + (ir_S \times t_S)] - 1\} \times [365 / (t_L - t_S)]$
Formula 3	IA = C x ir x t
Formula 4	SA = NA x ird x t
Formula 5	df = 1 / [1 + (rr x t)]
Formula 6	PVSA = SA x df
Formula 7	FP = SP x [1 + (ir x t)]
Formula 8	Outright forward = SP x $\{[1 + (ir_{vc} \times t)] / [1 + (ir_{bc} \times t)]\}$
Formula 9	Outright forward = SP x $[(1 + ir_{vc})^n / (1 + ir_{bc})^n]$
Formula 10	FP = {SP x [1 + (ir x t)]} + (SC x dte)
Formula 11	FVP = SP + CC
Formula 12	CC = {SP x [(rfr – I) x t]} + OC
Formula 13	FVP = SP + CC = SP + {SP x [(rfr – I) x t]} = SP x {1 + [(rfr – I) x t]}
Formula 14	FVP = A + B – C where A = dirty (all-in) price of underlying bond at market (current) rate on bond futures valuation date (fvd)

	B = A x {(rfr / 100) x [(ftd – fvd) / 365]} C = (c / 2) x (1 + {(rfr / 100) x [(ftd – cd_2) / 365)]}) or = (c / 2) / (1 + {(rfr / 100) x [(cd_2 – ftd) / 365)])
Formula 15	FVP (per ton) = SP + CC = SP + [SP x (rfr x t)] + (SC x dte) = SP x [1 + (rfr x t)] + (SC x dte)
Formula 16	FVP = SR x {[1 + (ir_{vc} x t)] / [1 + (ir_{bc} x t)]}
Formula 17	$C + \frac{X}{(1+r)^T} = P + S$