CHAPTER 4

FUTURES CONTRACTS

The price of an article is charged according to difference in location, time or risk to which one is exposed in carrying it from one place to another or in causing it to be carried. Neither purchase nor sale according to this principle is unjust.

- St Thomas Aquinas

4.1 INTRODUCTION

Many factors, including unrest on farms, El Niño, volatile exchange rates, product prices, changing producer price indices and labour acts, make agri-business risky. Since the 1995 marketing season, in South Africa, marketing is the producers' own responsibility. Not only can producers now select their own marketing channels, they may also choose between alternative schemes for timing the pricing of their crops. Before crops are harvested or even planted, the agricultural products may be committed for sale using forward and derivative contracts. At harvest, crops can be sold in the spot market. As a result of storage, pricing and marketing can be delayed even further.

If the futures market is used correctly, it can contribute a great deal to a farm's net income from commodity sales. Futures contracts are based on an underlying asset. These assets can be almost anything, ranging from the physical to the more abstract – from pork offal to market indices. Unfortunately for crop producers in South Africa, the futures market system is at present functional only in the maize, wheat and sunflower seed markets. But this is no reason for the producers of products other than wheat, maize or sunflower seed not to participate in this exciting new opportunity. Moreover, the futures market is not reserved only for big commercial producers, companies, or even major role-players. The market is open to all that can understand market conditions, negative or positive.

This chapter aims to provide a clear overview of the functioning of the futures market, the requirements of futures trading and of how futures contracts can be used to manage price risk.

4.2 HISTORY

Futures trading evolved in response to the changing needs of those who sell important commodities and to the increasing sophistication and level of civilisation of humankind. Active regulated markets in commodities existed in China, Egypt, Arabia and India twelve centuries BC. In the Western world, laws were enacted to ensure food supplies and to prevent market manipulation in the city-states of Greece, which were occasionally beset by famines. The specialisation of markets to trade in a single commodity was already accomplished in pre-Christian Rome. According to Baer and Saxon (1949),

> In the heyday of Roman dominion and power by land and sea there were in Rome nineteen ... trading markets called *fora vendalia* (sales markets), which specialised in the distribution of specific commodities, many of them brought from the far corners of the earth by caravan and galley.

During the era of the Tokugawa Shogunate (the Tokugawa dynasty of Japanese shoguns ruled Japan from 1600 until 1868), an orderly and well-disciplined futures market in rice developed. The market was officially recognised in 1730.

Some of the rules of this Oriental Exchange were, as recorded by Kaufman (1986) that:

- only trading in rice futures was permitted;
- the contract term was limited to four months and the year was divided into three four-month periods;
- all contracts in any four-month period were standardised;
- no physical delivery of rice against outstanding contracts was allowed;
- all differences in value had to be settled in cash;
- no contracts could be carried over into the new contract period and no new contracts could be made during the last three days of any trading period;
- all trades had to be cleared through a clearing house and traders were required to establish a line of credit with the clearing house of their choice; and
- any default on payments was borne by the clearing house.

Futures markets in agricultural products developed in the United States of America (USA) during the middle of the previous century. In the mid-1800's, the City of Chicago found itself rapidly becoming the grain-marketing centre of the USA. Chicago's favourable business conditions and geographical location made it an important grain terminal, because it had a large established cash market and extensive storage facilities (Kaufman, 1986).

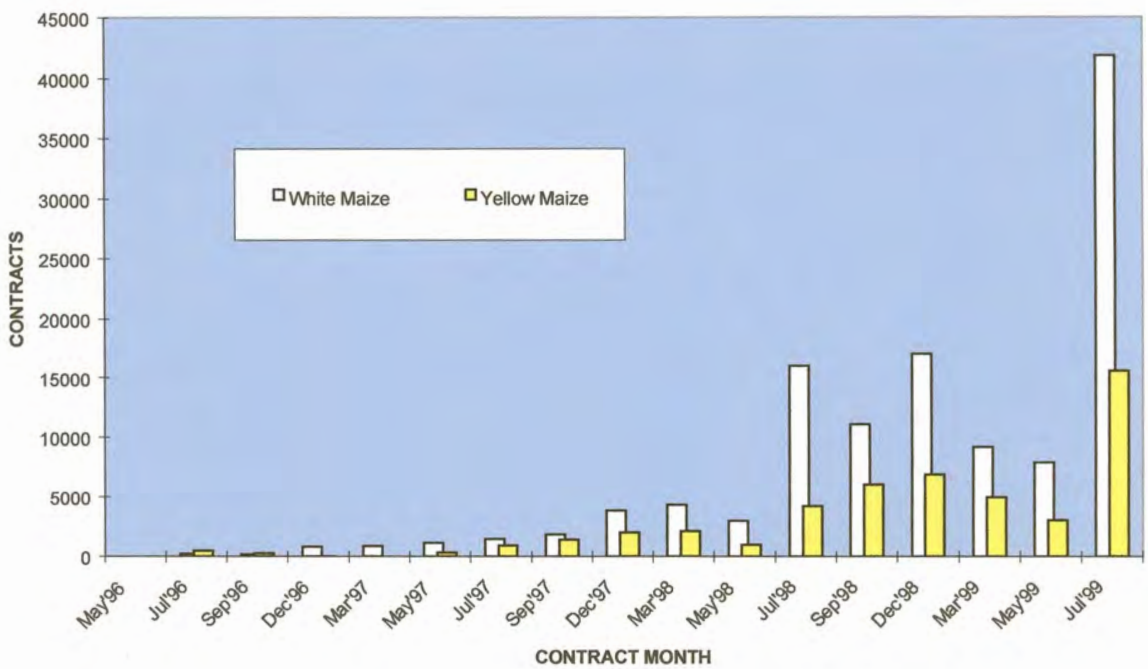
The agricultural futures market as we know it today is a place where all buyers and sellers can meet, or be represented, in order to buy and sell futures contracts. By separating the price from the physical delivery of goods, futures markets enable buyers and sellers to remove the uncertainty associated with the price (because the price is determined in advance) (Allen, 1997). The economic function of futures markets is to allow those who are directly involved with a commodity to reduce the risk of price volatility. Producers have the opportunity to use futures contracts, forward contracts and options to protect themselves from price risk.

The concept of hedging on international markets is not new in South Africa. During the 1960's, the South African Sugar Association, a copper dealer, and various wool companies were authorised to operate on foreign forward markets. Holcom Commodity Brokers (Pty) Limited were granted permission to act as a broker on the London Metals Exchange in 1973. Their authority was extended to include operations in other commodity markets in products such as gold, coffee, and wheat (Falkena, Kok, Luus & Raine, 1989). In South Africa, the Rand Merchant Bank took the initiative to start an informal local futures market in 1987. Initially only contracts in the All Share, Gold and Industrial indices of the JSE were traded. Later, contracts on long-dated stock, Kruger Rands and bankers' acceptances were introduced.

The South African Maize Board has operated quite successfully on the Chicago Board of Trade (CBOT) since the mid-1980's. The Maize Board started trading on the CBOT to hedge against price risk. The Board faced the risk that the producer prices paid might be more expensive than the prices received for maize in a given year.

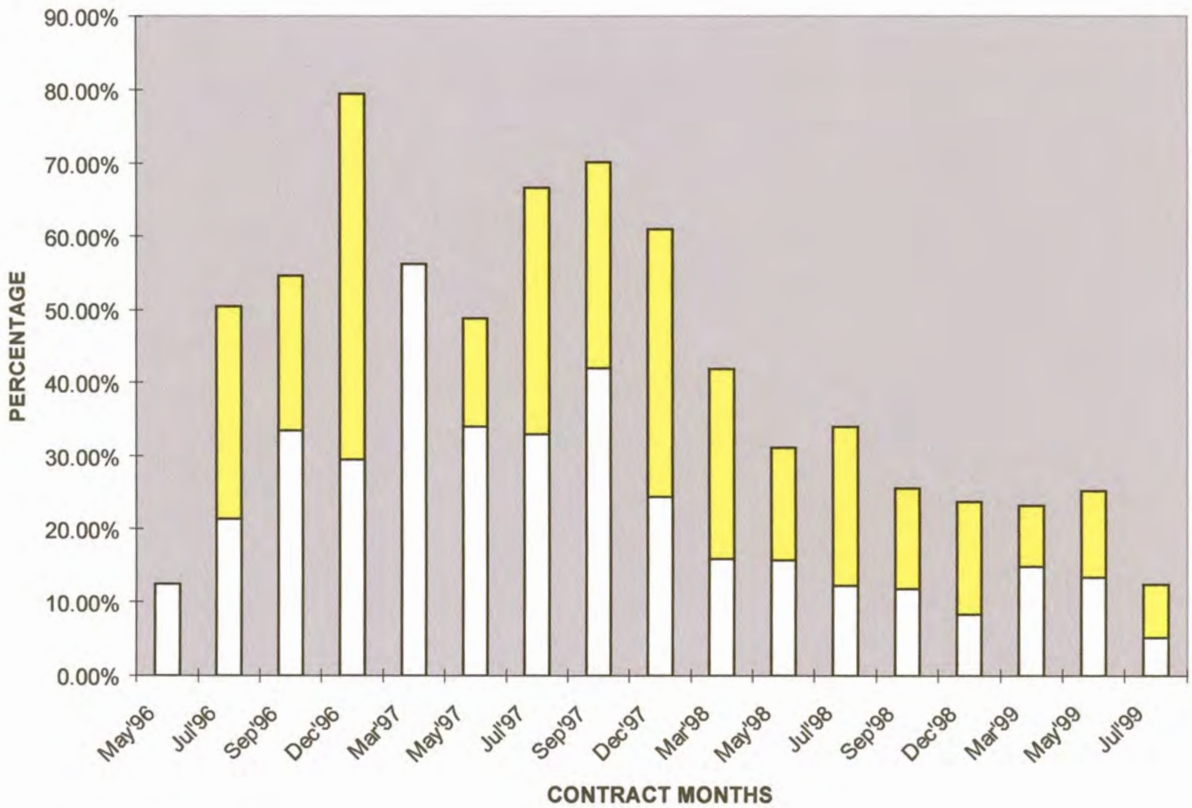
The agricultural futures market in South Africa was established during the 1995/96 season. During the first quarter of 1996, a total of 485 maize contracts were traded. Figure 4.1 presents the numbers of maize contracts traded on SAFEX between October 1996 and July 1999 (SAFEX, 1999).

Figure 4.1: Maize contracts traded on SAFEX



The first wheat contracts were traded on SAFEX during the fourth quarter of 1997, a total of 180 contracts. There was a drastic increase in the number of maize contracts traded from the third quarter of 1997. Until the fourth quarter of 1998, the highest number of contracts traded was 25 088 (in the third quarter of 1998), representing a 517% increase from the first quarter of 1996. In February 2000 the Agricultural Markets Division (AMD) of SAFEX set a new record with more than 39 813 contracts traded (www.safex.co.za, 2000). That is an increase of over 3 300 contracts compared to November 1999. Since July 1999, the AMD traded almost 2.2 million tons of maize each month. Figure 4.2 indicates the percentage of physical deliveries on SAFEX. The initial high percentage of physical deliveries indicates that producers used the market as a guaranteed forward market, and not as a hedging mechanism. Producers started to use the commodity market as a hedging mechanism during 1998 with only 15.86% of white maize delivered. That represents a dramatic large decrease of physical deliveries from the 1996 and 1997-period when as much as 56.22% of white maize contracts were delivered at Randfontein.

Figure 4.2: Percentage maize delivered on SAFEX



Source: SAFEX (1999)

Futures markets are not designed to determine or influence the absolute level of prices. Their pricing function determines only inter-temporal or contingent prices. An contingent price relationship is a relationship at a given time between prices applicable to different times. Inter-temporal prices should improve the conditions under which decentralised production and consumption decisions are made and should ensure that risk is taken into account more adequately. However, there seems to be some confusion in the literature when it comes to the question of why futures markets actually exist. That is, it is not clear that their primary social and economic function is to determine inter-temporal prices. While some believe that futures markets serve as a vital tool for managing economic and financial risks (Diercks, 1978), others believe the markets are gambling casinos (Hardy, 1944). The latter notion was especially valid in the early phases of futures markets because during these stages these markets were very much unsophisticated.

Keynes (1923), who developed the theory of normal backwardation, emphasised the financial burden posed by the necessity for carrying inventories of agricultural products. He therefore suggested that futures markets can facilitate hedging. On the other hand, Working (1949) promoted the notion that the primary function of futures markets is the provision of returns for storage services.

4.3 EFFICIENCY THEORY

According to Fama (1970), an efficient market is one that accurately incorporates all known information in determining the price of an asset. Fama's original definition came to be known as the efficient market hypothesis. The efficient market hypothesis states that, at any given time, security prices fully reflect all available information. It is essentially an extension of the zero profit equilibrium of a competitive market in a certain world to a more uncertain world of price dynamics. The implications of the efficient market hypothesis are truly profound. Most individuals who buy and sell securities do so assuming that the securities they are buying are worth more than the price that they are paying, while the securities that they are selling are worth less than the selling price. However, if markets are efficient and current prices fully reflect all information, then buying and selling securities in an attempt to outperform the market will effectively be a game of chance rather than skill. In an active market which includes many wellinformed and intelligent investors, securities will be appropriately priced and reflect all available information. If a market is efficient, no information can be expected to allow a product to outperform an appropriate benchmark. For the commodities market, the efficient market hypothesis states that all past information should already be incorporated into the current futures price, and therefore it should have no effect on the future spot price.

There are three forms of the efficient market hypothesis (Bodie, Kane & Marcus, 1998):

- The weak form asserts that all past market prices and data are fully reflected in securities prices. In other words, technical analysis is of no use.
- The semi-strong form asserts that all publicly available information is fully reflected in securities prices. In other words, fundamental analysis is of no use.
- The strong form asserts that all information is fully reflected in securities prices. In other words, even insider information is of no use.

Furthermore, Fama (1970) assumes that there are no transaction costs, that information is costless, and that the implications of current information for both current price and the distribution of future prices are generally accepted by all market participants. At least two of Fama's assumptions are unrealistic. Firstly, there are transaction costs, such as brokerage fees. The existence of transaction costs must change the criteria by which market efficiency is evaluated. Secondly, information is costly to acquire and analyse (Zulauf & Irwin, 1997). These assumptions make it difficult to describe any market as efficient.

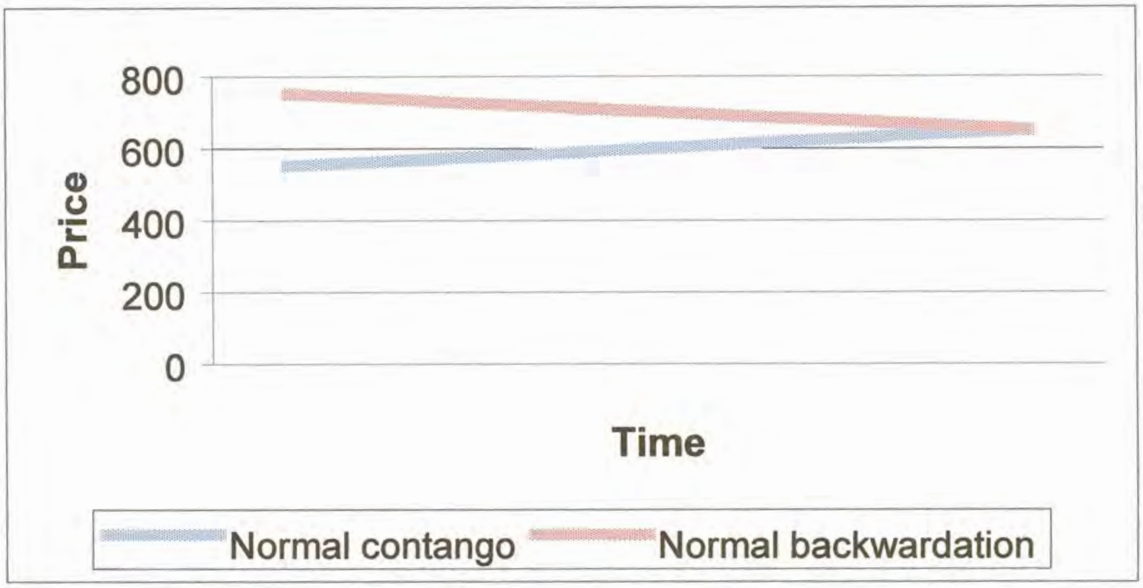
If a market is indeed efficient, that has a very important implication for market participants: all investments in an efficient market are expected to be zero net present value investments at the time the investment is made. If prices are neither too low nor too high, then the difference between the market value of an investment and its cost is zero, therefore no value is added to the business, resulting in a zero net present value. Grossman and Stiglitz (1980) show that, if information is costly, it is impossible for prices to reflect all available information perfectly. Otherwise, those who use various resources to obtain information would earn no compensation to cover their costs to acquire and analyse the data. This insight introduces a potential avenue for profitable trading. Profit can be earned by using information and analysing it to take a position in anticipation of price changes that occur as the rest of the market becomes aware of the information. These trading returns represent a return on the costs incurred in acquiring and analysing information. It also implies an alternative statement of market efficiency: a market is efficient with respect to the information set available at a future time, provided economic returns generated by trading on this information set do not exceed transaction and information costs (Conklin, 1998).

Market efficiency implies that futures prices equals expected future spot prices plus or minus a possibly time-varying risk premium. This risk premium includes factors such as interest rates, local and international demand and weather expectations. Futures prices are unbiased forecasters of future spot prices only if markets are both efficient and have no risk premium (Mckenzie & Holt, 1998). Research done by Beck (1994) and Mckenzie and Holt (1998) indicates that maize and soybean futures markets are both efficient and unbiased in the long run. These results suggest that in the long run, risk premiums do not exist in these markets.

4.4 THEORY OF NORMAL BACKWARDATION

In 1936, John M. Keynes originated the theory of normal backwardation. In his view, futures prices are unreliable estimates of the spot price prevailing on the date of expiry of the futures contract. He believed it is 'normal' for the futures price to be a downward biased estimate of the forthcoming spot price. His theory of normal backwardation has been reinterpreted many times over since its conception. The following discussion of his theory is therefore more of a discussion of post-Keynesian interpretations of his theory. Post-Keynesian interpretations argue that futures provide a mechanism to transfer risk from the hedgers (commodity producers who have natural long positions in the commodity) to speculators. Theoretically, the market is 'normally' inefficient, because the futures price is not an unbiased estimate of the subsequent spot price. To accomplish this transfer of risk, speculators only buy commodity futures contracts if the expected rate of return for holding futures would exceed the risk-free rate (Kolb, 1999). For the expected rate of return on the futures position to exceed the risk-free rate, the futures price would have to be less than the expected spot price and rise as the contract maturity date approaches. This relation, referred to by Keynes as normal backwardation, is illustrated in Figure 4.3.

Figure 4.3: Futures prices over time with constant future price expectations



Source: Adapted from Kolb (1999)

The view that futures prices tend to rise over the contract life due to the hedgers' general desire to be net short is known as **normal backwardation**. Normal backwardation should not be confused with a market that is in backwardation. A market is in backwardation at a given moment if the cash price exceeds the futures price or if a nearby futures price exceeds a distant futures price. In normal backwardation, the expected price is lower than the realised price. If this situation exists, futures prices should increase over the course of a contract, resulting in positive trading returns to a long position. A long position implies that there is a buyer for a futures contract. Conversely, if hedgers are net long, then the futures price would lie above the expected future spot price, and the price of the futures contract would fall over its life. This pattern of falling prices is known as a **contango** (illustrated by the falling line in Figure 4.3). The expected price is higher than the realised price. Hence, a short futures position can earn positive trading returns. A short position implies that there is a seller for a futures contract.

The three crucial assumptions of the theory of normal backwardation are that speculators:

- are net long;
- are risk averse; and
- are unable to forecast prices.

Given these assumptions, the theory has two important implications. The first implication is that over time speculators can earn profits by merely holding long positions in futures markets. The second implication is that there is an upward trend in futures prices, relative to spot prices, as the contract approaches maturity. Hicks (1946) and Houthakker (1959) modified the theory of normal backwardation by assuming that speculators are able to forecast prices. This modification implies that the returns to speculators may include a payment for forecasting as well as for risk bearing. Cootner (1960) argues that Keynes's hypothesis implies that futures prices should not necessarily rise until after the peak of net short hedging has passed. That is, he interprets the theory to mean that seasonal trends in futures prices should be taken as an indication of a risk premium.

Telser (1958) and Cootner (1960) both tested their interpretations of the theory of normal backwardation and obtained conflicting results even though they used the same data. Cootner found evidence to support the theory of normal backwardation, whilst Telser's conclusions were the opposite. Telser assumed that speculators require no remuneration to play the futures market and then went on to conclude that they earn no remuneration in a competitive market.

Several other writers have also tested the validity of the theory of normal backwardation. A concise summary of their findings is given by Rockwell (1967), who describes the state of the theory as follows:

> While the theory of normal backwardation may be valid for particular markets under special conditions, it is not adequate as a general explanation of the flow of profits in commodity markets...

Dusak (1973) tested for the existence of a risk premium within the context of the capital asset pricing model. Dusak argues that the risk premium required on a futures contract should depend on the extent to which the variations in prices are systematically related to variations in the return on total wealth. If the risk of a futures contract is independent of the risk of changes in the value of all assets taken together, then investors do not have to be paid for that risk since they can diversify the risk away. The Keynesian 'insurance' interpretation identifies the risk of a futures asset solely with its own price variability.

4.5 FUTURES CONTRACTS

A futures contract is a standardised agreement between two parties that commits one to sell and the other to buy a stipulated quantity and grade of a commodity, currency, security, index or other specified item at a set price on or before a given date in the future that requires the daily settlement of all gains and losses as long as the contract remains open (Purcell, 1991, Kleinman, 1997). The futures contract is not itself a purchase or sale of a commodity; it is a contract to conclude a purchase or sale in the delivery month. Ownership of the commodity does not change hands unless and until delivery is arranged after cessation of futures trading. These contracts have several key features:

- the buyer of a futures contract, the 'long', agrees to receive delivery;
- the seller of a futures contract, the 'short', agrees to deliver;

- futures contracts are market to market each day at their end-of-day settlement prices, and the resulting daily gains and losses are padded through to the margin accounts; and
- futures contracts can be terminated by an offsetting transaction (that is, an equal and opposite transaction to the one that opened the position) executed at any time prior to the contract's expiration.

A unique characteristic of futures is that the sellers are not linked with specific buyers, as would be the case in forward contracts. The intermediary between buyers and sellers is a clearing house that ensures that contracts held to delivery are fulfilled. If a producer buys a futures contract, the producer has a right to take delivery on the cash commodity at a given price in a specified future period and is defined as taking a **long** position in that contract. If a producer sells a futures contract, the producer has a right to deliver the cash commodity at a given price in a specified future period and is defined as taken a **short** position in that contract.

Standardisation is the key characteristic of futures contracts. This standardisation is evident in the contract specification for the commodities shown in Table 4.1. The homogeneity of well-specified contracts facilitates and encourages high volume trading on organised exchanges. The only non-standard item of a futures contract is the price of an underlying unit, which is determined in the trading arena.

Futures contracts are essentially guaranteed against default. The clearing house at the exchange is both a buyer to every seller and a seller to every buyer since neither party is named on the same contract.

Table 4.1: Commodity contract specifications

FUTURES CONTRACT	WHITE MAIZE	YELLOW MAIZE	WHEAT
ATS code	WMAZ	YMAZ	WEAT
Trading Hours	09:00 to 12:00	09:00 to 12:00	09:00 to 12:00
Underlying Commodity	White maize of African origin grade WM1	Yellow maize of African origin grade YM1	Bread Milling Wheat meeting protein, specific weight, moisture and falling number criteria with fall back positions for protein and specific weight (specified origin)
Contract Size	100 metric tons	100 metric tons	100 metric tons
Expiry Dates & Times	12:00 on eighth last business day of May, July, September, December and March; physical deliveries from first business day to last business day of expiry month	12:00 on eighth last business day of May, July, September, December and March. Physical deliveries from first business day to last business day of expiry month	12:00 on eighth last business day of May, July, September, December and March. Physical deliveries from first business day to last business day of expiry month
Settlement Method	Physical delivery of SAFEX silo receipts giving title to maize in bulk storage at approved silos at an agreed storage rate	Physical delivery of SAFEX silo receipts giving title to maize in bulk storage at approved silos at an agreed storage rate	Physical delivery of SAFEX silo receipts giving title to wheat in bulk storage at approved silos at an agreed storage rate
Quotations	Rands/ton	Rands/ton	Rands/ton
Minimum Price Movement	Twenty cents per ton	Twenty cents per ton	Twenty cents per ton
Initial Margin	R7000/contract up to first notice day. R10 000/contract up to expiry day. R20 000/contract up to last delivery day. R2250/ contract for calendar spreads. R4000/contract for white spreads	R6000/contract up to first notice day. R10 000/contract up to expiry day. R20 000/contract up to last delivery day. R1750/ contract for calendar spreads. R4000/contract for yellow spreads	R6000/contract up to first notice day. R10 000/contract up to expiry day. R20 000/contract up to last delivery day. R2000/ contract for calendar spreads. R4000/contract for Cape wheat spreads
Maximum Position Limits	None	None	None
Expiry Valuation Method	Closing futures price as determined by the clearing house	Closing futures price as determined by the clearing house	Closing futures price as determined by the clearing house
Booking Fee Charges By SAFEX	R34.20/contract	R34.20/contract	R34.20/contract

(continued overleaf)

Table 4.1: Commodity contract specifications (continued)

FUTURES CONTRACT	CAPE WHEAT	SUNFLOWER SEED
ATS code	CWHT	SUNS
Trading Hours	09:00 to 12:00	09:00 to 12:00
Underlying Commodity	Bread Milling Wheat meeting protein, specific weight, moisture and falling number criteria with fall back positions for protein and specific weight (specified origin)	FH South African Origin high oil content sunflower seeds meeting specified criteria
Contract Size	100 metric tons	50 metric tons
Expiry Dates & Times	12:00 on eighth last business day of May, July, September, December and March. Physical deliveries from first business day to last business day of expiry month	12:00 on the eight last business day of March, May, July, September and December. Physical deliveries from first business day to last business day of expiry month
Settlement Method	Physical delivery of SAFEX silo receipts giving title to wheat in bulk storage at approved silos at an agreed storage rate	Physical delivery of SAFEX silo receipts at approved silos at an agreed storage rate
Quotations	Rands/ton	Rand/ton
Minimum Price Movement	Twenty cents per ton	One Rand per ton
Initial Margin	R6000/contract up to first notice day. R10 000/contract up to expiry day. R20 000/contract up to last delivery day. R2000/ contract for calendar spreads. R4000/contract for Randfontein wheat spreads	R5000/contract up to first notice day. R8000/contract up to expiry day. R16 000/contract up to last delivery day. R1600/contract for calendar spreads
Maximum position Limits	None	1000 contracts within 10 days of expiry month
Expiry Valuation Method	Closing futures price as determined by the clearing house	Closing futures price as determined by the clearing house
Booking Fee Charges By SAFEX	R34.20/contract	R17.10/contract

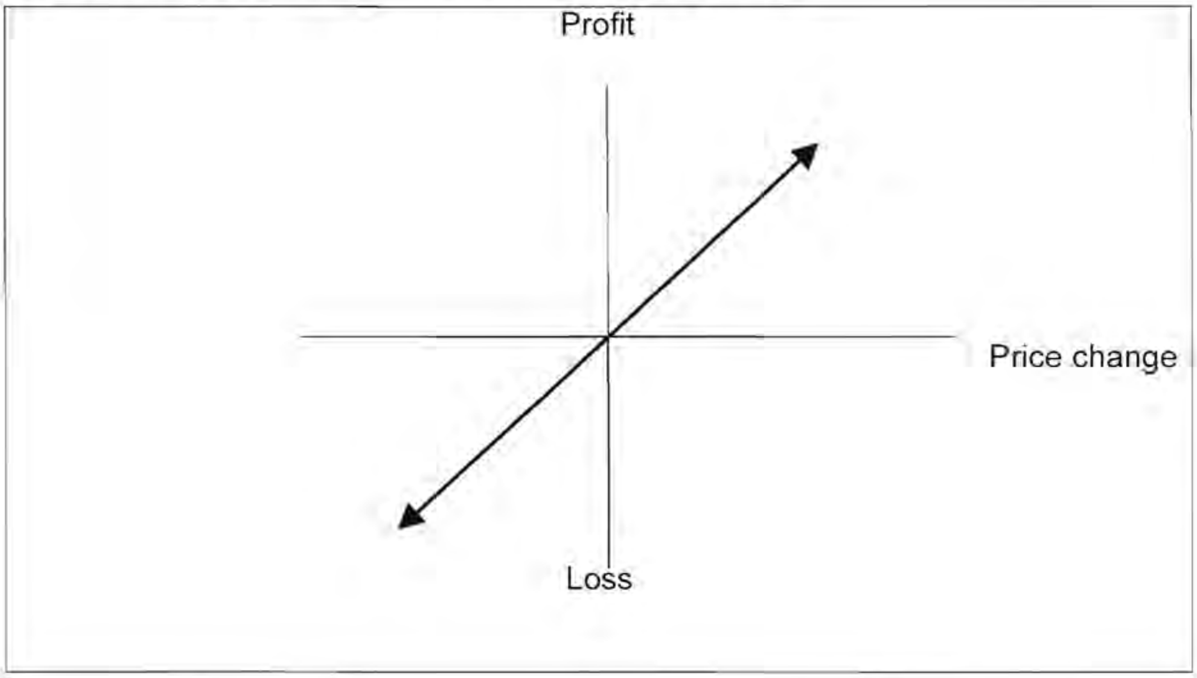
Source: http://www.SAFEX.co.za (1999)

Wherever there is price volatility, there is a potential need for futures contracts. Whatever the commodity underlying the futures contract, every market needs certain ingredients to flourish. These include (http://www.fiafii.org/tutorial.htm):

- Risk-shifting potential: The contract must provide the ability for those with price risk in the underlying commodity to shift that risk to a market participant willing to accept it.
- Price volatility: The price of the underlying commodity must change enough to warrant the decision to shift price risk.
- Cash market competition: The underlying commodity market must be broad enough to allow for healthy competition, which creates a need to manage price risk and decreases the likelihood of market corners, squeezes or manipulation.
- Trading liquidity: Active trading is needed so that sizeable orders can be executed rapidly and inexpensively.

The mechanics of futures trading are straightforward. Both buyers and sellers deposit funds with a brokerage firm. As indicated in Figure 4.4, if a producer goes long (buys) a futures contract and the price goes up, the producer gains by the amount of the price increase times the contract size. If the price decrease, the producer loses an amount equal to the price decrease times the number of contracts.

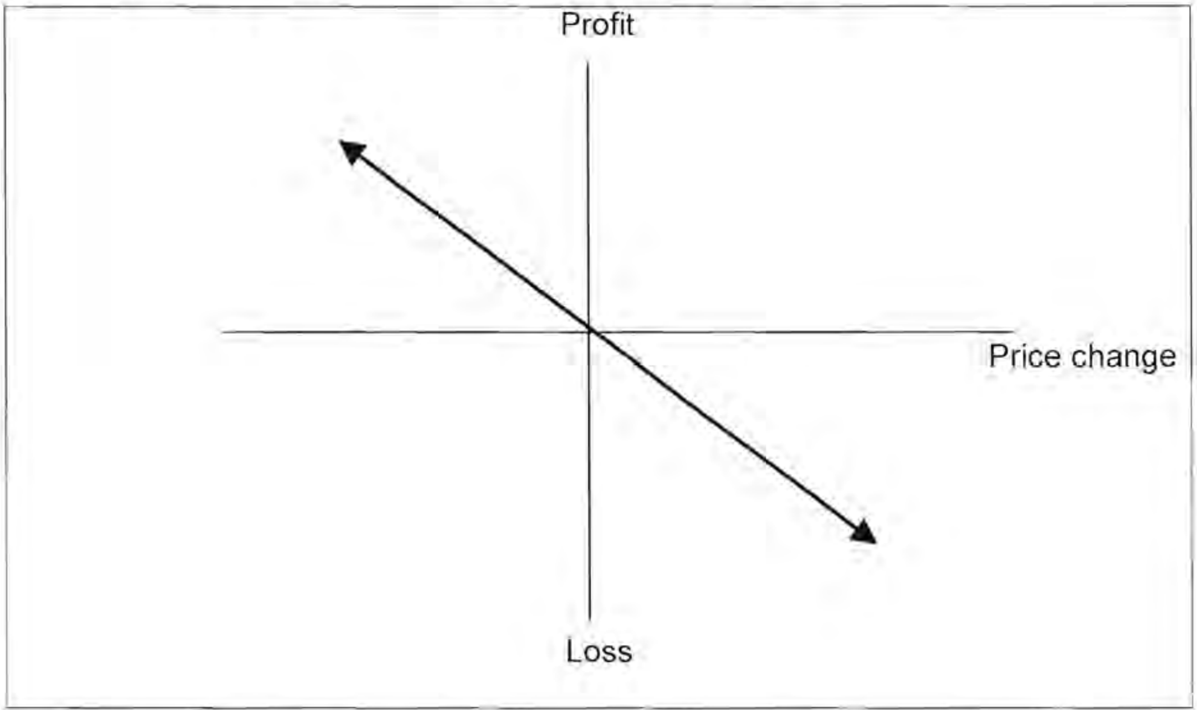
Figure 4.4: Payoff diagram of a long futures position



Source: http://www.fiafii.org/tutorials/htm

Figure 4.5 reflects the profit and loss potential of a short futures position. If a producer goes short (sells) on a futures contract and the price goes down, the producer gains by the amount of the price decrease times the contract size. If a producer sells and the price goes up, the producer loses an amount equal to the price increase times the contract size. These profits and losses are paid daily via the futures margining system.

Figure 4.5: Payoff diagram of a short futures position

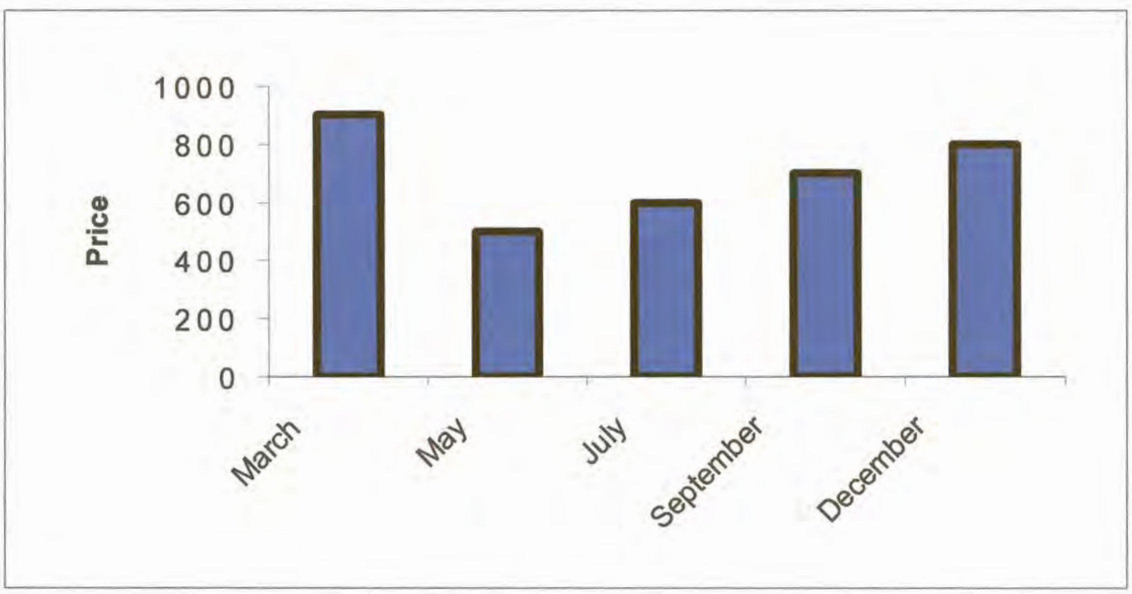


Source: http://www.fiafii.org/tutorials/htm

The futures price reflects the price at which buyers and sellers are prepared to buy and sell the commodity contract for a future month. The futures price therefore reflects a consensus of market opinion. It combines the opinion of a producer, for instance, who expects a smaller crop because of damage caused by wind and heavy rains, with the opinion of another producer who expects a bumper crop, with the opinion of a feed manufacturer who expects the demand for maize (for example) to be higher because of herd expansion after good rain, and the opinion of a grain trader who expects a good USA crop and changes in the statutory maize marketing scheme (Battley, 1989). The futures prices is therefore a forecast of what the spot price of the commodity will (probably) be for a given future month, based on currently available information. The futures price reflects the price of the commodity, the levy, storage and handling cost paid for delivery in the month the futures contract expires.

White and yellow maize futures contracts on the South African Futures Exchange (SAFEX) are both initially traded for five months – March, May, July, September and December. During 1999, SAFEX expanded the futures trading to the other months, January, February, April, June, August, October and November. The futures price for each successive month in the production season is usually higher (all other variables being constant) than the preceding month by the amount of storage and finance charges. Figure 4.6 indicates the hypothetical futures prices during a marketing season.

Figure 4.6: Hypothetical futures prices over time



The futures price for March, the last month of the maize marketing season, may differ sharply from the price for May and July. March reflects 'old-crop' which may be in short supply, while May and July reflect the incoming 'new crop', which may be expected to have a depressing effect on maize prices.

To avoid unwarranted swings in prices, the markets establish maximum daily price fluctuations. As soon as these limits are reached, the market closes for the rest of that day. In South Africa, this is R30 per ton for the first two days, and

R45 per ton for the third day. After the third day, there is no price limit, the prices can increase or decrease by more than R45 per ton per day without interference by SAFEX. The limit refers to price changes, up or down, during a trading day relative to the closing or settlement price of the previous trading day. The rationale is to allow re-assessment of market fundamentals overnight and avoid unfounded panic on any given market day. If the market moves the limit in the same direction in the following days, the limit is removed, based on the logical assumption that the fundamentals justify the fact that the market is seeking its new level.

The primary difference between a futures contract and a forward contract is that the futures contract is marked to market on a daily basis (Kolb, 1999). Marked to market means that the net profit or loss on each client's open position is recalculated at the end of each trading day. Funds are withdrawn from or deposited into the clients margin account so that the balance reflects the client's net profit or loss.

There are several advantages and disadvantages associated with the use of futures contracts to hedge against price risk. According to Eales (1995), the advantages are the following:

- the contract size, underlying commodity and delivery dates are standardised;
- the market is transparent and reflects all available information;
- the market is highly liquid, which generates small bid-offer spreads;
- the market is regulated by rules laid down by the exchange; and
- it is easy to buy and sell contracts through a broker.

The disadvantages of a futures contract are the following (Eales, 1995):

- an initial and maintenance margin is required, resulting in greater cash flow needs;
- exchange trading hours may be limited;

- if maximum price movement limits are reached, futures contracts may become totally illiquid at short notice;
- there is a basis difference between spot market and futures market instruments; and
- dealing is restricted to members of the commodity exchange (dealing can only be done through a broker).

It is imperative that each producer should consider the advantages and disadvantages of every instrument before venturing into any contract. Table 4.2 compares the differences between forward contracts (cf. Chapter 3) and futures contracts.

Table 4.2: Forward contracts versus futures contracts

	Forward contract	Future contract
Contract size	Negotiable	Standardised
Delivery date	Negotiable	Standardised
Trading locations	OTC dealer-type markets	Futures exchanges
Contract guarantee	None	By the clearing house of the commodity exchange
Price determination	Negotiated private by buyer and seller	Price determined in an auction-type market
Cash flows	Infrequently. Often at the end of delivery date	Daily, as the contract is marked to market
Security deposits	No clearing house. Depends on the credit relationship between buyer and seller	Buyers and sellers post initial margins with daily settlements. Clearing house guarantees fulfilling futures contract obligation
Frequency of delivery	Most are held to term	Some are held to maturity
Regulation	Self-regulated	Regulated

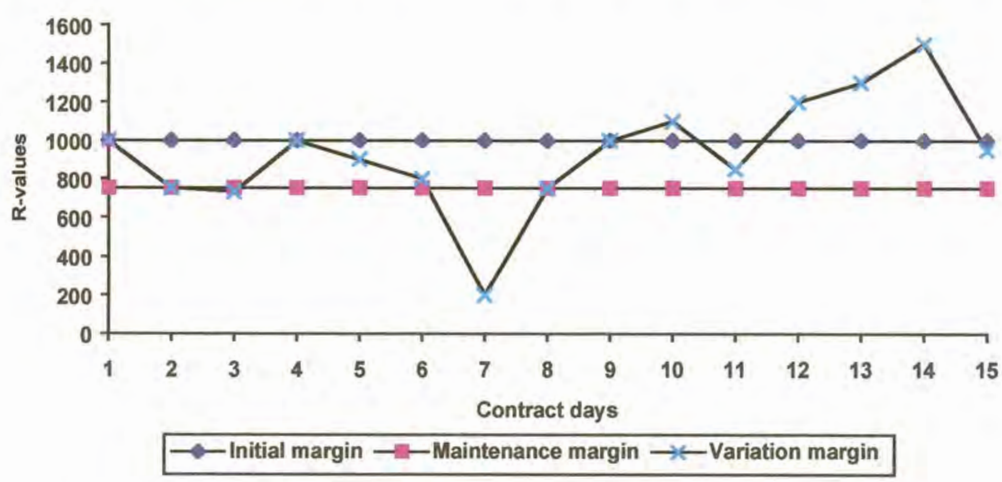
Source: Hull (1998)

4.6 MARGIN REQUIREMENTS

The mechanics of futures trading are straightforward. Both buyers and sellers deposit funds (traditionally called a margin) with a brokerage firm through whom they buy and sell the contracts. This money is not a down payment on borrowed capital, but more a kind of good faith payment that serves as an insurance to ensure contract compliance (Ferris, 1998). The price at which futures contracts are traded is guaranteed through a system of margining.

The commodity exchanges set initial and variation (or maintenance) margin levels for each contract. The initial margin is the amount required to be deposited when a position is initiated. The initial margin is based on historic price movements and is paid by both the buyer and seller of a futures contract. At the close of each trading day, the profits or losses are added or subtracted from the client's margin account. If the net amount is below the maintenance level, a margin call is issued for the amount needed to bring the total margin back to the initial level (Herbst, 1986). Figure 4.7 illustrates hypothetical margin account behaviour for a short futures position over 15 days (Eales, 1995):

Figure 4.7: Hypothetical short futures margin account behaviour



In the above figure, the maintenance margin represents 75% of the initial margin. As soon as the account moves beneath the maintenance margin, the investor should top it up, if not, the position is closed and the investor receives the difference of the margin and will no longer have a futures position. As soon as the account moves above the initial margin of R1000, in the above example, the investor can then withdraw the excess balance over the initial margin. The performance period of futures contracts is one trading day. Futures contracts are marked to market and settled at the end of every business day (the performance period is reduced to a single day). On each trading day, gains are credited or losses debited to the customer's margin account (in cash) as the futures position increases or decreases in value.

Closing out a position involves entering into an opposite trade to the original one. For example, an investor who buys five July maize futures contracts on 6 May can close out the position on 20 June by selling five July maize futures contracts and *vice versa*. Producers successfully hedge their position against a price fall by trading futures contracts at a level which covers their production costs and locks in a return on the investment. When producers close out their positions at a price of the futures contracts which reflects the expected surplus of maize on the market at around the expiry time of the contracts traded, their margin accounts would reflect the initial margin paid by the producers plus the variation margin paid into their accounts by the long position holders. When producers decide not to close out their position but deliver on the futures contract, they receive the initial margins paid by themselves, the variation margin paid by the long position holders and the value of the maize delivered to a SAFEX approved silo determined by the closing futures price on the day prior to delivery of the SAFEX silo receipts.

According to Fraedrich (1998), the cost of initial margin and the possible risk of margin calls are potentially important. If changes in futures prices are approximately a random walk, then the income or costs associated with changes in the value of the contract are about close to zero on average. Previous studies that have included margin costs have found them to be a small component of hedging costs (Alexander, 1986; Nelson, 1985). A prudent hedger would want to establish a line of credit for the greater part of the margin risk exposure, not just for the initial margin. Margin calls on anticipatory hedges are most likely to occur as yield expectations decline (and prises rise). The appreciation in the spot price is meaningless if a producer does not have any crop to sell. Thus, a lender has good reason for not extending credit for margin calls. In such situation, a producer may want to offset the futures position (Tomek, 1981).

4.7 BASIS

The difference between the spot prices of commodities and the prices of the related futures contract is referred to as the basis (Purcell, 1991). Every town where crops traded on SAFEX are produced has its own basis. The basis consists of two main components, namely differences in location, reflected in transport costs, and differences in time, reflected in storage costs. Figure 4.8 indicates a hypothetical spot price - futures price basis over time.

Figure 4.8: Hypothetical spot-futures basis over time

The formula to calculate basis is the following:

Basis = Spot price - Futures price

A negative basis implies that the futures price is greater than the spot price, and a positive basis implies that the futures price is less than the spot price. The hedger (the party with the long position in the commodity and the short position in the futures contract) profits if the basis gets smaller and loses if the basis gets larger. Figure 4.8 shows that, during harvest, a strong basis characteristically occurs that narrows from harvest time into the expiration of any upcoming futures contract and converges to the spot price of the underlying commodity. When the delivery period is reached, the futures price equals or is close to the spot price (Hull, 1998). The extent to which the basis narrows varies from year to year, depending on fundamental factors influencing supply and demand on the market.

The spot-futures basis is subject to a variety of influences, including seasonal factors, weather conditions, temporary gluts or scarcities of commodities, and the availability of transport facilities. Additional factors affecting the relationship between spot and futures prices are costs related to carrying such commodities and includes interest rates, storage cost and silo fees. The basis is an indication of local demand, affecting prices offered for commodities. When local users offer a price which result in a weaker than normal cash basis, local users indicate that supply is adequate. The users buy the crop, but only after deducting the full cost of storage from now until the time they can use or move the crop. Abundant supplies contribute to the wide basis at harvest time.

For maize to be harvested from June onward, the producer needs to have information on the spot futures basis using the July futures. For wheat to be harvested in November, the spot futures basis levels using the December futures are useful. From early in the year, even before the crop is planted, a maize producer can, for example, monitor the July futures to see what forward price the futures market is offering. As was stated in Chapter 3, the forward price is defined as:

Forward price = futures contract price + basis

The harvest-period basis, reflecting the July futures, is used to adjust or localise the quote coming from SAFEX. For example, at a location which normally delivers its maize to Randfontein (all futures contracts are priced at Randfontein basis, but can be delivered to any SAFEX silo), the local spot price of maize in January is likely to be below the March futures price by the cost of transporting maize to Randfontein plus the carrying charges for storing maize from January to March. Thus, if the transport cost is, for example, R41/t and the carrying charges are R20/t, the local spot price might be below the March futures price by a total of R61/t.

The hedger (the person with the long position in the commodity and the short position in the futures contract) profits if the basis gets smaller and makes a loss if the basis gets larger. The opposite is true for the speculator. The hedger has not eliminated all risk but has instead replaced price risk with basis risk. Basis risk is the risk of varying fluctuations of the spot and the futures price between the moment at which a position is opened and the moment at which it is closed (Herbst, 1986). Basis risk goes to zero if the hedge is maintained until the maturity date of the futures contract. Basis risk arises from unpredictable movements in the basis for shorter hedge holding periods. There are four primary sources of basis risk (Kruger, 1991), namely:

- changes in the convergence of the futures price to the spot price;
- changes in factors that affect the cost-of-carry;
- mismatches between the exposure being hedged and the futures contract being used as the hedge; and
- random deviations from the cost-of-carry relation.

Tracking basis information is also important for producers who market their commodities through the spot or futures market. When the basis strengthens, the market encourages spot sales. When the basis weakens, the market discourages spot sales and encourages storage.

4.8 HEDGING WITH FUTURES CONTRACTS

In contrast to speculators, a hedger is a person who enters the futures market in order to reduce a pre-existing risk. A hedger is therefore someone who has an interest in selling or buying the actual commodity. A seller is interested in pre-pricing a product (for example, maize) that will be for sale in the future in order to avoid a price decline. A buyer is interested in pre-pricing maize needed at some time in the future in order to avoid a price increase. A speculator is someone who has no interest in the actual commodity. The speculator is interested solely in profiting from the price movement. The threat of delivery or the threat of demanding delivery prevents speculators from controlling the market and ensures that there is an orderly relationship between the spot and futures market.

A hedge is a method of decreasing the risk of holding a cash position by taking an offsetting position in the commodity or futures market (Rinehimer, 1986). According to Rinehimer (1986), there are two basic types of hedge transactions. A short hedge involves ownership or purchases of a cash commodity and the subsequent or simultaneous sale of an equivalent quantity of futures. A long hedge involves the purchase of futures to protect against a possible price increase of the actual commodity prior to its physical delivery. In futures markets hedging involves taking a futures position opposite to that of a spot market position. That is, a producer would sell maize futures against the crop. This means that the producer will sell a contract and then, before it expires, buy a contract to close the position in the market. A producer does not trade directly on the futures market, but appoints a broker to do so on the producer's behalf.

The producer will therefore have to make provision for broker's commission. The financial implications of futures market transactions are illustrated by means of the following example:

Example 1: Financial implications of futures market transactions

Mr Bright is a maize producer and wants to use the futures market to hedge against price risk. Mr Bright instructs his broker to sell ten July 2001 white maize contracts at R600/ton on 1 December 2000.

Mr Bright will initially have to pay R72 000 for the transaction, R70 000 of which can be regarded as a 'deposit' on his SAFEX account. This amount comprises the following:

Initial margin	R70 000
	(R7 000/t * 10 contracts of 100 ton)
Brokerage	R2 000
	(For example: R2/t * 10 contracts)

When Mr Bright closes his position (buys back the contract), brokerage costs have to be paid. This amount (R72 000) is the minimum that will be required. Should the price of maize rise by R1/ton, it would mean a loss of R1 000 that Mr Bright will have to pay in on his initial margin. If the price of maize decreases by R1/ton, Mr Bright will receive the R1 000 in his margin account and no margin calls will be addressed to him. The margin account bears interest on a daily basis.

Prices decrease

On 30 June 2001, a July 2001 white maize contract trades at R500/t and Mr Bright decides to close his position by buying back 10 contracts.

1/12/00	
Sell 10 WMAZ contracts @ R600/ton	
Initial margin	(R70 000)
Brokerage	(R2 000)
30/06/01	
Buy 10 WMAZ contracts @ R500/ton	
Repayment of initial margin	R70 000
Payment of profit (R600 -R500 * 10 contracts)	R100 000
Brokerage	(R2 000)
Sell maize on spot market @ R500/ton	R500 000
Profit realized	**R596 000**

Prices increase

Suppose that the July white maize price increased to R650/ton. The net effect of the hedge transaction will be as follows:

1/12/00	
Sell 10 WMAZ contracts @ R600/ton	
Initial margin	(R70 000)
Brokerage	(R2 000)
30/06/01	
Buy 10 WMAZ contracts @ R650/ton	
Repayment of initial margin	R70 000
Payment of loss (R650 -R600 * 10 contracts)	(R50 000)
Brokerage	(R2 000)
Sell maize on spot market @ R650/ton	R650 000
Profit realized	**R596 000**

The producer locked in a price to protect himself from any possible future price decreases. If the price increases, the producer cannot gain from the higher price, but is at least protected from any possible price decrease.

4.9 CONCLUSION

Changes in the marketing mechanisms of South African grains since 1995 have created considerable interest in marketing strategies based on futures and options markets to enhance the income of crop producers. These marketing contracts are important tools for managing price and income risk in the volatile environment of the new century. Successful use of such tools requires a complete understanding of how various contracts function, the kinds of risk they are designed to control, and the areas of risk that remain after the contract has been signed.

Hedging in organised futures markets has clear benefits in terms of transferring risk and assuring competitive returns identified by existing price relationships. Forward markets cannot provide above average returns for all producers. Any claim that hedging in futures can provide above-equilibrium prices is mere fiction.

The benefits of using organised markets have a cost. These costs may be relatively large for individual producers. Transaction costs, including margins, can be large. The complexity of the contracts may affect the returns from the hedge. Producers may perceive futures as complex instruments that have high costs in terms of a scarce management resource.

Today's prices in the futures market reflect the current consensus opinion of the market of what the underlying commodity will sell for at a specified time some months in the future. The participants determine the price based on their best estimates on the balance of supply and demand for the commodity in the future. These estimates are derived from the currently available information. All new information that has any influence on these projections is reflected in the price almost instantly. The above phenomenon is referred to as the efficient market hypothesis.

The following conclusion can be reached if one accepts the efficient market hypothesis: whilst individuals can beat the market, few can consistently do so. One implication is that, with few exceptions, the crop producers who survive are those who manage price risk above production cost since efforts to improve revenue through better marketing will have limited success. Marketing strategies can assist in managing price risk and therefore add to the net crop revenue.

Theoretically, in the absence of any supply/demand imbalances, the future price of a commodity should be equal to the spot price of the commodity today, plus storage, interest, insurance and any other related expenses. The spot futures basis is extremely important to decision-makers. Looking at the behaviour of spot prices versus the nearby futures prices can provide an indication of the strength of demand in the spot market. The expected basis at harvest allows producers to monitor the forward price offered by local buyers and gives a means of comparing forward contracts with futures contracts for delivery during harvest. Storable products should be placed in storage when the projected basis improvement exceeds the cost of carrying the product.

However, futures seldom trade at the 'theoretical' price. The projected imbalance of supply and demand causes the futures price to deviate. All new information is discounted and reflected in the current price. Futures markets are very dynamic and change rapidly. The risks associated with commodities trading underscore the challenges of decision-making under uncertainty and the large number of factors that affect supply/demand imbalances. For instance, if current estimates of supply and demand figures, locally and overseas, for three months from now show that the commodity will be in short supply, the futures price rises above the current expected price. The price differential encourages storage of the commodity. Prices in the spot market rise and the current demand is reduced through lower usage and substitution. If, on the other hand, an abundance of the commodity is projected, the futures price declines and discourages storage. Prices in the spot market decrease and attract new sources of consumption.

Producers have to consider a number of factors such as domestic production, competing foreign production, current levels of grain stocks in storage, seasonality in production, and exchange rates when they estimate the available supplies of the commodity and expected prices. Changes in weather conditions influence prices on a daily basis. The markets pay due attention to supply estimates from production. After the harvest, when the crop is stored, the focus shifts to the demand side of the equation. All forms of usage such as domestic demand, the state of the domestic economy, export demand and seasonality factors have a direct influence on prices. It is nearly impossible for producers to keep track of all this ever-changing information and the futures market is a tool to help producers manage their price risk.

Futures and option contracts support producers in managing price risk at a level above the break-even price, that is the minimum price that producers can accept to ensure that all input costs are covered by the expected market price. The next chapter explains the basics of option contracts and how option contracts can be used to manage price and investment risk for crop producers in South Africa.

CHAPTER 5

OPTIONS ON FUTURES CONTRACTS

We may never conquer the future, but we can see ways to better manage both the change and the uncertainty.

- Bill Flory

5.1 INTRODUCTION

The volatility of agricultural commodity prices makes marketing just as important as production. It is vitally important that a producer should protect himself/herself from downside price risk. A marketing strategy that allows the producer to capitalize on rising prices is beneficial as long as it enables the producer to meet price objectives and stay within the range of financial risk and cash flow ability.

Producers must continually search for new marketing instruments to help them cope with increased price variability and meet the growing need to be competitive in a global marketplace. The ability to use a diverse set of marketing instruments helps producers to optimize price and production risk while striving to achieve their financial goals and objectives. Options give the agricultural industry a flexible pricing tool to assist in price risk management. Option contracts offer a type of insurance against adverse price movements, require no margin deposits for buyers, and allow buyers to participate in favourable price moves. Commodity options can be adapted to a wide range of commodity pricing situations. For example, agricultural producers can use commodity options to establish an approximate floor price for their crops. Millers can also use commodity options to establish an approximate ceiling price. Given today's large price fluctuations, the financial payoff of controlling price risk to protect profits can be substantial.

In the previous chapters, various marketing instruments available to producers to manage price risk have been discussed. In this chapter, options on futures contracts are explained as a price risk management instrument in agriculture. The options on futures contracts explained in this chapter refers to commodity option contracts. This chapter briefly explains the historical development of option contracts, different types of option contracts, factors affecting premium values, the pricing of options, risks associated with options, and option strategies available to producers. The chapter also briefly explains swaps and spreads as alternative marketing strategies in the agricultural sector.

5.2 HISTORICAL DEVELOPMENT

The practice of options trading in agricultural commodities is not a new phenomenon. Options were traded as 'privileges' in the late 1800's and grew into options markets in the USA. These markets were not yet regulated properly to protect buyers, and sellers and were banned in the USA during the early 1930's. This ban on options in agricultural commodities remained in place until the Futures Trading Act became law in the USA during 1982.

In South Africa, options on equities have been traded on the Johannesburg Stock Exchange since the end of the last century. Initially, only European type, non-transferable options were traded; later, fixed-interest securities were added. Since 1984, the trading activities with regard to options have escalated dramatically. The first agricultural options started trading on SAFEX during March 1998. The agricultural option market experienced excellent growth with

11 504 contracts traded in February 2000, an improvement of 369.55% from February 1999 to February 2000 (http://www.safex.co.za, 2000).

5.3 OPTIONS ON FUTURES CONTRACTS

An option contract is simply the right, but not the obligation, to buy or sell a futures contract at some predetermined price within a specified time period. Essentially, commodity options provide the 'opportunity', but not the 'obligation' to sell or buy a commodity at a certain price. In the case of options on futures contracts, the underlying commodity is a futures contract and not the physical commodity. If the futures price changes in favour of the option holder, a profit may be realised either by exercising the option or selling the option at a price higher than originally paid. If prices move so that exercising the option is unfavourable, then the option may be allowed to expire. The contract specifications of put and call options traded on SAFEX are set out in Table 5.1.

Table 5.1: Contract specifications of put and call options

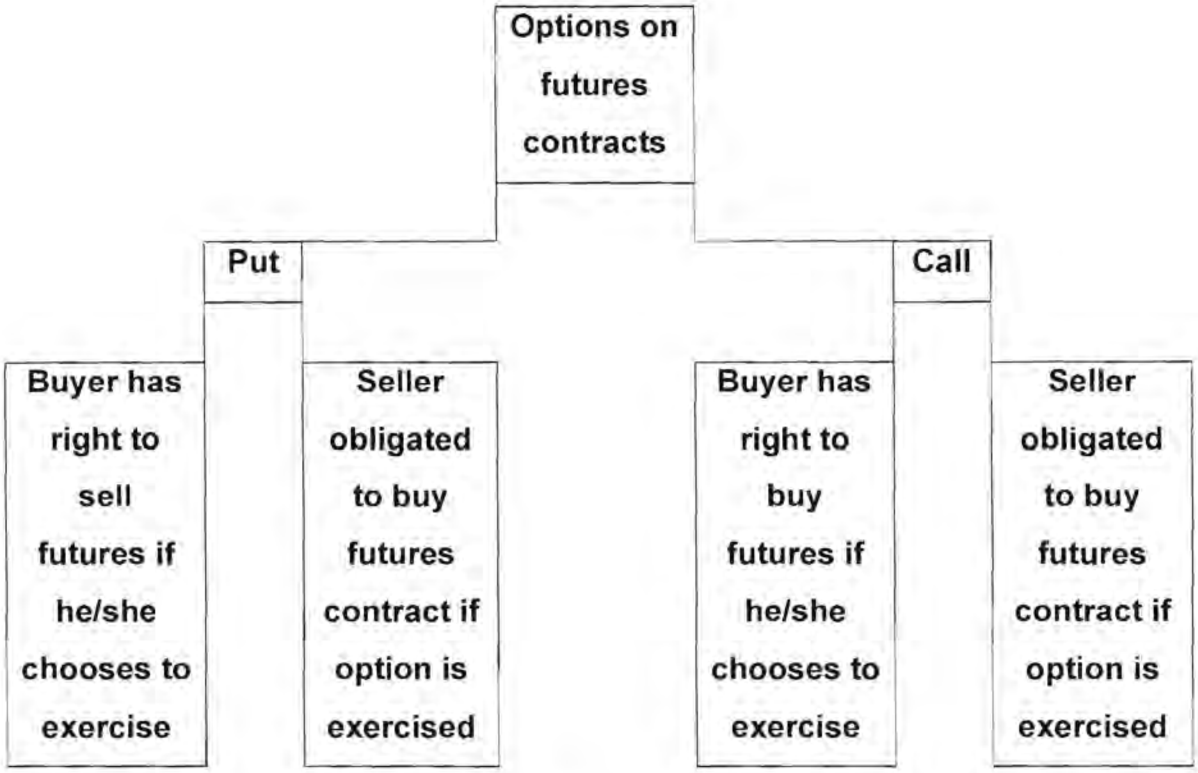
OPTIONS CONTRACT	WHITE MAIZE	YELLOW MAIZE	WHEAT
ATS Code			
Trading Hours	09:00 to 12:00	09:00 to 12:00	09:00 to 12:00
Underlying Instrument	1 White Maize futures contract	1 Yellow Maize futures contract	1 Wheat futures contract
Options	American type, puts and calls	American type, puts and calls	American type, puts and calls
Strike Price Intervals	R20.00 per ton	R20.00 per ton	R20.00 per ton
Quotation	In whole Rand per contract	In whole Rand per contract	In whole Rand per contract
Contract Months	March, May, July, September and December	March, May, July, September and December	March, May, July, September and December
Expiration Date and Time	12:00 on the fifth last trading day of the month preceding the expiration month of the underlying future contract	12:00 on the fifth last trading day of the month preceding the expiration month of the underlying future contract	12:00 on the fifth last trading day of the month preceding the expiration month of the underlying future contract
Exercise	Long position holders may exercise their options during market hours at any time up to and including the expiration date; provided that all in-the-money options shall be automatically exercised by the exchange at expiration	Long position holders may exercise their options during market hours at any time up to and including the expiration date; provided that all in-the-money options shall be automatically exercised by the exchange at expiration	Long position holders may exercise their options during market hours at any time up to and including the expiration date; provided that all in-the-money options shall be automatically exercised by the exchange at expiration
Expiration Price (for automatic exercise)	Mark to market price of the underlying future on expiration date	Mark to market price of the underlying future on expiration date	Mark to market price of the underlying future on expiration date
Calculation Of Mark To Market	Mark to market prices will be calculated from volatility quotes for at-the-money using the Black options pricing model	Mark to market prices will be calculated from volatility quotes for at-the-money using the Black options pricing model	Mark to market prices will be calculated from volatility quotes for at-the-money using the Black options pricing model
Volatility Scanning Range (for margining)	3.5%	3.5%	3.5%
Clearing House Fees	R17.10 per contract	R17.10 per contract	R17.10 per contract

Source: http://www.safex.co.za(1999)

The biggest difference between options and minimum price contracts (cf. Chapter 3) is, that in the case of options, the producer can decide whether the option should be exercised. This is not the case with minimum price contracts. Options provide protection against adverse price movements, while allowing option holders to gain from favourable cash price movements. In this sense, options provide protection against unfavourable events similar to the type of protection provided by insurance policies. To gain this protection, a hedger in an options contract must pay a premium, as one would pay for insurance.

There are two types of options: puts and calls. A **put** is a contract that gives the holder the right to sell a specified commodity at a specific price any time before the contract matures. A **call** is a contract that gives the holder the right to buy a specified commodity at a specified price any time prior to contract maturity (http://www.safex.co.za, 1999). The option buyer (holder) is the person who obtains the rights conveyed by the option. The option seller (grantor or writer) is the person who grants the rights contained in it. The option buyer pays a premium for the right to obtain the contract, and the option seller receives the premium paid by the option buyer for the risk taken by the seller. The option seller must maintain a margin account (a good faith deposit which serves to guarantee due performance) at the clearing house. For every purchase of a put option, there is a sale of the same put option. The put option buyer receives the right to sell a specified commodity at a specified price, and the option seller is obliged to buy the commodity at that price. For every purchase of a call option, there is a sale of a corresponding call option. The call option buyer receives the right to buy a specified commodity at a specified price before the contract matures. If the call option buyer exercises the option, the option seller is obliged to deliver the commodity and receives the price paid (strike price) by the option buyer. A put and a call are not opposite sides of the same transaction. Figure 5.1 presents this concept.

Figure 5.1: Flow diagram of put and call options



Source: Adapted from http://www.ianr.unl.edu (1999)

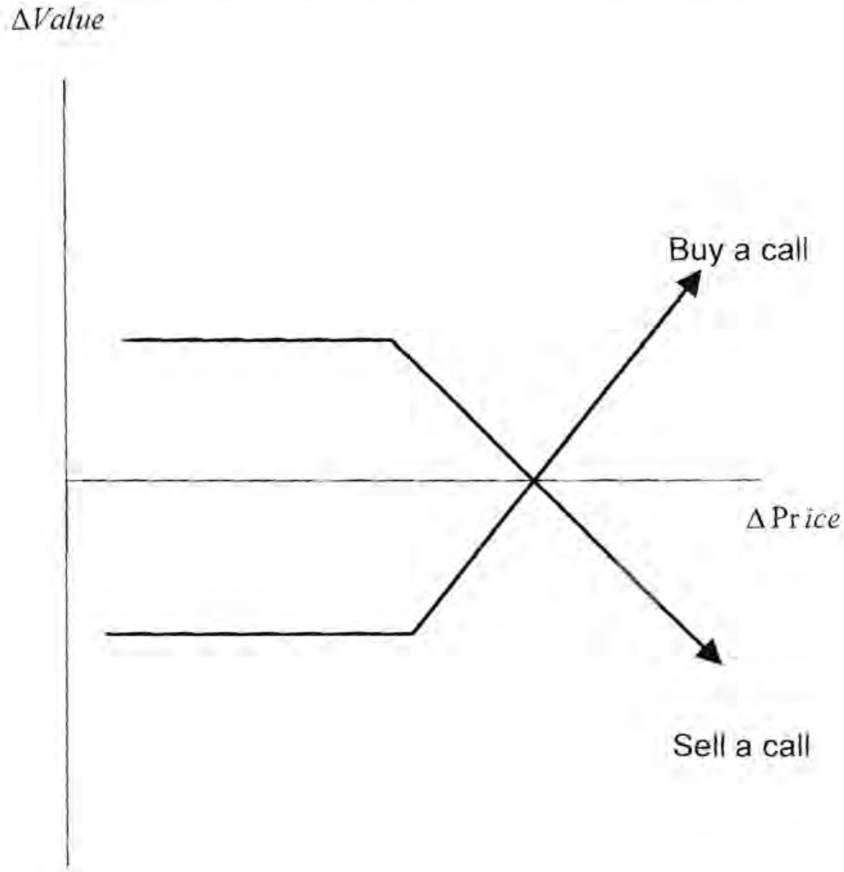
The specified price is called the exercise or strike price. The bidding is manifested in the option premium, which is the market value of the option. A buyer pays the premium for the right to sell or buy futures on commodities at the indicated strike price. At any time before the option expires, the option buyer can exercise the option. The expiration dates for commodity options traded on SAFEX are set out in Table 5.2.

Table 5.2: Expiry dates for option contracts traded on SAFEX

Contract month	Expiry dates
July	12:00 on 5^{th} last trading day in June
September	12:00 on 5^{th} last trading day in August
December	12:00 on 5^{th} last trading day in November
March	12:00 on 5^{th} last trading day in February
May	12:00 on 5^{th} last trading day in April

The buyer of a put option can convert an option position into a short (selling) futures position, established at the strike price, by exercising the put option. If the buyer exercises the option, the option seller is obliged to take the opposite futures position at the same strike price. The option seller receives the premium from the option buyer. Because of the seller's obligation, when the option contract is exercised, to take a commodity futures position, an option seller must post a margin to ensure due performance. Figures 5.2 and 5.3 show the payoff profiles for a call and put option (both including premiums) from both the buyer and the seller's side.

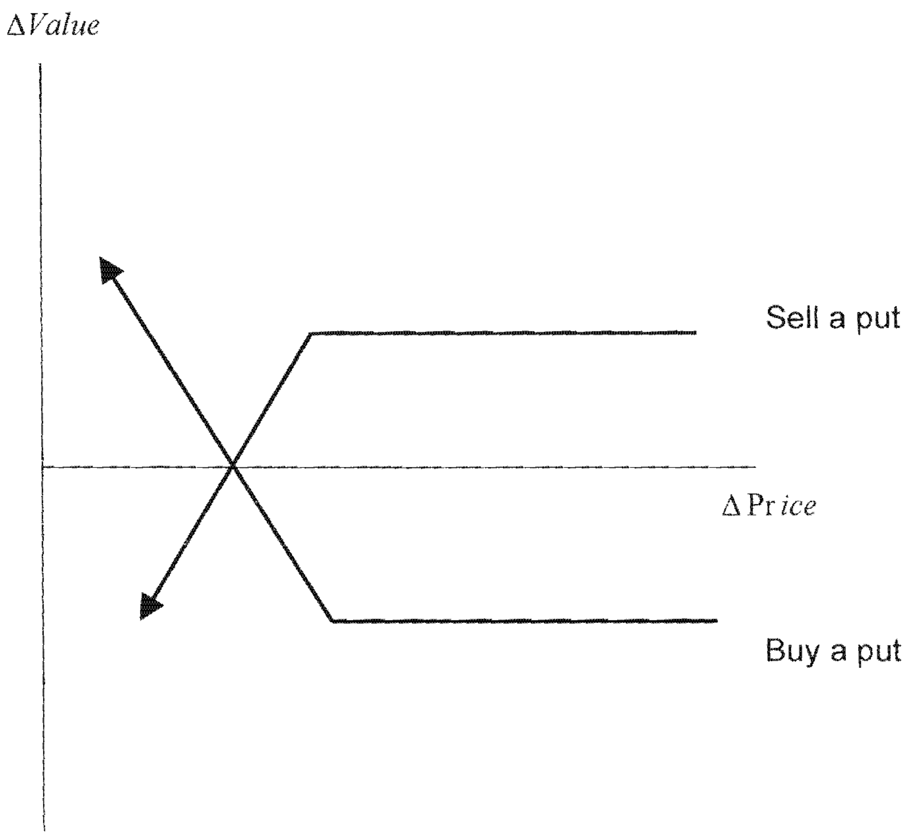
Figure 5.2: Payoff profile of a call option on a commodity futures contract



Source: Ross *et al.* (1996).

If the underlying futures price rises above the strike price, then the owner of the option will exercise it and enjoy a profit, whereas the seller of the option contract will realise a loss. If the underlying futures price decreases, the long call option contract will expire worthless and the seller of the option will profit from the premium received from the buyer (long) of the call option.

Figure 5.3: Payoff profile of a put option on a commodity futures contract



Source: Ross *et al.* (1996).

If the underlying futures price falls below the strike price, the buyer profits. The long option expires worthless with a price increase.

The intrinsic value of an option is the amount that the buyer would recover if the option is exercised immediately (Ferris, 1998). If a hedger decides to minimise price risk by hedging with options, the first question to consider is the strike price (the price at which the underlying futures contract can be bought in the case of a call, or sold in the case of a put). Options are classified into three categories, depending on the underlying relation between the exercise (strike) price and the current market price of the asset. These categories are the following (Hull, 1998; Kolb, 1997; Chance, 1989):

- In-the-money options are options that have intrinsic value, for instance, a put option with a strike price higher than the current spot price or a call option with a strike price lower than the current spot price.

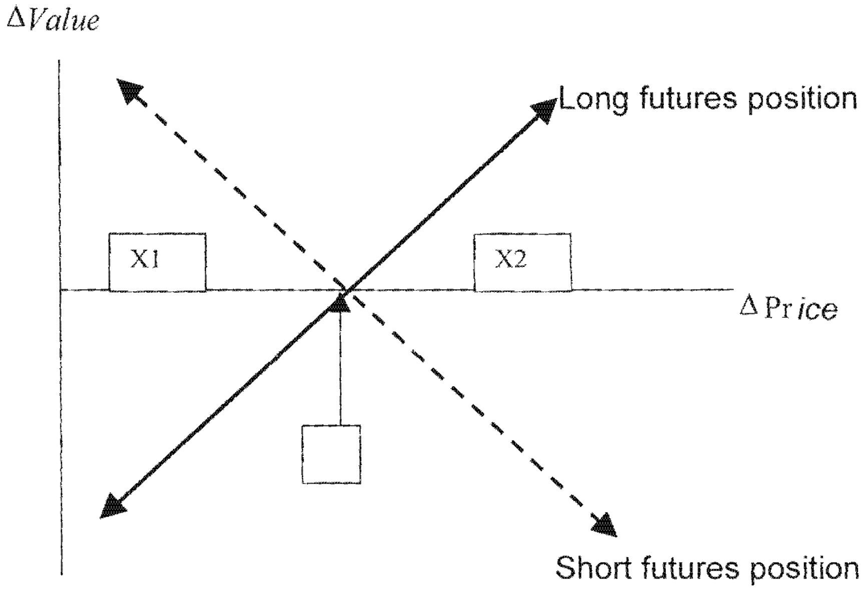
- At-the-money options are those options with a strike price at the current spot price.

- Out-of-the-money options are those options that have no intrinsic value – a put option with a strike price lower than the current spot price or a call option with a strike price higher than the current spot price.

Whether an in-the-money or out-of-the-money option is purchased depends on the level of price insurance desired. An in-the-money option offers more price insurance (a higher price ceiling for a producer), but the premium paid is higher. Conversely, an out-of-the-money option offers less price insurance, and costs less.

To indicate the difference between a futures contract and an option on a futures contract, a comparison between futures and option contracts is necessary. Figure 5.4 indicates the effects of a change in price on commodity futures on the profits of long and short positions in futures.

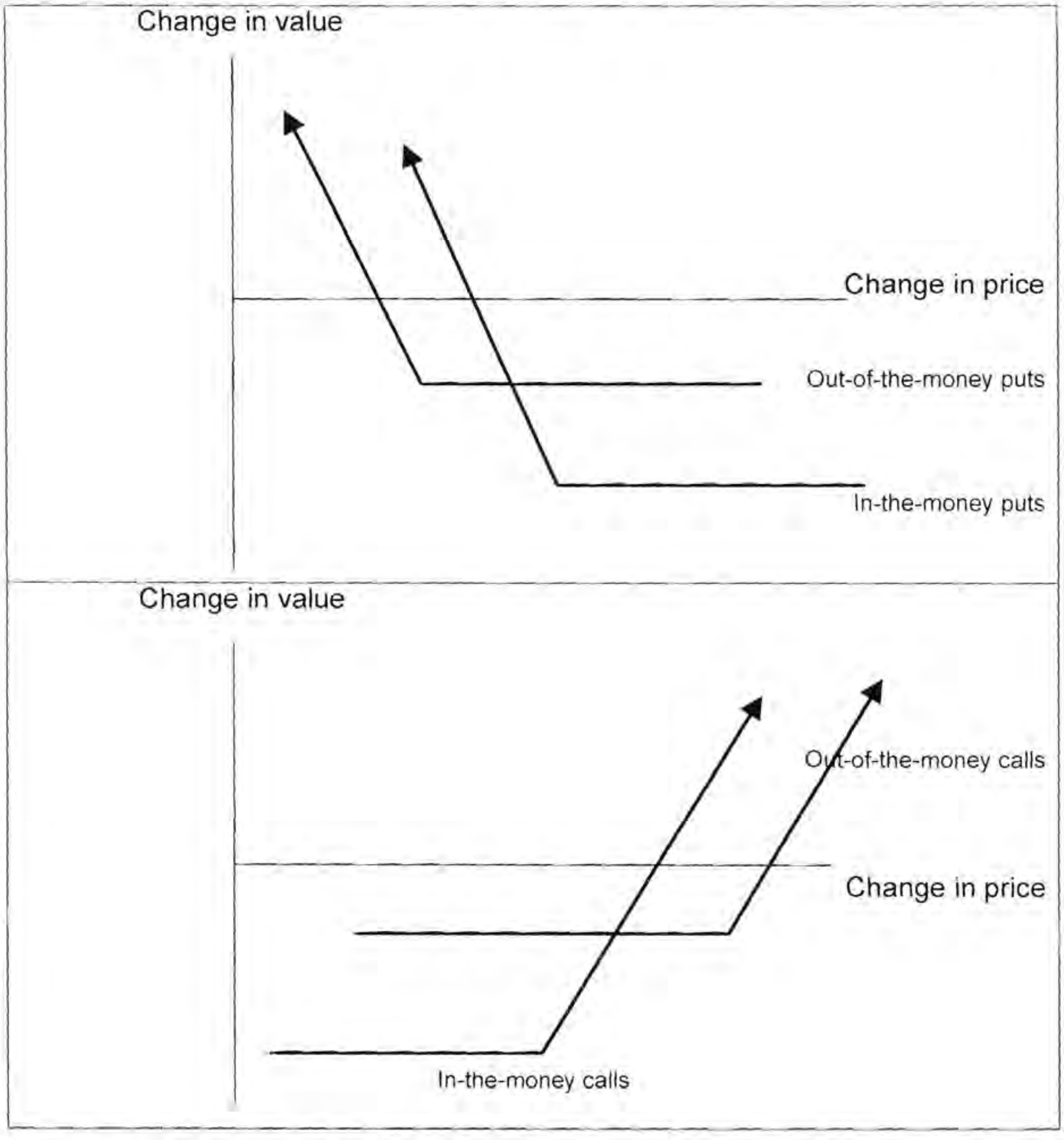
Figure 5.4: Effects of changes in commodity futures prices on profits



Source: Ferris (1998)

Profits on long positions (buy) are directly related to changes in futures prices, while profits on short positions (sell) are inversely related. If the futures price moves from Y to X1, the short position will realize a profit (Y - X1) and the long position will realize a loss (X1 - Y). If the futures price increases to X2, the long position will realize a profit (X2 - Y) and the short position will incur a loss (Y - X2). Figure 5.5 indicates the relationship between a change in the futures price after a position has been taken in the option market and subsequent profits at expiration.

Figure 5.5: Effects of changes in commodity futures prices on profits in options



Source: Ferris (1998)

When the prices on the underlying futures decline, the right to sell at a given strike price becomes more valuable for a put option. If the additional value at expiration exceeds the premium paid by the buyer for that right (plus commissions), a profit is realised. If the prices on the underlying futures increase, the intrinsic value of the put option declines. This establishes the maximum loss for a buyer of put options – the premium plus commissions. A buyer of puts has no upper limit on profits, but a lower limit on losses. The opposite is true for sellers of puts.

For buyers of in-the-money put options, a decline in futures immediately increases the intrinsic value. The intrinsic value is the positive difference between the strike price and the underlying futures price. For a put, the intrinsic value is the amount that the strike price exceeds the futures price. Before or at expiration, if the increase in intrinsic value exceeds the original time value, the buyer profits. When the commodity futures price rises to and above the strike price, the intrinsic value of the option becomes zero and, at expiration, the buyer of the put incurs losses equal to the original premium. Sellers of in-the-money puts incur losses if futures decline more than the time value on the option.

When the prices of futures contracts rise, the value for the buyer of a call option will increase and the call option will move in-the-money. A decline in the price of the underlying futures reduces the value of the right to buy and eventually renders it worthless as time value evaporates. The maximum loss is the original premium (plus commission paid to the trader). The seller of a call faces the opposite pattern. The futures-profit relationships on calls are essentially mirror images of those on puts.

There are three basic steps to consider in using options.

- The first is the selection of the appropriate option contract expiration month. To do this, a buyer/seller has to select the option that will expire closest to, but not before, the time when the physical commodity will be sold or purchased.

- The second step involves selecting the appropriate type of option. To insure products to be sold at a later time against price declines, the producer can buy a put option. To insure products to be bought at a later time against price increases, the producer can buy a call option.
- The third step involves determining what the option strike price offers in terms of a minimum spot selling price for put options. The calculations for the minimum selling price (MSP) can be calculated in the following manner:

	Strike price
Less:	Premium
Less:	Opportunity cost
Less:	Commissions
+/-	Basis (cf. Chapter 4)
=	MSP

A producer who has bought option contracts has three alternatives, namely:

- to let the option contract expire;
- to exercise the option contract; or
- to offset the option contract.

If the spot price increases above the strike price before the expiration date, the producer could simply let the put option contract expire. The producer is free to take advantage of the price increase and use another marketing alternative (such as futures contracts, forward contracts and spot sales). By allowing the put option contract to expire, the producer loses only the premium and brokerage fees.

If futures prices decrease, the producer could exercise the option contract. There are two alternatives to choose from when a put option contract is exercised:

- the producer can deliver his/her crop, or
- the producer can close out the futures position, profit from the lower exercise price and sell the crop on the spot market.

When a producer decides to close out the futures position to profit from the lower exercise price, the put option contract is exercised and a position in the futures market is assigned to the producer. A buyer of a put would be assigned a short position in the respective futures. A buyer of a call would be assigned a long position. At SAFEX, sellers of options are drawn at random to take the opposite position in futures to the buyer when the buyer decides to exercise. The buyer of the put option can close out the short futures position by entering into a long futures position. The profit secured by this action is the difference between the strike price of the put option contract and the price of the long futures contract. The crop can be sold on the spot market.

If prices decrease and the premium value increases, the producer may decide to offset the put option. The producer would offset the put option by selling an equal and opposite put option. The producer must sell an option identical to the one previously bought. It must have the same strike price and expiration date. By offsetting the option contract, the producer can profit on the change in value of the premium. The cost of premium and broker fees must be deducted from the final commodity sale.

5.4 FACTORS AFFECTING PREMIUMS

Premiums are affected by the intrinsic value, the underlying interest rate, the volatility of prices, and the length of time (time value) to expiration of the option. Time value reflects the risk that the option seller bears in selling the option to the buyer. For example, if a R750 December maize put sold for R50 per ton when

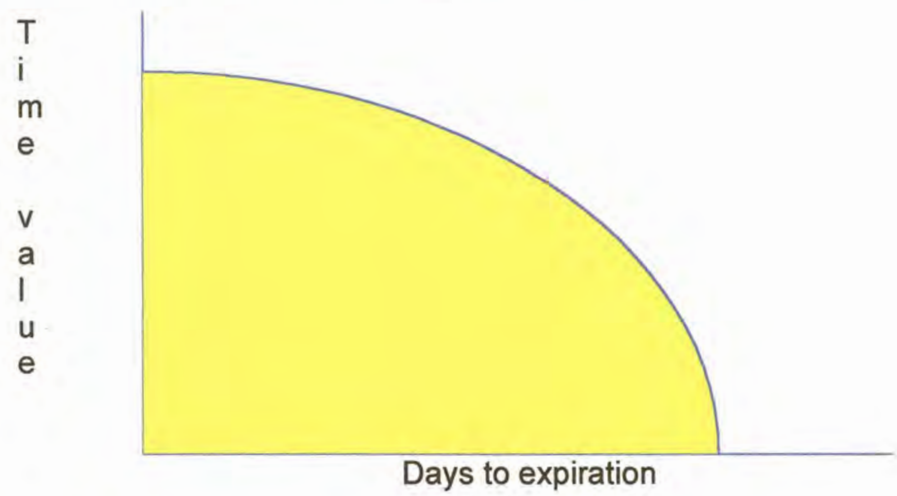
December maize was trading at R740, the put would have R40 per ton of time value (R50 premium - R10 intrinsic value = R40 time value). The total cost of this put option would be R5000 (R50 * 100 ton) plus a commission charge. Commission is payable to traders when an option contract is bought or sold. Of this amount, R1000 would be the intrinsic value and R4000 the time value. For options with no intrinsic value, the entire premium equals time value.

Suppose that in July a December maize put with a strike price of R800 is offered for R45 per ton. At the same time, the December maize futures price is quoted at R820. The option is R20 out-of-the-money and has no intrinsic value. Even so, the put option has a time value of R45 per ton. The R45 premium represents the risk the seller takes that the option could expire in-the-money.

The question can be asked: why would anyone pay for something that has no intrinsic value? It has value because the option still has four months before expiration in November, and during that time, the option buyer and seller know that the underlying futures price could fall below the R800 strike price. If the December maize futures price were to fall below R755 (strike price - premium), the holder of the put option would be sure of a profit. If in December the maize futures price is between R755 and R801, the put option buyer would recover all or a portion of the initial premium cost.

Time value originates from the fact that the longer the time until expiration, the more opportunity for buyers and sellers to profit – therefore, the premium reflects more than just the intrinsic value. The amount of time value depends on the time remaining until expiration. Time value decreases with the length of time until expiration. On the expiry date, the time value must be zero. However, the time value does not erode on a straight line basis. It decreases much more rapidly during the last few weeks of an option's life as the chances of a price change diminish progressively. At the beginning of a long-term option's life (three months or longer) the effect of time erosion is usually minimal, but during the last month it becomes more severe. Therefore, as can be seen in Figure 5.6, the decay of time forms a negative exponential curve.

Figure 5.6: Decay of option values with time



Source: Falkena *et al.* (1989)

At expiration, an option's premium consists only of intrinsic value, because the option no longer has any time value.

Consider the previous out-of-the-money maize put example. Four months before expiration, it commanded a premium of R45 a ton. The question that could be asked is the following: What are the factors that determine the option's premium? What are the factors that influence the option's time value? There are four primary factors that affect the value of premiums. They are (Ferris, 1998; Kleinman, 1997; Ross, *et al.*, 1996; Labuszewski, Sinquefield & Shculman, 1984):

a) *The relationship between the underlying futures price and the option strike price*

One indicator of this relationship is the option delta. The option delta is a measure of the amount by which an option premium will change for a corresponding change in the underlying futures price. In-the-money options have a delta near or equal to one, which means that the option and the underlying futures price move closely in tandem. Out-of-the-money options have a delta close to zero, meaning that for a given change in the price of the underlying instrument, the option price changes very little, if at all. If a producer is strongly convinced that the prices are going to increase strongly, an in-the-money option with a delta near one would be preferable.

The second indicator is gamma. The gamma of an option expresses the change in the delta as a result of a small change in the futures price. As the call option premium is positively related to the futures price, the delta increases as the option goes deeper in-the-money and decreases as the option goes deeper out-of-the-money. All things being equal, an at-the-money option has no more time value than an out-of-the-money option. The reason is that the at-the-money option has a much better chance of eventually becoming worthwhile to exercise. The figures in Table 5.3 illustrate the difference in time value. The table also shows how the cost of buying a put option to sell white maize in July 1998 at R760 per ton has increased as the price of July 1998 white maize futures contracts fell.

Table 5.3: Increase in put option premiums for July 1998 white maize

Date of trade	Weighted price of option	Ruling futures price at close of business on day of trade
09/04/98	R32.50	R750
14/04/98	40.00	737
20/04/98	48.00	727
23/04/98	100.00	665
24/04/98	95.00	653
13/05/98	130.00	633
14/05/98	130.00	622
15/05/98	151.00	605

From the information in Table 5.3, it appears that it is cheaper to lock in a price of R760 per ton for July if the July futures price is trading at R750 than if it is trading at R650.

b) *The length of time remaining until expiration*

The longer the outstanding time of an option until expiration, the higher the premium, because the option and the underlying futures contract price have more time to fluctuate in value. The longer the time to expiration, the larger the probability that the option will, at some point, move into the money and become profitable for the buyer.

c) *The volatility of the underlying futures price*

Volatility is a measure of how quickly the underlying commodity changes in price. Option premiums are higher during periods when futures prices are volatile. Because increased price risk is associated with a volatile market, the cost of obtaining the insurance through options is also greater. An option is more likely to move in-the-money and become profitable for the buyer when prices are volatile. It is possible for an option three months from expiration to command a higher premium in a volatile market than for an option four months from expiration in a stable market to do so. Because expected option price volatility cannot be predicted accurately, it is often approximated by the most recent historic price volatility of the underlying futures contract. The most common method of estimating volatility is to use the standard deviation of daily or weekly historical price changes over a longer period (Fitzgerald, 1987). Another method is to calculate the implied volatility. The responsiveness of the option premium to changes in the price volatility of the underlying futures contract is measured by the kappa of an option. Kappa is the points change in theoretical value for each one percentage point change in the volatility of an option.

d) *Interest rates.* According to the option pricing model is it assumed that interest rates and option premiums move in opposite directions, all else being constant. When interest rates increase, option premiums decline. The holder of an option pays the premium and commission fees upfront in order to receive a potential profit from that action at some time in the future. If interest rates increase, the current value of the expected future profit declines, while the implicit cost of the option increases.

5.5 THE PRICING OF OPTIONS

Several formulae have been developed to determine the value of options at given points in time to indicate what the premiums or prices of options should be. If the premium differs from the calculated value, arbitrage (a transaction which involves buying the asset or derivative at a lower price and selling it at a higher price) should bring the premium into line, unless traders perceive the expected volatility to differ from that measured by the formula. A breakthrough in option pricing theory was the Nobel Prize-winning work of Fischer Black and Myron

Scholes in 1973. Their model was developed to determine why options trade at their respective prices. They concluded that the fair value price (or fair premium) of an option depends upon the probability distribution of the futures price on the expiry date of the option. They noted the equivalence between options and dynamic positions (prices change continuously) in the underlying risky asset and cash.

Black and Scholes developed their formula based on the trading of options on shares. The assumptions made by Black and Scholes when they derived their option pricing formula were the following (Hull, 1998; Chance, 1989):

- the rate of return on shares follows a lognormal distribution (the logarithm of 1 plus the rate of return follows the normal, or bell-shaped curve);
- there are no commission charges or taxes;
- there are no dividends on the share during the life of the option;
- there are no riskless arbitrage opportunities;
- trading is continuous;
- investors can borrow or lend at the same risk-free rate; and
- the risk-free rate and variance of the return on the shares are constant.

There are two types of options, American and European style options. The main difference between these types is that American style options can be exercised at any time before expiration. European style options can only be exercised at expiration.

The Black-Scholes model for determining option prices on **European options** is the following (Chance, 1998):

$$CP = SN(d_1) - Xe^{-rt}N(d_2)$$

where:

CP	=	call option premium
S	=	current asset price
X	=	strike (exercise) price
t	=	time to expiration
N	=	cumulative normal distribution function
e	=	Naperian constant (e = 2,71828)

The option value does not depend on the expected rate of return on the share (when the underlying asset is a share); it is already built into the formula with inclusion of the share price, which itself depends on the share's risk and return characteristics.

The Black-Scholes equation uses six variables to calculate the fair value of an option contract:

- the asset's price;
- the option's strike price;
- annualised dividend payments;
- interest;
- volatility; and
- number of days until expiration.

The price of the option is calculated from the price of the asset and the option's strike price, and is used to determine the amount that the option is in- or out-of-the-money. The economic value of time is calculated from the interest cost of purchasing the entire position from borrowed funds, less any potential dividend payments during the period. The formula for the fair value of a futures contract is the following:

fair value = (share price*interest rate*days to expiration) - dividend payments

As the price of the underlying asset rises, so does the premium for put options and call options. Rising interest rates increase the premium for calls, but reduce the premium for puts. Dividends have the opposite effect, both on calls and puts. The Black-Scholes pricing model can be used to determine the change in the theoretical value of a put or a call if the price of the underlying futures changes, if the volatility rises or falls, if the dividend changes, or if interest rates change. Time deterioration can be determined by simply changing the number of days until expiration in the formula. Target prices, stop limits and time stops can all be formulated by forecasting price changes (Hull, 1998; Chance, 1998; Falkena, Kok, Luus & Yates, 1989; Chance, 1989).

In 1976, Black developed a variant of the option pricing model specifically to value options on futures contracts (Kolb, 1999). This model is a variation of the well-known Black-Scholes formula and is defined as follows:

$$VLCL = e^{-IT} * \{FTP * N(d_1) - STP * N(d_2)\}$$
$$VLPT = e^{-IT} * \{FTP * N(-d_1) - STP * N(-d_2)\}$$

where:

d_1 = $\{\ln(FTP/STP) + SD^2 * T * 0.5\}/(SD * \sqrt{T})$

d_2 = $d_1 - (SD * \sqrt{T})$

VLCL = value of call

VLPT = value of put

FTP = price of underlying futures

STP = strike price

T = time to expiration in proportion of a year

I = short-term annual interest rate on low-risk securities

SD = historical annualised standard deviation of the daily percentage change in the price of the underlying futures

This model has the virtue of not requiring a risk-free interest rate as an input to determine the value of a put option or a call option. This model is used by SAFEX (AMD) in determining the premium payable by buyers of options.

5.6 OPTION RISK

The link between probability theory and investment risk makes it possible to quantify option investment risk. In addition to strike prices, any change in the other variables (changes in the interest rate, futures prices, days to expiration, and volatility) in Black's option pricing model may bring about changes in option prices over the duration of the option cycle until expiration. Thus, these variables represent the risks of an option. These risks can be measured by 'Greeks' (Baird, 1993; Natenberg, 1994; Ferris, 1998):

5.6.1 Delta risk

The Black model provides the means to calculate a relationship called 'delta'. Delta relates the change in the option premium to the change in the price of the underlying futures contract. The delta formulas are the following:

$$DLTCL = e^{-IT} * N(d_1)$$
$$DLTPT = -e^{-IT} * N(d_1)$$

where:

DLTCL	=	delta for a call
DLTPT	=	delta for a put

The delta risk of an option on a futures contract is a ratio which reflects the monetary value of change in an option price for every monetary value change in the underlying futures price. It is a measure of the sensitivity of the calculated option value to small changes in the underlying commodity price. The formula to determine delta risk is the following:

Delta risk = Rand change in option price / Positive Rand change in futures price

These delta figures also indicate 'hedge ratios' for options. If they are close to 0.5, approximately two calls or puts are necessary to offset one futures contract. If either the call or the put is deep in-the-money, the intrinsic value is highly correlated to changes in the price of the underlying futures and provides closer to 1:1 coverage in hedging.

5.6.2 Gamma risk

An option's delta is not a constant. The delta changes as the futures price changes and makes the option more or less in-the-money, at-the-money, or out-of-the-money. The change in an option's delta is referred to as gamma risk. The formula for gamma risk is the following:

Gamma risk = net change in delta risk / Rand change in futures price

Gamma is a measure of the calculated delta's sensitivity to small changes in the underlying commodity price. Gamma can be both negative and positive. Long calls and puts always have positive gammas, and short calls and puts have negative gammas. If gamma is small, delta changes slowly, and adjustments to keep a portfolio neutral only have to be made relatively infrequently.

5.6.3 Theta risk

The change in option prices due to the days remaining to expiration represents the time decay, or theta risk. The formula for theta risk is the following:

Theta risk = change in option's value / one-day change in time remaining to expiration

All else being equal, an option contract with fewer days remaining is worth less than an equivalent one with more days to expiration, because the extra days add value. There is still time left before expiration when prices can change and the options can move in-the-money.

5.6.4 Vega or kappa risk

Even if there is no change in the underlying commodity futures price risk (delta or gamma) or in time risk (theta), an option price may be affected by changes in the market's valuation of implied volatility. This change in value is referred to as vega. Therefore, vega is the rate of change of the value of the portfolio in respect of the volatility of the underlying futures price. It is the most important risk and is formulated as follows:

Vega risk = rand change in option price / positive one-point implied volatility change

If vega is high in absolute terms, the portfolio's value is very sensitive to small changes in volatility.

6.6.5 Rho risk

The rho of an option contract is measured by the rate of change of the value of the option caused by interest rate changes. Thus, rho measures the sensitivity of the value of an option to interest rate changes. In the case of options, the interest rate represents the cost-of-carry of an option position, or the opportunity cost of trading in options. It represents whatever unoccupied capital may safely earn. A positive cost-of-carry earns interest, while a negative cost-of-carry incurs interest payments. If interest rates change, the cost-of-carry and the value of an option also changes, all else being equal. Change in the cost-of-carry that leads to change in the value of an option is referred to as rho risk.

5.7 OPTIONS VERSUS FUTURES CONTRACTS

Options on futures contracts and futures contracts are similar in the sense that both represent actions that occur in the future. Futures contracts are either to accept or deliver the actual physical commodity, while in the case of options on futures contracts the underlying asset is a futures contract. It is important to compare the advantages and disadvantages of options and futures contracts. Knowing what the advantages and disadvantages of option contracts are will aid producers in optimizing the use of all those different marketing instruments. These advantages and disadvantages, are set out in Table 5.4:

Table 5.4: Comparison between options and futures contracts

OPTIONS	FUTURES CONTRACTS
Advantages	
No margin calls	No premium
Ability to take advantage of favourable price moves	If price moves are favourable, the producer realises the greatest return with this alternative
Limited risk	No risk
Disadvantages	
Premium payable	Subject to margin calls
May yield less return than other strategies due to the premium	Initial margin required
If exercised, a futures position, with all its financial and contract obligations is assumed	Net price subject to basis change

Source: http://www.ianr.unl.edu, 2000 & http://bluehen.ags.udel.edu, 2000

To make a true comparison between futures contracts and an option contract, the producer should set up potential price scenarios based on future market trends.

5.8 DIFFERENT MARKET SCENARIOS

5.8.1 Uptrending market

Suppose that, after planting maize, a producer decides to use a forward pricing technique to market a portion of the crop. Furthermore, suppose that spring rains are good and the weather outlook for the rest of the season is favourable. Also assume that due to bad weather conditions in the USA, a below-average maize crop is expected in the USA. In addition, the value of the US dollar has increased since planting. Therefore hopes are raised that global buying patterns will shift away from US agricultural products, causing a bullish market from the South African producers' point of view.

Alternative 1: Hedging with futures

During December, July maize futures trade at R820 per ton. Although the producer feels that prices may move higher than R820, a futures hedge (on 15 December) is placed to guard against the risk of a price decrease. The local spot price is R780 per ton. On 1 July, the producer closes the futures position by buying back the July contract that is now trading at R835 per ton. Grain is delivered to the local silo, where the spot price is R795 per ton. The producer's actions and returns are set out in Table 5.5.

Table 5.5: Transactions and returns on futures hedging with price increase

Date	Action	Value
15 December	Sell July maize futures	R820
1 July	Buy July maize futures	R835
Futures profit/(loss)		**(R15)**
1 July spot price	Sell to local elevator	R795
Futures profit/(loss)		(R15)
Net return		**R780**

Even though the prices turned against the producer's position, an assured price for the maize crop was secured. Loss in the futures market was completely offset by the gain in the local spot market (R795 - R780 = R15 vs. R15 loss in the futures market). Due to the nature of a futures contract position, the producer was unable to take advantage of any price increases. As prices traded above the R820 contract position, margin calls also had to be met.

Alternative 2: Option contract

Suppose an option contract had been used instead. The producer buys a R820 July option for a R25 premium expense. With futures prices trading at R835 on 1 July, the producer allows the put option contract to expire. The producer's actions and returns are set out in Table 5.6.

Table 5.6: Transactions and returns on a put option with price increase

Date	Action	Value
15 Dec	Put option July maize	R820
	With premium cost	R25
1 July	Futures July maize	R835
	Spot price	R810
	Allows contract to expire and sells maize locally:	
	Spot price	R810
	Less premium	-R25
	Net return	**R785**

This strategy allows the producer to take advantage of the higher local spot price without the offsetting of a loss of R15 in the futures market. The producer is also not subject to margin calls when futures prices rise above the strike price of R820.

When one considers the futures hedge, it may be argued that any price increase would be offset by an equal gain in the spot market. Although there would generally be a price increase in the local market, it may or may not equal the price increase in the futures market. The options contract would generally remain more profitable for the producer than the futures contract alternative, taken into account the associated price increase in the spot market. As long as the premium value is less than the loss on the futures contract, the option contract alternative would be most profitable in an uptrending market.

5.8.2 Downtrending market

Suppose grain carryover stocks from the previous crop year continue to overshadow and depress prices and the USA is expecting a bumper maize crop. The producer's outlook for the industry is bearish.

Alternative 1: Hedging with futures

Suppose that on 15 December, the July maize futures are trading at R750 per ton. The current bid price at the local elevator is R710 per ton. Fearing lower prices, the producer hedges maize by selling a futures contract. On 1 July, the producer closes the futures contract position by buying back the July contract that is now trading at R710 per ton. Upon delivery of the maize to the local market, the producer receives a spot price of R670 per ton. The producer's transactions and returns are set out in Table 5.7.

Table 5.7: Transactions and returns on futures hedging with price decrease

Date	Action	Value
15 December	Sell July maize futures	R750
1 July	Buy July maize futures	R710
Futures profit/(loss)		**R40**
1 July spot price	Sell to local elevator	R670
Futures profit/(loss)		R40
Net return		**R710**

The producer secures an assured price for maize on the futures market. Because prices have traded in the producer's favour, no margin calls were made. In addition, no premium values are associated with futures contracts.

Alternative 2: Option contract

Suppose the producer established an option contract in a downtrending market. The producer decides to purchase a R750 put option contract, which has an associated premium of R35 per ton. With futures prices trading at R710 on 1 July, the producer exercises this put contract. The producer would immediately offset this position by purchasing a July maize futures contract at the current R710. The producer's transactions and returns are set out in Table 5.8.

Table 5.8: Transactions and returns on a put option with price decrease

Date	Action	Value
15 Dec	Put option July maize	R750
	With premium cost	R35
1 July	Futures July maize	R710
	Spot price	R670
	Exercise contract and offset futures position:	
1 July	Sell July maize futures	R750
1 July	Buy July maize futures	R710
Futures profit/(loss)		**R40**
1 July	Spot price	R670
Futures profit/(loss)		R40
Net return		R710
	Less premium	R35
	Net return	**R675**

In this situation, the producer takes advantage of the R35 insurance plan. When prices move below the R715 break-even price (strike price - premium), the producer exercises this option. In this way, the producer profits on the futures market by R40 per ton. With this position, the producer is still free to take advantage of any price increases that occur. The hedging alternative is most profitable in this example of a downtrending market.

5.9 THE WINDOW STRATEGY WITH OPTIONS

There are several marketing strategies that use futures and options to establish a floor price and allow for upside price potential. The problem with many of these strategies is that the option premium is often higher than many producers can justify. One hedging strategy that sets a floor price and allows for limited upside price potential, while also reducing option premium costs, is referred to as a window.

The window strategy involves simultaneously buying a put option and selling a call option. The window, or the range between the floor price and price ceiling, is determined by the two strike prices of the put and call options. Table 5.9 shows how the price floor and ceiling price are derived.

Table 5.9: Floor price and ceiling price with a window strategy

Floor price	Ceiling price
Put strike price	Call strike price
- Put premium paid	- Put premium paid
+ Call premium received	+ Call premium received
+ Local basis (may be negative)	+ Local basis (may be negative)
- Brokerage/transaction costs	- Brokerage/transaction costs
= Window floor price	**= Window price ceiling**

The floor price is derived in a similar way to the purchase of a put option. The difference is that, with a window, the premium received from selling a call option must be taken into consideration.

The selling of a call option requires a margin account to be maintained because the option seller must maintain equity in the position. Call option premiums fluctuate, depending on market conditions. Margin calls are based on the change in the value of the call option premium (http://www.fiafii.org/tutorials.htm). Call option sellers should also be aware of the possibility that the option could be exercised. If the futures price is above the call strike price at expiration, the buyer of the call option has an incentive to exercise the call option. If the option holder chooses to do so, the option seller could be placed in a short position at the strike price, which is likely to result in a loss for the call option seller. When a call option holder exercises a call, SAFEX randomly assigns the short futures position to someone who has sold a call option. Any loss, which is paid through margin calls, will be roughly offset later by a higher cash price received when the grain is sold. However, a short-term cash flow problem could arise.

Several studies have explored the risk-return properties of options as they affect farm business. Many of these studies have found options to be a potentially useful method for stabilising returns (Heifner & Plato,1986; Curtis, Kahl &

McKinnell, 1989). In an efficient market, the producer's return from buying put options over a series of many years is expected to equal the return either on hedging with futures or on simply selling the crop at harvest, except for commissions (http://www.econ.ag.gov). Although returns are approximately the same in all three cases, hedging with either put options or futures reduces uncertainty about returns.

5.10 SWAP CONTRACTS

Commodity swaps are designed to assist producers to manage the risks associated with the prices of input resources such as energy, precious metals, and agricultural products. Swaps are a contractual agreement between two parties in which one party agrees to protect the other for a predetermined commodity quantity at an agreed price at a future date (Kolb, 1999). Both parties who agree that a specific cash or futures market will serve as the benchmark achieve price transparency, by which the contracts' gain or loss is measured. A fairly common procedure used in commodity swaps is to set the variable payment at the average price of the commodity over a specific period, rather than at the price of the commodity on the settlement date. This type of arrangement makes commodity swaps similar in principle to Asian options. An Asian option is an option whose payoff depends on the average price of the underlying asset or the average of the exercise price. The payoffs are determined by the average price of the asset during a period over the option's life.

A swap is or can be a portfolio or series of forward contracts. In contrast to forward contracts, with a swap there are multiple exchanges instead of just one. There are several reasons for using swaps. According to Ross *et al.* (1996) the benefits are the following:

- reducing funding cost;
- increasing debt capacity;
- enhancing the yield of assets;
- creating synthetic instruments; and
- modifying the exposure of cash flows.

5.11 OPTION SPREADS

An option spread involves the simultaneous purchase and sale of two options of the same type but with different strike prices, terms until expiration or both (Purcell, 1991). The spread trader becomes simultaneously long on one option contract and short on another option contract. An option spread is similar, in principle, to a futures spread in that offsetting positions are taken in the same market by buying and selling contracts with slightly different contract terms. When a futures spread is constructed, the difference in the long and short legs of the spread are the contract maturities. An option spread is more complicated than a futures spread, because option contracts can either be puts or calls, and may have different strike prices, in addition to having different terms until expiration. A producer normally engages in a bull spread if it is expected that the market could go up marginally, or is at least slightly more likely to rise than to fall. A bear spread is normally used in situations when the producer thinks that the market will fall marginally or is at least slightly more likely to fall than rise.

A spread between different contract months in the same commodity is called an interdelivery or intracommodity spread. These spreads consist of buying one month in a particular commodity, and simultaneously selling a different month in the same commodity. A spread between different commodities is called an intercommodity spread. These spreads consist of buying one commodity and simultaneously selling a related commodity. Examples would be buying silver and selling gold, or buying hogs and selling pork bellies. A spread of commodities in different markets are called intermarket spreads. Option spreads allow for exceptional variations in risk, from the small changes of the carrying charge spread to the highly leveraged intercommodity spread.

An option straddle is the simultaneous purchase of a put and a call option, or the simultaneous sale of a put and call option (Labuszewski, *et al.*, 1984). A straddle transaction is distinguished from a spread in that a straddle involves two long or two short positions in the same 'type' of option, that is, either a put or call, while a spread involves a sale and purchase of the same type of option. An investor may be inclined to buy a straddle where the investor is not sure of the direction in which the underlying commodity price will move, but the investor is confident that there will be a substantial move in one direction or another. An investor would sell or write a straddle when the underlying price is likely to remain static.

5.12 CONCLUSION

There have always been arguments around harvest time about the level of the Maize Board's prices, and, more recently, about the appropriate level of the Maize Board's floor price. Inevitably, the process has become highly politicised. After deregulation, producers now have an opportunity to set their own floor price, using their own initiative, without waiting for the outcome of a political tug of war between the National Agricultural Maize Producers' Organisation (NAMPO) and the Minister of Agriculture in South Africa.

When prices on the spot market and futures market are relatively low, it is a particularly sound time for buyers to insure themselves against a sudden leap in maize prices such as those after the 1997 harvest when the final carry-over stock differed dramatically from the forecast carry-over value. When spot and futures prices are relatively high, but the producer is not sure of the crop size, the options market allows a producer to guard against the possibility that prices will come down.

Options on futures contracts give the holder the right, but not the obligation, to take a futures position at a specified price before a specified date. The value of an option reflects the expected return from exercising this right before it expires and from disposing of the futures position obtained. Options provide protection against adverse price movements, while allowing an option holder to gain from favourable movements in the cash price. In this sense, options provide protection against unfavourable events similar to the protection provided by insurance policies.

Hedging, or the shifting of price risk from risk-averse to risk-seeking parties, is a function traditionally accomplished by using futures markets. Commodity option markets have a similar capacity to protect producers against adverse price movements. Option markets therefore represent an alternative hedging vehicle that offers unique advantages not available to the users of futures markets.

In the next chapter, a decision support system to manage the investment risk of grain producers is developed, based on the information gained from the literature review and the hedging mechanisms explained in the chapters.