An analysis of the funding of margin requirements for a grain hedging company

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ABSTRACT

Trading in agricultural derivatives in South Africa started since 1995 when white maize could be traded on the South African Futures Exchange. Today trading in agricultural products are common practice amongst grain producers and processors. This enables grain producers and processors to hedge themselves against price risk. The word “hedge” means to protect and in the volatile agricultural markets that were illustrated, it is of utmost importance for these market participants to protect themselves against these price risks.

Grain hedging companies are companies that assist these market participants in protecting themselves against price risk. For these companies to be able to hedge grain for grain producers and processors, they must undergo major risks in these volatile markets. It was statistically illustrated that variables like supply and demand, exchange rates, international grain prices and price parity have a direct impact on the price of white maize in South Africa. These volatile white maize prices as a result have an impact on the margin requirements to fund the hedging transactions for market participants. This stresses the demand for trading strategies to mitigate these risks associated with the funding of margin requirements.

This study used a trading strategy to assist the hedging company to manage the capital requirements to fund their margins on the South African Futures Exchange. The trading strategy that was used was the Slow Stochastic Indicator, which served as a framework to determine what the margin requirements would be when this specific trading strategy was used. The finding of the research is that by using this trading strategy when hedging grain for grain producers and processors, the margin requirement may depending on the situation decrease dramatically. Thus, decreasing the amount of capital required to fund these margins.

Keywords: Grain hedging, capital requirements, margin requirements, SAFEX, white maize.

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ABBREVIATIONS

CBOT	Chicago Board of Trade
CCP	Central Counter Party
CIF	Cost Insurance Freight
CME	Chicago Mercantile Exchange
FOB	Free on Board
IM	Initial Margin
JSE	Johannesburg Stock Exchange
KCBT	Kansas City Board of Trade
LCE	London Commodity Exchange
MTM	Mark-to-market
RSA	Republic of South Africa
RMCO	Risk Management Committee
SAFCOM	SAFEX Clearing Company
SAFEX	South African Futures Exchange
Sds	Standard Deviation
SICOM	Singapore Commodity Exchange
US	United States of America
VaR	Value at Risk
VM	Variation Margin
WM	White Maize
YM	Yellow Maize
ZAR	South African Rand

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1.1 Introduction

In the agricultural soft commodity sector there are different role players. These role players consist of producers, processors, input providers and service providers. For role players wanting to decrease their risks, there are companies specialising in hedging these risks. The meaning of the word “hedge” is to protect. A hedge is a method of decreasing price risk by holding a position in the commodities’ future market, while offsetting the position in the physical market (JSE, 2013:143). For a position to be effectively hedged, the number of positions in the commodities’ future market must equal the number of units in the physical market (Whaley, 2006:134). Different role players have unique needs in the agricultural sector and they fulfil distinct roles. These roles could be split up between producers, processors, merchandisers, speculators, exporters and importers. A hedging company is a company that enables the different role players (hedgers) to offset their risk through entering opposing positions on the financial derivatives market to hedge price risk. Hedging companies require capital to fund these positions on the agricultural derivatives market. Capital availability for funding these requirements is in most cases limited.

For the JSE to be able to do proper risk management for every unsettled position, margins are required. The JSE explains a margin as a “good faith deposit” (JSE, 2013:51). These margins are required to cover for the risk of losses on unsettled positions. A large amount of a hedging company’s available capital will always be captured in their margins, whether it is initial margins or variation margins. According to the JSE (2016:7) initial margin (IM) could be defined as the amount collected by the central counter party (CCP) to mitigate losses in the case of a default of the trading member. The IM is returned to the trading member on the closeout of their position (JSE, 2016:7). According to the JSE (2016:7) variation margin (VM) amounts to the cash movements relating to daily profits and losses on unsettled positions. The positions are daily mark-to-market to calculate the profit and loss, to be settled by midday on the following day (JSE, 2016:7).

The problem that exists for hedging companies is that large amounts of capital are captured in IM and VM. The availability of capital to fund these IM and VM also limits the number of transactions a grain hedging company can process for its clients. An example of this is that a grain producer or processor will consult with a grain hedging company. The client, being grain producer or processor, will then hedge himself against the price risk. This transaction to hedge oneself will result in IM and VM needed to be settled. In highly volatile seasons where volatile prices are seen, a hedging firm is not only exposed to large price movements that affect the VM, but the IM is also higher. This results in the funding of margins for the different clients that hedge out their risk, being highly capital intensive. With margin requirements rising in highly volatile markets and decreasing in periods of lower volatility, it could put pressure on the ability of funding these margins (Murphy *et al*., 2014:4). The effect of the funding of margin requirements can have enormous capital constraints and lead to bankruptcy in some cases. This stresses the importance of effective capital management to fund margin requirements. Margin requirements accommodate different variables that influence the market. One of these variables is volatility of markets and volatility is influenced by market information (Monk *et al.,* 2010:456). Other variables influencing market volatility are supply and demand, exchange rates and price parity. Price parity is the calculation of where the price of a commodity is, with regards to the import or export of a specific commodity. One of the reasons why supply and demand, exchange rates and price parity play a role in market volatility is because South Africa imports and exports grain. Once South Africa has ample supply of grain, the commodity price trades at levels closer to export parity. In seasons of drought or limited supply of grain the commodity price trades closer to import parity. Effective management of financial instruments like futures and options can lead to minimising margins. By using grain hedging strategies, financial instruments could be used to hedge the grain of clients at more optimal prices, resulting in lower capital requirements. Hedging strategies will make recommendations of when the hedging of grain should take place, thus ensuring more available capital in a business and directly managing risk and exposure of a company.

Broad academic research by the JSE explored the characteristics of margin requirements to identify the risk of losses on a portfolio and to ensure that losses can be abided (JSE, 2012:3). Research was also done on what role margins play in a hedging environment and the effects of margin on the economics of trading firms (Pirrong, 2015:9). Research done by Santa-Clara and Saretto (2009:393) states that high margins could keep participants out of the market, affecting the liquidity of the market. Their research assisted in identifying different risks that could lead to high margins and increases in margin requirements. According to the JSE (2001:7) these risk factors could be highlighted under the following categories:

- Price volatility risk - the more volatile the price of a commodity, the greater the chance of insufficient funding to deposit amounts of money in line with margin requirements.
- Spread risk - spreads are the difference between bids and offers. The greater the gap between the bids and offers, the more difficult it could be to buy or sell the underlying commodity.
- Liquidity risk - this could determine how liquid the trading of a commodity is. A lack of liquidity in the commodities market could have difficulty of exiting a position as a result.
- Impact cost risk - when high volume of positions are open relative to total volume and open interest of the day. This could be explained if difficulty arises when wanting to exit positions of commodity traded; and
- Model risk - arises when the model calculating margins fail to accurately quantify the risk.

Market movements in the opposite direction as the position held by the hedging company could force traders to exit positions at times when they could afford it the least (losing the most money). The use of hedging strategies could decrease these risks. By using futures and options a company that hedges commodities for clients could attempt to have a net terminal value of zero (Whaley, 2006:185). By having a net terminal value of zero the company attempts to have an equal amount of long and short positions, being it in futures, forwards or options.

Trading companies have different types of risks that influence the profitability of a company (Pirrong, 2015:8). Market risk is the possibility that the value of an investment could decline due to the influence of independent market factors (Gitman, 2011:208). Market factors include economic events, political events, and the effect of the climate. In effect market risk influence the funding of grain hedging positions. Derivative trading related losses are no new dilemma in the derivative trading industry. According to Wang (2016:1) at year-end 1993 derivative-related losses was up to $1.3 billion in the US. At that time MG Refining & Marketing Inc, hedged gasoline, diesel, and heating oil for clients (Wang, 2016:1). These hedging positions resulted in exposure to the physical market, and due to price movements resulted the firm not being able to fund its margin requirements. Due to market risk, companies hedging physical commodities for clients will experience large capital requirements to fund derivative positions. Hedging companies are not just influenced by risk but also availability of capital. One of the main capital constraining factors in such a company is margin requirements.

Companies hedging physical grain for clients are required to meet funding requirements of the specific hedge. Whether a future contract or an option is used to do the hedge, the company in most cases funds the initial and variation margin. A grain hedging transaction could be explained as follows: for a grain producer to hedge, the producer will sell his grain on the South African Futures Exchange. The counter party in this transaction will be the grain processor buying his grain on the South African Futures Exchange. For both parties a grain hedging company will process the transaction on the South African Futures Exchange, in effect having to fund the initial margin requirements (being a good faith deposit to protect the JSE from clients defaulting on the delivery of positions). Another type of margin, being the variation margin, will also be funded by the grain hedging company. All positions are settled daily, market movements are considered, and clients have to settle the capital gained or lost with regards to the movement of the market for the day. This funding of margin requirements, being initial or variation margins, is the main reason for capital constraints whilst hedging grain for clients.

Different research that was previously done focussed on several factors that influence margins. Hardouvelis and Peristiani (1992:1333) argued that margin requirements place official restrictions on the amount of capital being borrowed to investors by brokers for the buying of stocks. When a hedging company hedges a commodity for a client, an initial and variation margin is required, resulting in capital being held up in these margins. The larger the number of clients and hedging positions, the larger amount of capital will be required. This could result in restrictions on the number of hedges that the company can do for its clients. However, there have been minimal research to attempt how to accurately measure the funding of margin requirements in risk management literature (Wang, 2016:1). According to Wang (2016:1) to understand the risk of financing derivative positions, one must note that the maximum margin requirement may occur before the expiration of the futures contract. Researching the way hedging positions are managed, whether with futures or options, will contribute to the manner a company manages their risk and availability of capital. Identifying the factors influencing margins and working out solutions to effectively manage it can be a great asset to a hedging company. Although broad research was conducted by researchers and institutions, the effect of margin requirements on availability of capital has not been thoroughly researched.

The discussion to follow pivot around the following: Firstly, the agricultural derivatives market will be broadly discussed; from the history of the market to how the market works today. After obtaining a broad background of the market, more specific attention will be given to what influences the market and margin requirements, but also how it can be managed. These variables, influencing the market and margin requirements, will be examined statistically to determine the correlation it has on grain prices, more specifically the July white maize futures contract. The effects of hedging positions will be explained by making use of a hedging strategy to test validity of the research outcome. An experimental hedging book will then be used to run the hedging strategy on the July hedging month to ultimately support the hedging strategy a company can use to manage its margins.

1.2 Problem statement

By attempting to hedge grain for producers and processors with a capital requirement as close as possible to zero, participants will be able to trade derivatives in a sustainable way with minimal funding for positions required. Even though this is the ideal, substantial amounts of funding could be required to trade for grain producers and processors on the agricultural derivatives market. Margin requirements tend to rise in periods of crisis and market stress (Murphy *et al*., 2014:4). These periods of crisis result in market risk increasing. This results in substantial amounts of capital being captured in margins. Market risk does play an enormous role in price movements effecting margin requirements. Even though market risk was not the aim of the study it was not purposefully left out but briefly addressed in chapter 4.

1.3 Objectives of the study

The study is set out to determine whether there is trading strategies which will assist market participants in mitigating the capital requirements. Identifying the effect of futures positions on margins will also assist a hedging company in the planning of required capital. The effect of price volatility and the different variables affecting price volatility will be statistically examined to determine the effect it has on margin requirements. If an effective manner in attempting to have a capital requirement of zero could be determined, hedging companies could make use of these strategies to manage price volatility and margin requirements more effectively. The findings of this dissertation will provide grain hedging companies with insight in how to do hedging transactions for clients with the minimum capital required.

1.3.1 Primary objective

The general objective was to determine how to limit capital requirements of a grain hedging company.

1.3.2 Secondary objectives

- To determine what effect the use of a trading strategy has on capital requirements of a grain hedging company;
- To determine what the effect of economic variables like supply and demand, exchange rates, international grain prices and price parity have on market volatility; and
- To determine the capital required to fund margin requirements for a grain hedging company.

1.4 Scope of the study

The aim of the study was to identify if there are ways to limit the capital requirement of a grain hedging company. The industry in which the study took place was the agricultural industry and more specifically companies hedging grain for grain producers and processors. White maize was the grain that was focussed on during the study.

1.5 Research methodology

The research methodology was used to address the aim and objectives of the study. Chapter 1 to 4 will address the theoretical background of the study, whilst Chapter 5 and 6 will address the research objectives.

1.5.1 Literature / theoretical study

The research aims of this dissertation were attained through research done on the topic. This would be done by conducting a literature review into the different aspects of the study.

1.5.2 Empirical study

The empirical study was done to support the research objectives and to determine if there were ways in managing the funding of capital requirements in a grain hedging company.

1.6 Limitations of the study

Grain hedging companies focus on different fields of the agricultural industry. Some companies focus on only the buying and selling of grain, whilst other focus on doing speculative transactions in grain markets. This study only evaluated a certain field of hedging grain for clients, whilst sectors focusing on speculative transactions also have the funding of margins as a result. Although risk is an important factor to consider in overall commodity risk. For the purpose of this study all types of market risks were not explicitly considered. Due to the limitation requirements of a study of this nature not all types of market risks were studied. Reason for this is that the study focusses on how to manage margin requirements.

1.7 Layout of the study

Chapter 2 will give a broad theoretical background of the agricultural derivatives market. The background will explain how the agricultural derivatives market works and what the different trading mechanisms are. Investigation into what margin requirements are and how initial and variation margins work will then follow. This will aim to supply important background into the problem and clarify any uncertainty around how margins work and what effect it has on a company's funding requirements.

Chapter 3 will examine what the most important underlying variables are that influence market volatility. The underlying variables that will be discussed are supply and demand, exchange rates, the effect of international grain prices and price parity. The effect of the variables will be explained by determining the statistical correlation between these variables and the July white maize contract.

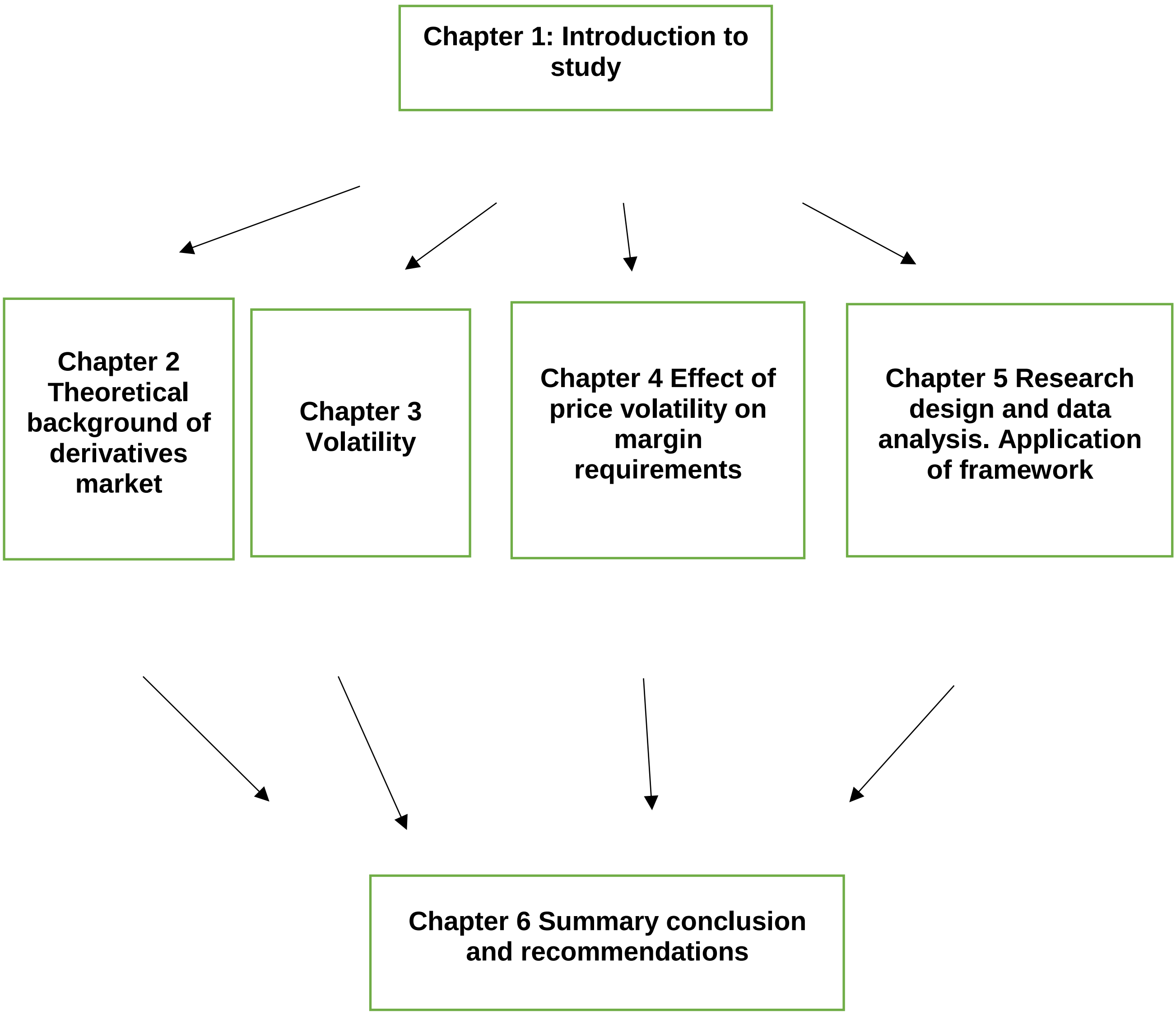
After knowing what effect the underlying variables has on the July white maize contract, **Chapter 4** will be used to study the effect of these variables on margin requirements. Attention would be given to previous research done on pricing strategies to help mitigate capital requirements. In this chapter the aim would be to develop a hedging strategy to help the farmer and the mill to develop a pricing strategy in which they could mitigate price risk and in the same time outperform the market.

Chapter 5 will present the research design and data analysis. A framework will be implemented, and the aim would be to decrease capital funding required to stand good for margin movements.

Chapter 6 will conclude with a summary in relation to the aims of the study. Concluding remarks and recommendations would be provided in this chapter on how to manage the funding of capital requirements.

The following diagram will illustrate the relationship between the different chapters.

Figure 1.1: Overview of study



Chapter 2: Theoretical background of derivatives market

2.1 Agricultural derivatives market

The South African Futures Exchange (SAFEX) is the market where agricultural derivatives tie with physical commodities. Commodities could be defined as tangible, unprocessed goods with value that could be further processed and traded (Van Wyk *et al.,* 2012:452). These commodities could be classified as hard and soft. Hard commodities are the non-perishable and non-renewable products, such as oil, iron ore and copper. Soft commodities are perishable and renewable plant and animal resources. South Africa is considered as a modest supplier of soft commodities in international terms and the soft commodities being produced comes from the agricultural sector. Agricultural commodities, currently traded on SAFEX, consist of white maize, yellow maize, wheat, soya beans, sunflower and sorghum (JSE, 2013:6). In years with normal production South Africa is a net exporter of maize, with the main exporting markets being Asia and South America (JSE, 2013:10). South Africa is a net importer of other agricultural commodities like soya beans, sunflower, wheat and sorghum (JSE, 2013:11).

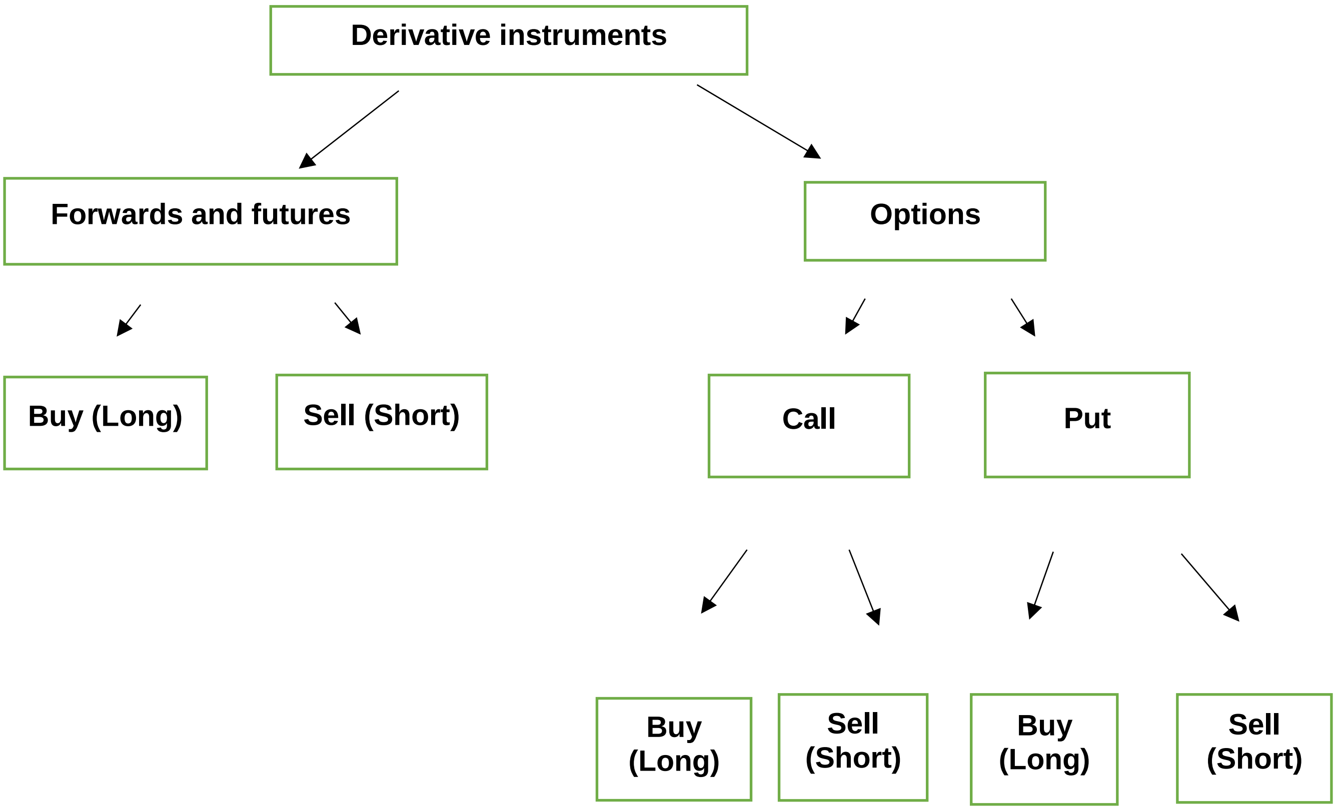
Derivatives are referred to as a group of instruments that derive their value from an underlying asset such as a commodity, share or currency (JSE, 2013:20). According to IAS 39 (2007) a derivative has the following three characteristics:

- Its value changes in response to changes in specific variables, like interest rate, price of a commodity, price of an instrument or foreign exchange rate;
- An initial net investment is required and is smaller than what would be required for other types of contracts with the same response to different market factors; and

- A derivative is settled at a future date of maturity and allows individuals or companies to hedge risks that are the result of factors they cannot control.

According to Van Wyk *et al.* (2012:391) derivatives could be grouped under the following headings, namely forwards, options, swaps and futures. A forward contract is a contract not traded on an organised exchange and the contract holds the obligation to sell or buy the underlining asset at a specific price on an agreed upon date (JSE, 2013:27). Futures contracts hold the obligation to sell or buy with a standard quality and quantity traded on an organised exchange (JSE, 2013:36). A swap is a contractual agreement between two parties to exchange a series of cashflows over a specified period (JSE, 2013:88). Option contracts hold the right to sell or buy a specific asset at a specific quantity and quality at a specific price within a specific period but not the obligation to buy the asset (Geyser, 2013:81).

Figure 2.1: Different derivative instruments



Source: JSE, 2013:45

South Africa is a relatively small role player in the global commodities market, but the exposure of global markets has an important effect on South African derivatives. Agricultural derivatives could be traded on various exchanges across the world. Table 2.1 lists several exchanges where agricultural commodities are traded.

Table 2.1 List of several exchanges where agricultural derivatives are traded

Acronym / Abbreviation for exchange	Name of Exchange	Web page with Exchange information
SAFEX	South African Futures Exchange	www.jse.co.za
CBOT	Chicago Board of Trade	www.cmegroup.com
KCBT	Kansas City Board of Trade	www.cmegroup.com
SICOM	Singapore Commodity Exchange	www.sgx.com
LCE	London Commodity Exchange	www.londoncommodityexchange.com

In South Africa exchange-traded derivatives trade on the Johannesburg Stock Exchange (JSE). The exchange subdivisions that trade on the JSE is the currency derivatives market, equity derivatives market, interest rate market and the South African Futures Exchange market (Van Wyk *et al.,* 2012:391). Derivatives trading on the South African Futures Exchange market serve as a platform for price discovery and to manage price risk in an efficient manner. Trading on a formal exchange is done through an operating system to create an environment where buyers and sellers can meet. This enables market participants to trade where all transactions are managed through a formal derivative clearing structure. The JSE provides clients with several international and local agricultural commodities. These products consist of white maize, yellow maize, wheat, soya beans, sunflower and sorghum (JSE, 2017).

2.1.1 History of agricultural derivatives market

Prior to 1995 the government controlled the market and prices of grain such as white maize, yellow maize, oilseeds, wheat and sorghum (JSE, 2013:21). Producers of agricultural commodities were only able to sell their products to government control boards and buyers could only buy by placing orders with the relevant boards (Krugel, 2003:51). In 1995 the market deregulated, and it led to the origination of a proper commodities trading platform. On this commodity trading platform grain producers, processors and traders could trade in a free market where supply and demand forces set the price of commodities. This resulted in the Agricultural Markets Division (AMD) of the South African Futures Exchange (Van Wyk *et al.,* 2012:460). The first two agricultural derivatives contracts listed were contracts for the trade of beef and potatoes. Unfortunately, the beef and potato contracts were removed and white maize and yellow maize followed in 1996. In 1997 the first wheat contract was introduced, and other grain contracts then followed. The South African Futures Exchange was then taken over by the JSE in 2001, but the SAFEX brand remained. SAFEX then evolved under the JSE to become the Commodity Derivatives Market (SAFEX CDM) and developed as an environment for the discovery instrument being used as the standard reference point throughout South Africa (Van Wyk *et al.,* 2012:460).

2.2 Margin requirements

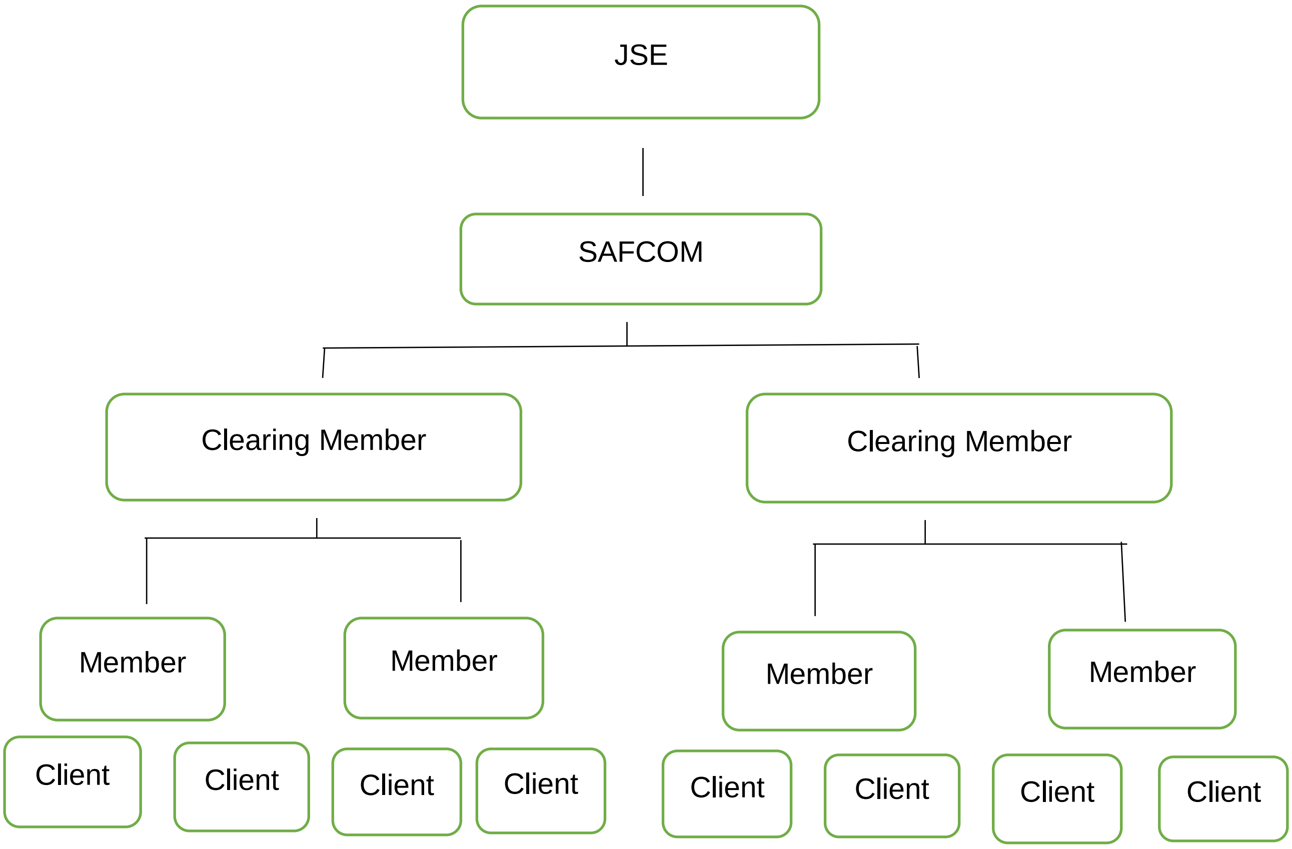
It is the responsibility of the JSE that the daily derivative market actions are handled efficiently and with the highest ethical standards (JSE, 2013:51). The detail working of margin requirements could be explained in the following way. At the JSE the risk management philosophy comes in at “You stand good for your client”. The JSE provides facilities for the trading in agricultural derivatives to take place. Agricultural derivatives are traded on the JSE through having a buyer (long position holder) and a seller (short position holder). For every buyer there must be a seller and vice versa. This results in initial margin and variation margin needed to be settled daily. Initial and variation margins are the security that gets paid to the JSE daily to protect the JSE from members defaulting on their contracts with opposite parties (buyers and sellers). Transactions that are traded per day are then processed by the JSE and margins due are determined.

Facilitators in this area are the clearing members. The role of the clearing members is that they stand good for their clients. Clearing members have a responsibility against the JSE to settle all margin requirements of their specific clients, therefore leaving the JSE with minimal risk of default from clients (JSE, 2013:51). Currently the clearing members for the JSE are all the major banks (JSE, 2013:51). Different parties have the obligation to fulfil their commitments under exchange traded derivatives; these commitments are secured by margining arrangements (Van Wyk *et al.,* 2012:391). At the end of each trading day the accounts of the different members are settled and the IM and VM must be paid by 11:00 the following day. Settlement of accounts is done by paying the initial margin for new transactions for the day and the settling of the profit or loss made for the day (variation margin). The responsibility of collecting these payments lies with the clearing members. They then collect it from their clients, who are in effect responsible for the hedging transactions done. Clients of a clearing member consist of hedging companies hedging grain.

Initial margins are therefore required from the members to cover these positions. These margins normally consist of at least two days of market risk and can be amended as need be. Historical price history and volatility of historical contracts are used to determine the initial margins required to enter a contract. As market prices change, payments are due to restore the margin at the clearing member. These payments are called variation margins (Tomek, 1985:149). Once the variation margin exceeds the initial margin, a margin call results. A margin call in effect requires capital from the grain hedging company to fund these margin calls.

Initial margins normally represent the view of the exchange (Edwards, 2000:48). In highly volatile markets initial margins increase. An example of this was the increase in initial margins on SAFEX since the start of the 2016 drought. Due to the large price movements on SAFEX the risk of members defaulting on contracts became so high that the JSE increased initial margin requirements from R12,400 per July white maize (WM) contract to R65,300 per July WM contract. This had devastating consequences for hedging companies having to fund these margins. Other examples were when the Singapore Futures Exchange (SIMEX) doubled the initial margin following the Nick Leeson Barings scandal (Edwards, 2000:48). The “Silver Thursday” scandal in 1980, when the Hunt brothers tried to corner the global silver market (the silver market is the exchange where the commodity silver is traded), is another example of a margin call putting not only the investor, but also the brokerage firm at risk (Business Insider, 2016). These are good examples of incidents that led to volatile market periods resulting in an increase in margin requirements.

Figure 2.2: JSE Risk Management Structure



Source: JSE, 2013:51

The JSE derivatives market uses the SAFEX Clearing Company (Pty) Ltd (SAFCOM) as its clearing house (JSE, 2013:51). The function of the clearing house is to process all the trades executed daily. It acts as the counterparty to all transactions done. The clearing house also undertakes the contractual relationship between the different sellers and buyers (Van Wyk *et al.,* 2012:390). Profit and loss are determined daily at closing (this is done at the end of each trading day). The process of revaluing the positions is referred to as mark-to-market (Van Wyk *et al.,* 2012:390).

2.2.1 Initial margin

According to SAFCOM the responsibility of setting margin parameters with regards to the extent of market moves lies with the Risk Management Committee (RMCO) (Etheridge, 2013:2). The risk parameter is measured in standard deviations since the introduction of margin methodology. The standard deviation (Sds) is set at 3.5 Sds (Etheridge, 2012:3). Initial margin in the agricultural derivatives market is based on a historical Value-at-risk (VaR) methodology using a 99.7 % confidence interval and a 4-year lookback-period, which includes a 1-year stressed period (Du Preez, 2012:3). The VaR is the maximum loss incurred given at the given probability using a 99.7 % confidence interval. In the case of a larger price move than the 99.7 % confidence interval, initial margin will be insufficient to cover losses. Should this appear, SAFCOM could introduce an “intra-day margin call” resulting in the payment of funds from the clearing bank to SAFCOM with immediate effect (Etheridge, 2013:3). The clearing member will then collect the funding paid to SAFCOM from the member party.

An example of the initial margin calculation could be explained as follows: The agricultural derivatives market makes use of a one day holding period of the initial margin. If the initial margin of 1 contract of white maize is R20,000 at a one day holding period and a 99.7 % confidence interval, there is only a 0.03 % chance that the value of the white maize contract will move more than R20,000 from one day to the next day.

The calculation of initial margin could also be influenced by various positions in different expiry months and positions between different commodities. Each expiry month has different parameters defining its risk parameters (Du Preez, 2012:6). This enables members to aim to optimise the use of capital to minimise the amount of capital required to fund these positions.

2.2.2 Variation margin

Margins are reassessed daily. At the end of each trading day the values of all open positions are assessed according to the mark-to-market (MTM). The MTM could also be referred to as the settlement price at the end of each day (JSE, 2012:2). Calculation of the settlement price will rely on a random sample selected any time in the last 5 minutes of trading at the discretion of the exchange (JSE, 2012:2). The profit or loss on all open positions are then calculated and must be settled by 11:00 the following day in relation to intraday margins.

2.2.3 Example of the cash flow of a short position holder

The example below illustrates the detail of the margining requirements of a SAFEX July WM contract.

Table 2.2: Example of the cash flow of a short position holder

			Seller			Buyer		
Date	**Futures price (R/ton)**	**Change (R/ton)**	**Daily cash Flow**	**Margin top up**	**Total margin account balance**	**Daily cash Flow**	**Margin top up**	**Total margin account balance**
10 Jul'17 Trade	2000		IM -34000 / VM 0			IM -34000 / VM 0		
10 Jul'17 MTM	2000	0			34 000			34 000
11 Jul'17 MTM	2070	70	VM -7000	-7000	34 000	VM 7000		41 000
12 Jul'17 MTM	2040	30	VM 3000		37 000	VM -3000		38 000
13 Jul'17 MTM	1980	60	VM 6000		43 000	VM -6000	-2000	34 000
14 Jul'17 Position	1970	10	VM 1000		44 000	VM -1000	-1000	34 000
closed								
Total net cash flow			**Beginning balance**	IM -34000 / VM 0		**Beginning balance**	IM -34000 / VM 0	
over period			**Total margin**	44 000		**Total margin**	34 000	
			Margin top up	-7000		**Margin top up**	-3000	
			Profit	3 000		**Loss**	-3000	

In the example above a client of a clearing house member decides to sell 1 July 2017 white maize (WM) contract (100 metric tonnes of WM). At the end of day 1 the market closed at R2,000/mt, which equals the selling price of R2,000/mt. This results in only the IM that must be paid; R34,000 per contract by 11:00 the next day to the clearing bank of the member. The margin account then stands at R34,000. On day 2 the market closed R70/mt higher than the previous day, resulting in a payment of VM (margin call) of R7,000 per contract (i.e. R70 x 100mt contract). The market account then still stands at R34,000, because it was funded with the R7,000 VM. On day 3 the market closed at R30/mt lower, resulting in an income of R3,000 per contract. The market account then stands at R37,000. This is due to the income of R3,000 that was generated by the market that closed lower. On day 4 the market closed at R60/mt lower, resulting in an income of R6,000 per contract. The market account then stands at R43,000. Due to the decline in the July 2017 WM price, the market account increased with the R6,000 profit. On day 5 the market closed at R10/mt lower, resulting in an income of R1,000 per contract. The market account then stands at R44,000. In the total net cash flow for the past 5 days the seller of the one July 2017 WM contract would have realised a profit of R3,000 per contract and the buyer (opposite position holder) would have realised a loss of R3,000 per contract. This scenario could also be explained from the long position holder; the net effect will stay the same because the amount of profit that one party makes is lost by the counter party.

2.3 Conclusion

In this section the history of the South African agricultural derivative markets was discussed. Agricultural marketing moved from being a government regulated environment to a more open system. The agricultural derivatives market plays an important role in price discovery and market efficiency in the South African Futures Exchange. The working of the JSE was explained at the hand of the JSE risk structure. Out of this explanation a detailed discussion about margins and margin requirements followed. IM was explained as the amount of capital collected by the CCP to serve as security for the JSE if a trading member defaults on a contract (JSE, 2016:7). VM was, as the funding of the daily cash movements, relating to profits and losses on unsettled positions. In this discussion the margining of a short position holder was explained to create a basic understanding on the margining system.

Chapter 3: Market volatility

3.1 Underlying variables influencing market volatility

Volatility is a measure of possible movement or variation in an economic variable (Poit-Lepetit & M'Barek, 2011:13). Earlier research indicated that volatility do affect the behaviour of the Federal Reserve when determining margin requirements (Officer, 1973:434). In relation to the above statement it was also indicated that high margin requirements reduced market volatility. A reduce of volatility could be explained by the number of contracts traded on SAFEX that decreased. This is due to the availability of capital to fund these hedging positions. It could also be related to the South African Futures Exchange due to volatility having a large impact on the calculation of IM. Price as an economic variable changes as an adjustment to different market circumstances. Agricultural commodity prices are known for highly volatile price movements. This is due to many factors influencing market volatility. Agricultural derivatives market is a dynamic market constantly changing, resulting in in-depth knowledge of the different variables influencing these markets.

Previous research done indicated that a lack of knowledge in the agricultural commodity market could lead to inefficient marketing strategies. It also indicated that not all market participants have knowledge about agricultural derivative markets (Venter *et al.,* 2012:3). Volatility associated with different variables influencing volatility is also difficult to interpret and is associated with price risk.

The information required to optimise the interpretation of these variables is attained through interpreting large volumes of economic and political data (Ayankoya *et al.,* 2016:483). These different variables such as supply and demand, exchange rates, international grain prices and price parity influence price movements.

3.2 Market volatility and price movement

According to Jordaan *et al.* (2010:320) past trading activities in the agricultural derivatives market influence future trading activities. Therefore, it is important to consider all factors influencing local South African grain price movement. As discussed, the main factors influencing market volatility are:

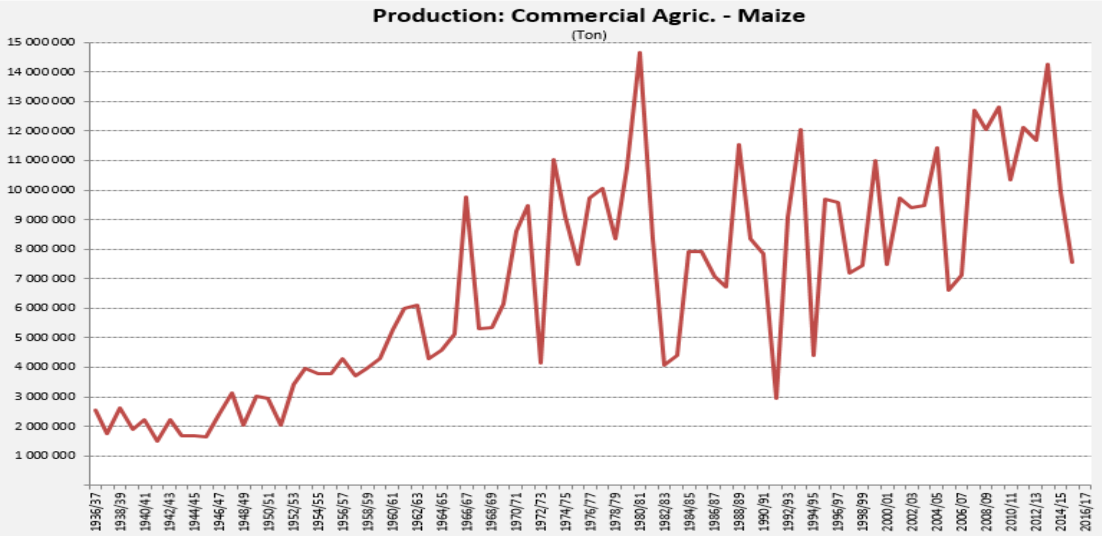
- Supply and demand;
- Exchange rates;
- International grain prices; and
- Price parity.

World grain prices and domestic grain prices of major agricultural commodities have shown volatile prices. Major factors influencing these volatile price movements include changes in production affecting the supply of grain and changes in consumption affecting demand. These changes in supply and demand affected local maize prices and the cost of production. Extreme weather patterns also played a key role in local grain price discovery.

3.2.1 Supply and demand

The interaction between supply and demand under normal conditions derives the price of agricultural commodities (JSE, 2013:195). Supply and demand are considered fundamental components of the market. In 2014 South Africa produced a surplus in maize and is considered as a net exporter of grain. Main countries to which South Africa export grain during years of surplus production are Taiwan, Japan, South Korea and African countries like Lesotho, Botswana, Namibia, Mozambique and Swaziland (JSE, 2013:10). In 2016 a major drought caused South Africa to be a net importer of maize and South Africa imported 2.2 million tonnes of maize.

Graph 3.1: Commercial agricultural maize production



Source: Sagis, 2017

In the above graph, the amount of hectares maize planted is illustrated. This indicates the variability of maize hectares planted between the different production seasons and how it changes from year to year. Focussing on the supply side of the supply and demand analysis, the significant influencing factors are maize production and inventory carried over from the previous year. This could be explained by making use of the stocks-to-usage calculation. What the stocks-to-usage measures is the amount of surplus grain carried over from the previous years as a percentage of the total demand. Stocks-to-usage as a percentage is very effective in illustrating the amount of surplus grain, because it is illustrated as a percentage and not tonnage; in effect illuminating the effect of certain years of less demand than others. The demand side of the analysis focuses on the amount of maize consumed in a year. South Africa uses on average 47.9% of maize for human consumption and 51.9% of maize for animal consumption on a yearly basis (Sagis, 2017).

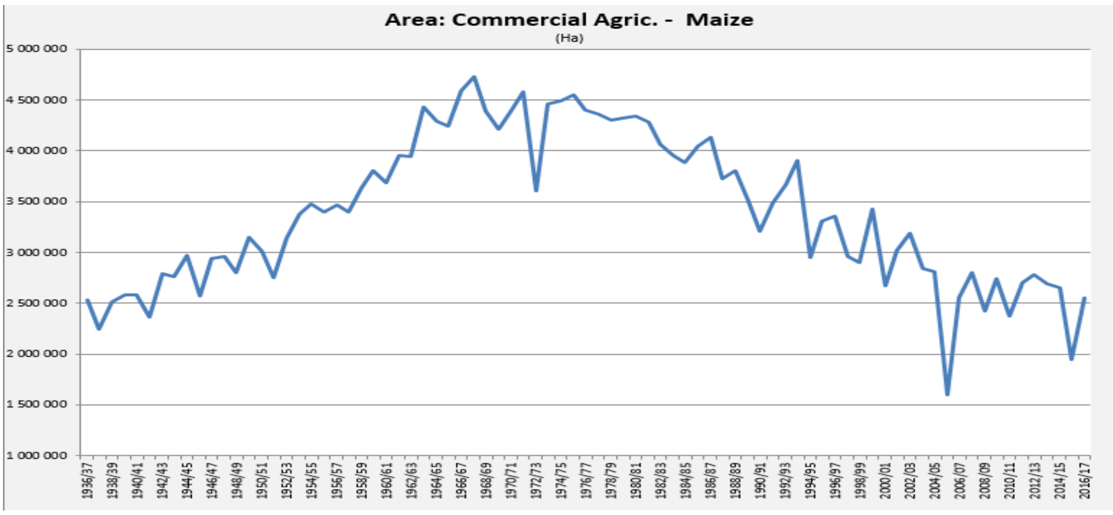
Table 3.1: Example of factors contributing to supply and demand analysis

Factors contributing to supply and demand			
Supply		**Demand**	
Decrease in supply	**Increase in supply**	**Decrease in demand**	**Increase in demand**
Increase in input cost for example fertilizer, fuel and seed.	Optimal weather conditions.	Unaffordability of food for developing communities.	Growth of population.
Water restrictions and environmental constraints.	Increase in hectares planted.	Supplementay food products.	Economic growth.
Extreme weather conditions for example droughts and floods.	Advance technology.		Increase in meat consumption.

Source: Filimon, 2011:6

Areas planted for grain production per year is one of the determinants of the tonnage of grain produced. Farmers are the main decision makers determining the hectares of grain planted. Production decisions of farmers are done with consideration of the factors indicated in the above table. The table clearly indicates how the several factors will result in an increase and decrease in supply and demand.

Graph 3.2: Commercial agricultural area planted with maize



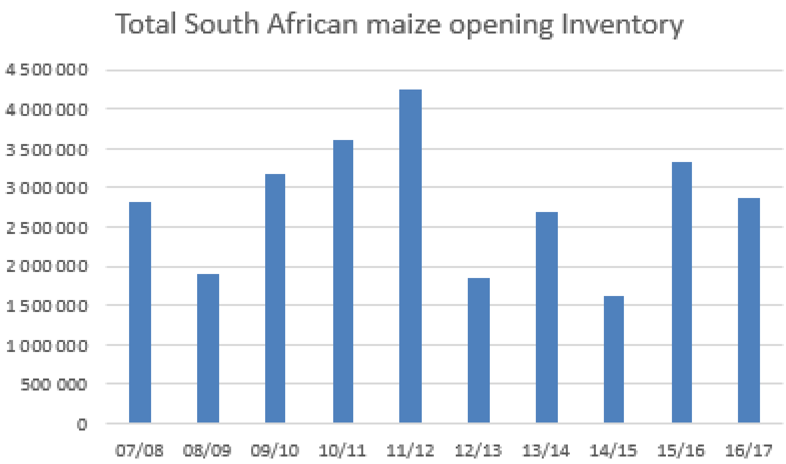
Source: Sagis, 2017

In the above graph, the area planted with maize is indicated. This indicates a difference of up to 3 million hectares between the year with the smallest area planted and the year with the most number of hectares planted with maize. Factors influencing these decisions of farmers could range from production cost of planting maize, current maize prices and weather. Weather is one of the major determinants of supply and demand. Due to agricultural products being dependent on rain, weather plays an enormous role in the supply of grain. Weather plays its most critical role during the planting and pollination stages of grain. In years of drought, as experienced in the drought of 2016, weather dramatically influences the supply of grain. Excess demand puts upward pressure on price until it reaches a higher equilibrium (Filimon, 2011:2). For example, optimal rain will increase the supply of grain, resulting in lower prices. Demand is mostly determined by the need for human and animal consumption.

Yield also plays a significant role in the supply of grain; it measures the crop output per unit area of land under cultivation (Filimon, 2011:14). Rainfall, cultivation and fertilisation directly influence the yield of grain.

The size of the grain inventory carried over from one season to the next production season also plays a role in the supply of grain.

Graph 3.3: Total South African maize opening inventory



Source: Sagis, 2017

In the above graph, the amount of opening inventory in maize is illustrated. In years when the maize opening inventory is below average, it will have an increase in prices as a result. A comfortable opening inventory will be anything between 2 and 3 million tonnes, resulting in enough maize for the demand of between 60 to 80 days.

3.2.2 Exchange rate

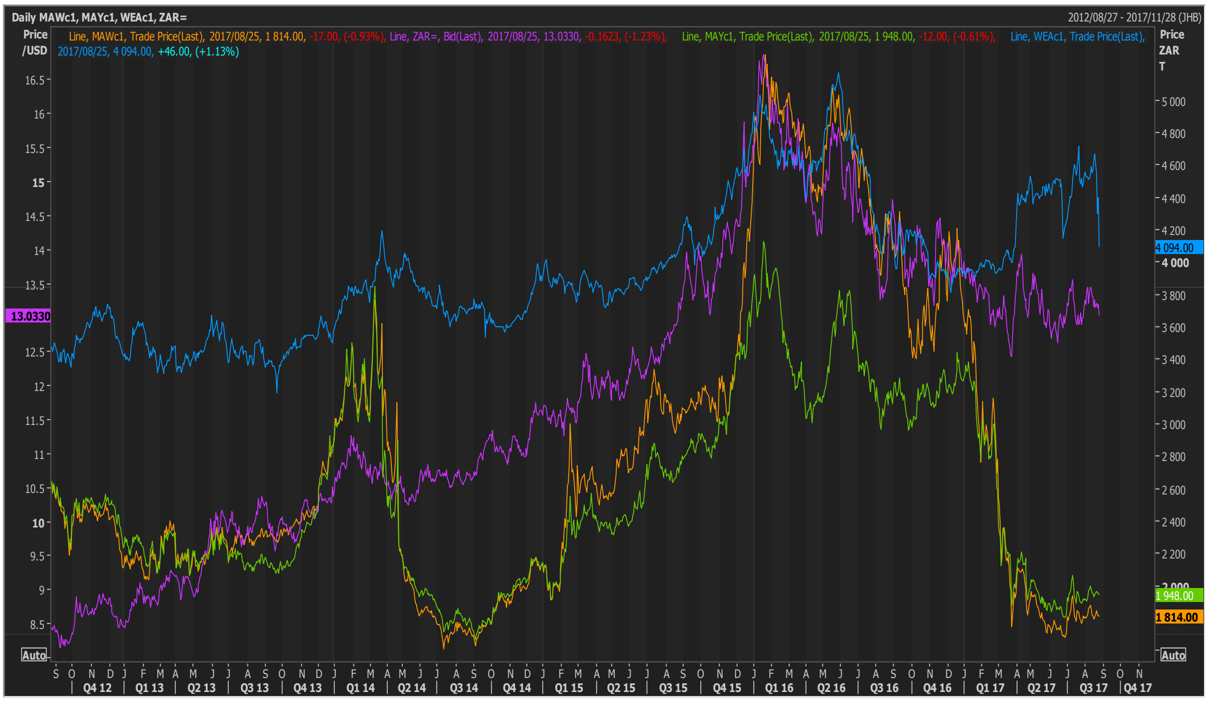
Since South Africa is a net exporter of maize and a net importer of wheat, the exchange rates of major currencies play an enormous role on grain production. In the graph below the volatility of the South African Rand / Dollar exchange rate is illustrated. The exchange rate undergoes major fluctuations. These fluctuations could be influenced by economic factors or political factors. Periods of political instability over the past 2 years are indicated with the red line, for example during the fourth quarter of 2015 the South African president, Jacob Zuma, made reshuffles in his cabinet. The South African Rand went through volatile periods. These volatile movements in the rand have a major effect on agricultural commodity prices as well as on production costs of agricultural commodities.

Graph 3.4: Exchange rate movements in major currencies

Source: Thompsons-Reuters, 2017

The graph below illustrates the correlation between agricultural commodities and the rand. As seen in the graph, the Rand and US dollar exchange rate plays an enormous role in price volatility. As the exchange rate becomes more volatile, dependent markets react to these changes.

Graph 3.5: RSA white maize, RSA yellow maize and RSA wheat prices compared to ZAR / USD



Source: Thompsons-Reuters, 2017

The purple line indicates the Rand / Dollar exchange rate, illustrating how white maize (yellow line), yellow maize (green line) and wheat (blue line) reacted to these volatile price movements. Exchange rates not only have a major effect on price discovery and market volatility, but also influence input costs for farmers producing grain. All imported fertiliser, machinery and chemicals used in the production of grain become more expensive as the Rand weakens. The other side of a weakening currency is the effect of South African grain being more competitive in major export markets. According to Sihlobo (2017) statistical evidence illustrates a strong correlation between the Rand / Dollar exchange rate and grain prices. Sihlobo (2017) also states that there is a 0.5% movement in the price of grain for every 1% change in exchange rate.

3.2.3 International grain prices

International grain prices have a major effect on the South African grain prices. The main reason is that South Africa must either import grain or export grain depending on the availability of the different agricultural commodities. The main drivers of international grain prices are international supply and demand of grain. The United States is one of the world's largest producers and exporters of maize. The US produces 40% of maize in the world, therefore world agricultural commodity prices tend to derive its value from US markets.

Graph 3.6: 10-year price movements in the CME corn price

Source: Thompsons-Reuters, 2017

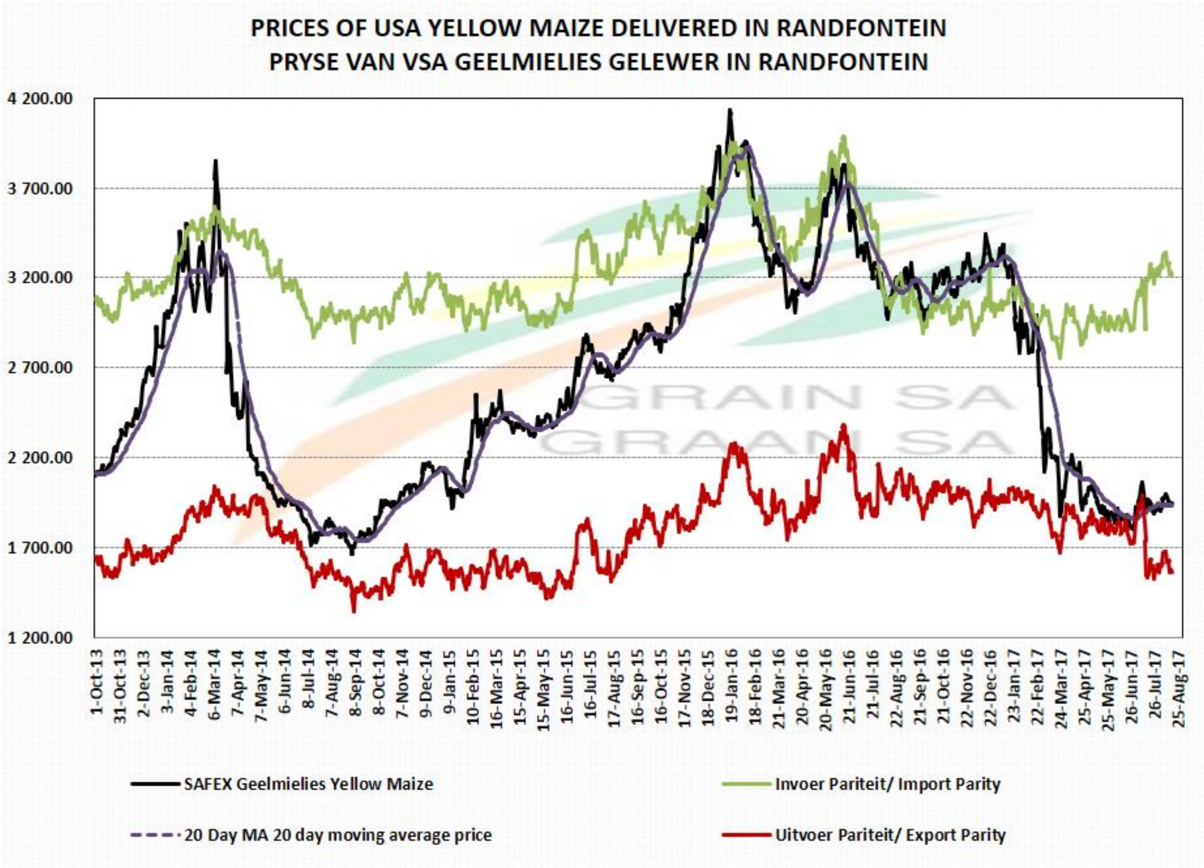
The graph above illustrates the 10-year price movements in the Chicago Mercantile Exchange CME corn prices. In 2007/2008 the world economic recession increased corn prices. Following this in 2009 ethanol production in the United States started to support grain prices due to an increase in demand for corn. This was followed by a drought in 2010 to 2012, after which the US had record corn crops for the proceeding 4 years.

3.2.4 Price parity

Price parity of grain reflects the two extreme points between importing grain and exporting grain (JSE, 2010:192). An effective market will have the ability to predict, with regards to supply and demand, whether it should trade at import or export parity. The domestic price of maize will trade between these two levels. Import parity refers to the reference price of maize on another exchange from where maize could be imported to South Africa. These prices are usually obtained from North and South America where the bulk of maize is produced. Import parity illustrates the highest level of local maize prices, because if maize prices go above import parity, maize imports could be booked. If prices do go above import parity, local processors would be forced to import maize as it could be imported cheaper than local maize prices. Import parity is calculated for delivery in Durban, Cape Town and Randfontein (JSE, 2010:193).

Export parity is an illustration of the lower level of domestic maize prices. Export parity is calculated as a delivered price of grain in a port in another country willing to buy grain. As exporting of grain opportunities arise, demand will be stimulated, which will in effect have higher prices as a result once the ample supplies are in equilibrium. The main variable with regards to import or export parity is the amount of stock available in the country.

Graph 3.7: Parity prices of USA yellow maize delivered in Randfontein



Source: Sagis, 2017

The above graph illustrates how the black line, which is the SAFEX yellow maize price, moved between import and export parity. During 2016 South Africa had one of its worst droughts resulting in yellow maize prices trading at import parity. In the following year (2017), South Africa had a record maize crop resulting in ample maize supplies and grain prices trading at export parity.

Free on board (FOB) prices of other countries importing or exporting grain and cost insurance freight (CIF) prices of other countries willing to import or export grain are determining the import and export price of grain. According to Investopedia (2017) the difference between FOB and CIF prices is where the buyer of the product assumes responsibility of the product. With CIF agreements insurance and other costs associated with the transit of the product are the responsibility of the seller. FOB agreements relieve the seller of all responsibilities from when the product is shipped. FOB prices and several other components are used to calculate import and export parity. The FOB prices of different countries are used to calculate import and export parity to and from the different destinations.

Graph 3.8: No 2 yellow corn Free on Board (FOB) United States Gulf price

Source: Thompsons-Reuters, 2017

The above graph illustrates the FOB price of No 2 yellow corn in the United States Gulf. As mentioned earlier the US had a record corn crop from 2014 up to 2016. This resulted in a low FOB price in No 2 yellow corn in the United States Gulf. During this period, the US grain market was very competitive in the world export markets and influenced import and export parity of other grain producing countries.

3.3.1. Price movement of July SAFEX price the past 6 years

A SAFEX futures contract has a standardised contract size and delivery month. The delivery months for white maize contracts traded on SAFEX are March, May, July, September and December (JSE, 2010:36). Below are the detail specifications of a SAFEX WM futures contract.

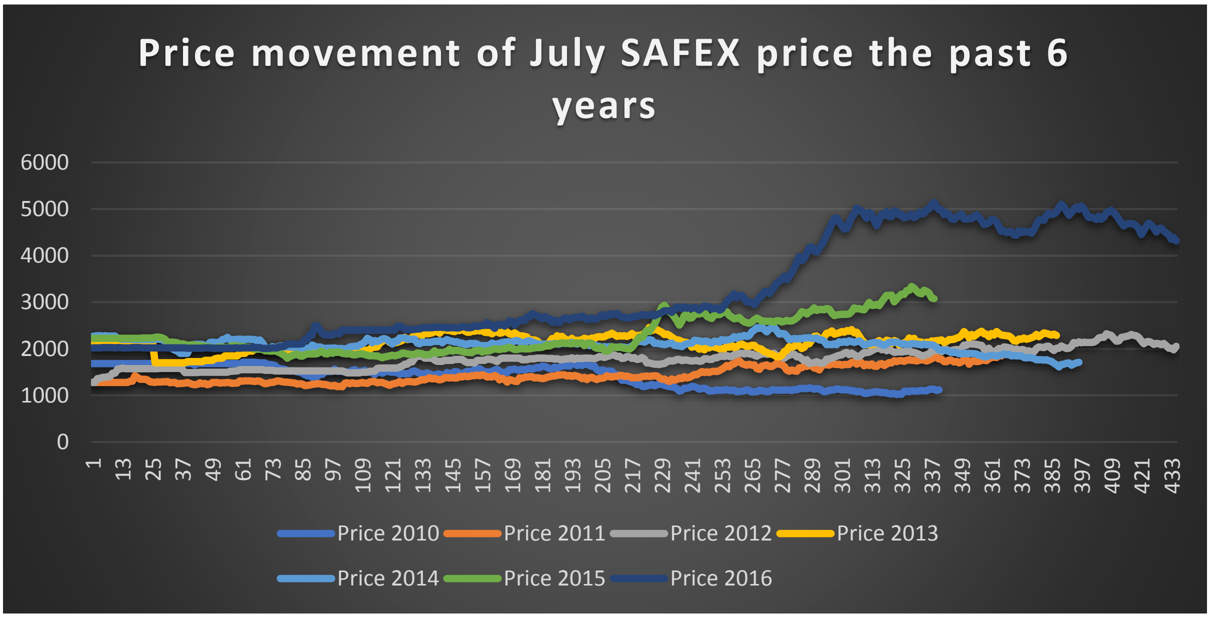
Table 3.2: SAFEX WM futures contract specifications

SAFEX WM Contract Specifications	
Trading Hours	09:00 - 12:00
Trading Code	WM
Commodity Specifications	White Maize with the grade of
	WM1, graded by the SA grading regulations
Contract size	100 metric tonnes
Date of expiry	12:00 on the last business day of specific delivery month.
Quoted	Rand/tonne
Minimum price movement	R0.20/mt
Maximum price limits	R100/mt with extended limits of R150/mt.

Source: JSE, 2013:27

For this study, the July futures contract will be examined. The July futures contract falls in the harvesting period in South Africa; this is also where farmers and millers buy or sell most of their white maize. Due to the substantial number of hedge transactions on the July futures, many factors are priced in. These factors include weather risk to produce a crop, exchange rate risk, international grain prices and many other factors. July is also the period when the US maize crop pollinates, resulting in volatile market movements.

Graph 3.9: Price movement of the July SAFEX price the past 6 years



Source: Thompsons-Reuters, 2017

The price volatility on the July SAFEX WM futures contract is indicated on the above graph. This graph illustrates the effect that the underlying variables like supply and demand, exchange rates, international grain prices and price parity have on the July SAFEX WM futures contract. As indicated by the 2015 WM price (green line) and the 2016 WM price (blue line) it could be seen that in periods of uncertainty the market drastically reacts. In both these two years the market reacted on droughts that started over the planting period in December. These droughts continued up until January and February when pollination should have taken place. It clearly illustrates that the market reacts to extreme weather conditions. In years when there were no extreme weather threats, the market wasn't so volatile and traded between prices of R1,500/mt and R2,400/mt; this could be seen when looking at the 2010 (light blue), 2011 (orange), 2012 (grey) and 2013 (yellow) SAFEX WM futures prices.

3.3.2 Price movements since the arise of the futures market in South Africa

Before 1995 the agricultural commodities prices were regulated very strictly; this resulted in grain prices with very little price volatility. From 1995 onwards, agricultural commodities were traded on SAFEX. Previously variables were there but regulation prohibited price movement. In years with little uncertainty it could be seen in the graph below that market prices did not trade very volatile. This could be seen in the period from 1998 up to 2002. Thereafter different variables influenced the SAFEX WM price; an example of this is the world economic recession in 2007 and 2008. The production of ethanol in the US also supported US grain prices resulting in higher WM prices. Periods of record crops and extreme droughts in world markets as well as local markets then followed. The graph below illustrates a price difference of up to R4,500/mt between the lowest and highest prices.

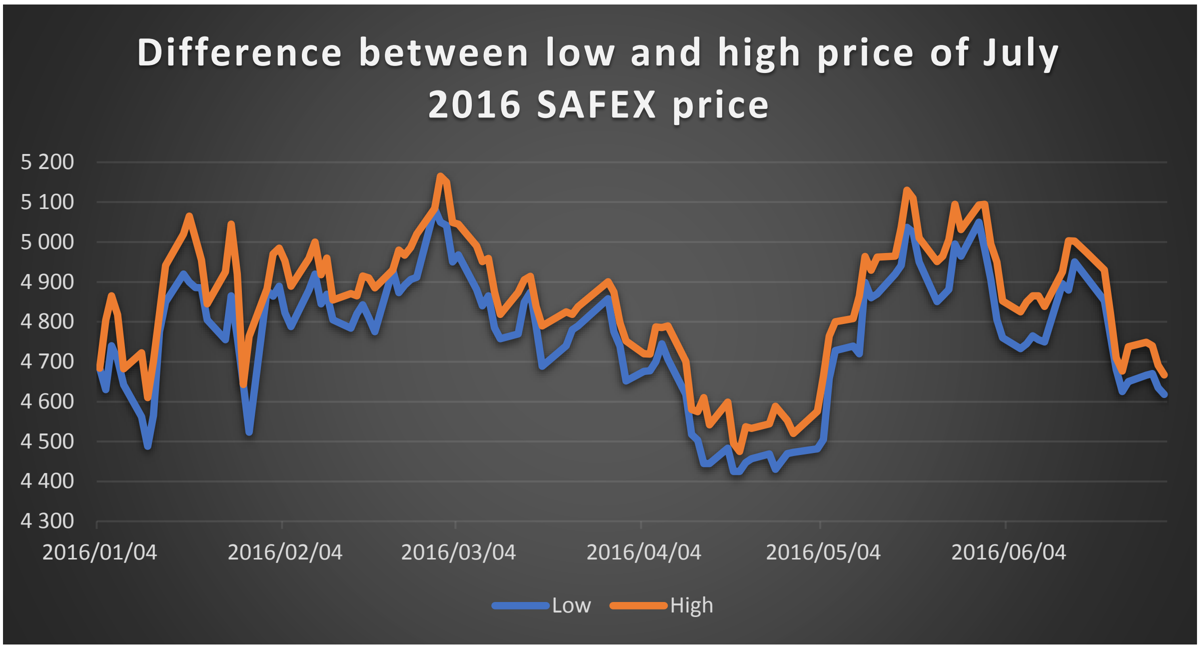
Graph 3.10: Price movements since the arise of the futures market in South Africa

Source: Thompsons-Reuters, 2017

3.3.3 Daily price movements over the SAFEX July 2016 White Maize (WM) futures contract

The graph below illustrates the price difference on the SAFEX July 2016 WM futures contract. During 2016 there was an average price difference between the low and the high of the SAFEX July 2016 WM futures contract of R86/mt. This illustrates how volatile price movements can get. The lowest July 2016 futures WM price was R4,425/mt and the highest July 2016 WM futures price was R5,165/mt.

Graph 3.11: White maize low and high prices for the July 2016 WM SAFEX price



Source: Thompsons-Reuters, 2017

The above information supports the research problem, namely that these large price movements result in large capital requirements to fund margin requirements. Statements made that large price movements result in higher volatility and therefore resulting in larger initial margin requirements are also supported when looking at how volatile the July 2016 WM SAFEX price was. In volatile periods the difference between high and low prices increases.

3.3 Conclusion

Different variables influence the volatility of white maize prices. A fundamental understanding of these variables could assist a grain hedging company in mitigating risks associated with the capital requirements of a grain hedging company. These variables consist of supply and demand, exchange rate, international grain prices and price parity. In Chapter 3 the different variables were discussed to create a theoretical understanding of the effect it has on grain prices, especially the July WM futures contract. The next chapter will focus on determining what the effect of these variables is on margin requirements.

Chapter 4: Effect of price volatility on margin requirements

4.1 Background into risk of extreme market movements in grain hedging

Different risk management methods were researched in previous studies. According to a study done by Ying Wang in 2016 he used advance risk measuring models. A model that was used to measure the dependence of corn, wheat and soybeans was the Vine copula model (Wang:2016:1). The study illustrated the important effect extreme price movements in the future market has on risk management in agricultural commodity markets. When focussing on the background of previous hedging companies that went bankrupt due to the inability to fund their margins, focus will be given to both South African companies and international companies. Starting with South African companies, a good example will be the case of The JSE Securities Exchange South Africa v Joint Municipal Pension Fund v Deloite & Touche and others. In this case JSE Securities Exchange South Africa v Joint Municipal Pension Fund v Deloite & Touche and others (2007), WJ Morgan & Associates (Pty) Ltd, a member of the JSE, was appointed to trade on behalf of the fund on a discretionary basis. WJ Morgan & Associates (Pty) Ltd then bought an enormous number of agricultural commodities on SAFEX. The positions that WJ Morgan & Associates (Pty) Ltd bought are considered long positions.

Example: WJ Morgan & Associates (Pty) Ltd purchased (long position) 1,000 tonnes of white maize futures contracts on the SAFEX July expiry month. This was done as a speculative transaction to generate profit for the Joint Municipal Pension Fund. To optimise profits WJ Morgan & Associates (Pty) Ltd purchased (long position) more SAFEX July WM futures contracts. This was done to the extent that WJ Morgan & Associates (Pty) Ltd owned a large part of the SAFEX July futures contracts. At a certain period the price of the SAFEX July futures contract started to fall, the result of this was the payment of VM to fund these positions. VM that had to be paid resulted in the increase of capital requirement of WJ Morgan & Associates (Pty) Ltd. As the market kept on falling the capital requirement then increased to an extent that WJ Morgan & Associates (Pty) Ltd could not fund these positions anymore, resulting in the company defaulting on the funding of these positions.

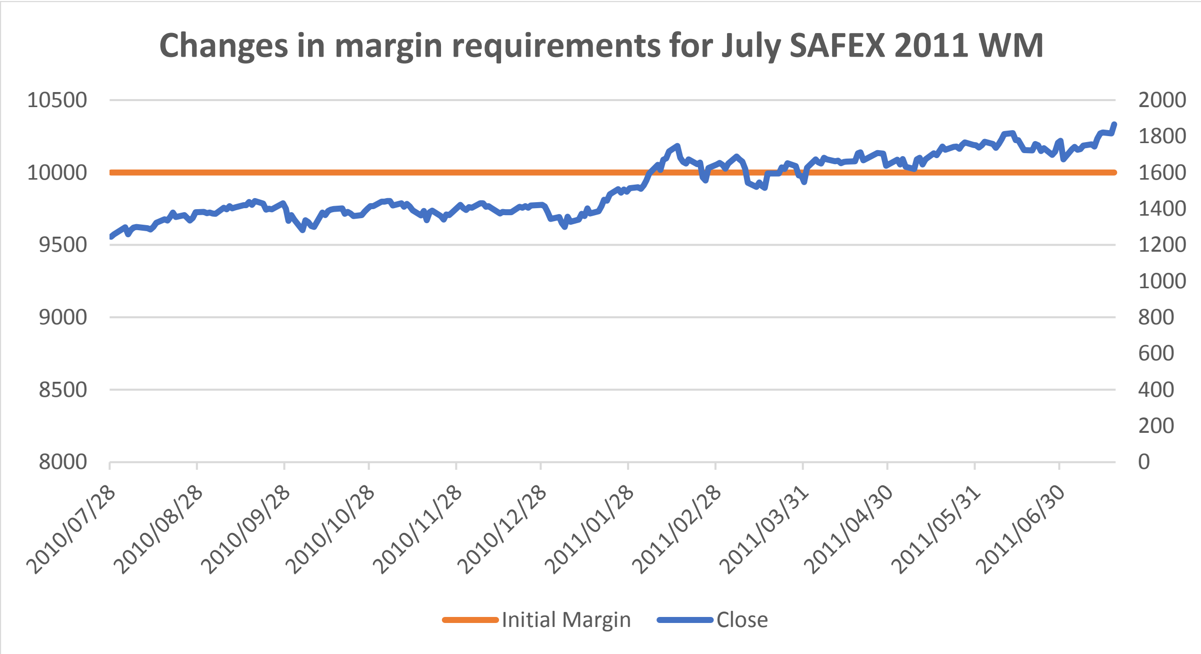
WJ Morgan & Associates (Pty) Ltd used the capital of the Joint Municipal Pension Fund to fund the IM and VM requirements of these long positions. Whilst the market went up all was well and WJ Morgan & Associates (Pty) Ltd made profits on their long positions. The problem arose when the prices of the agricultural commodities bought started to decline, resulting in VM to be settled. At first WJ Morgan & Associates (Pty) Ltd had sufficient capital to fund these VM, but as the market kept on declining the company had problems with keeping up with the funding of these VM. The company then booked the losses of these transactions over to the pension fund. The total damages lost for the pension fund was R1.9 billion, resulting in court cases. This illustrates the importance of managing the IM and VM of positions entered on SAFEX. Even though the discussed court case was due to fraudulent transactions, it supports the problem that extreme market movements could result in extreme losses and there should be attempted to avoid these losses in the future.

An example of an international company that went bankrupt is Barings Bank, one of the biggest financial scandals in history. Nick Leeson was a derivatives trader at Barings Bank (Leeson, 1996:43). Leeson was a very successful trader until he started to acquire losses on speculative transactions. He then hid the losses in a secret account; the scandal was only revealed by an earthquake in Kobe, Japan. Leeson entered an option strategy called a short straddle on the Nikkei (Leeson, 1996:24). A short straddle is an option strategy where the trader sells a call option and simultaneously sells a put option (JSE, 2010:132). The short straddle strategy is effective once there is very little price movement on a commodity. In the case of Nick Leeson, the earthquake in Kobe, Japan, resulted in a sharp drop in the Nikkei. This had the effect of Barings Bank having to fund these positions entered into. The reaction of the Asian markets then resulted in a further drop and more funding required stand good for the margin requirements. This example illustrates how natural disasters could trigger enormous moves in stock markets resulting in extreme market movements.

4.2 Effect of price volatility on margin requirements from a South African perspective

The graphs below illustrate the price movements of the SAFEX July WM futures contract, compared to the increase and decrease in IM requirements. In the graphs below it is clearly illustrated that, as the SAFEX July WM futures contract trades higher, there is an increase in IM requirements. This also supports the statement that volatile markets have the effect of higher IM.

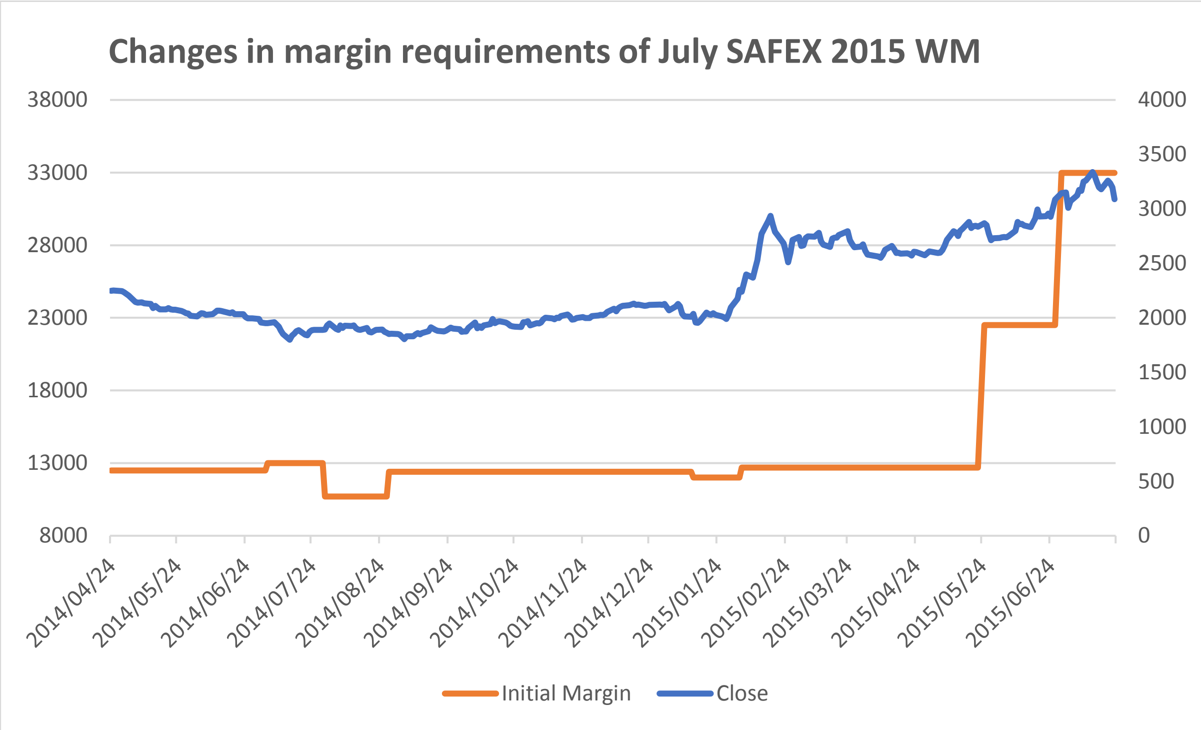
Graph 4.1: Changes in IM requirements for 2011, compared to the closing price of the SAFEX July WM futures contract



Source: JSE, 2017

In the graph above the July WM contract trades between R1,200 per tonne and R1,900 per tonne. The IM during this period stayed constant on R10,000 per July WM contract. Limited volatility during 2011 had the effect of no increase in IM during this year.

Graph 4.2: Changes in IM requirements for 2015, compared to the closing price of the SAFEX July WM futures contract



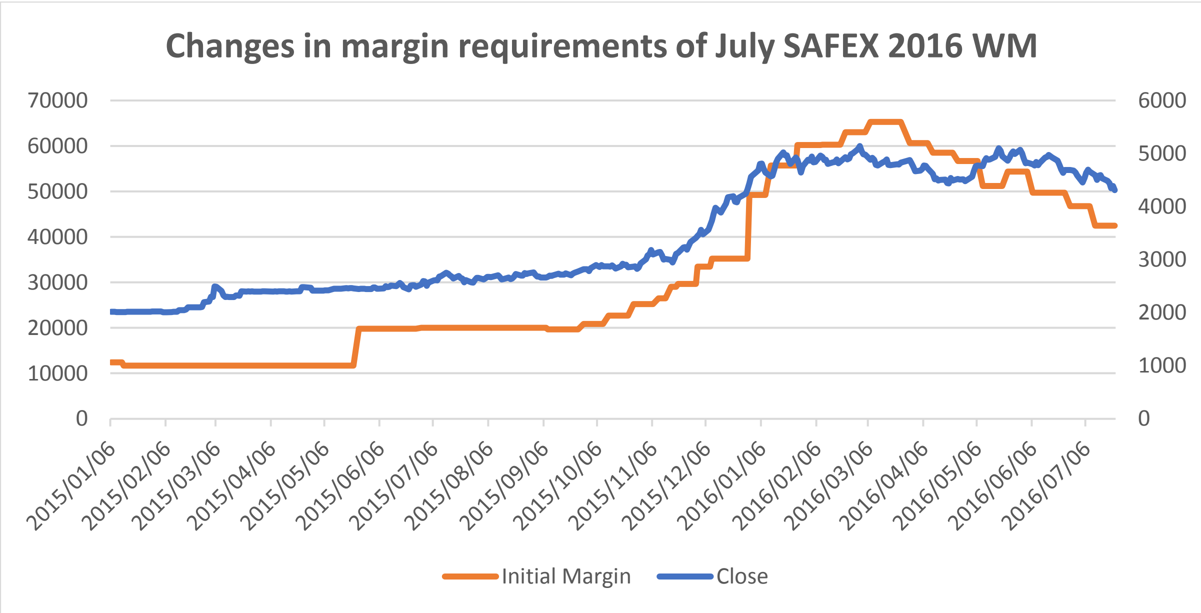
Source: JSE, 2017

During 2015 the SAFEX July WM contract traded in a range of between R1,800 and R3,500 per contract. This had the effect of the IM increasing from R13,000 to as high as R33,000 per contract. In 2015 the IM of the July WM contract increased with R20,000 per contract. The effect of this increase will be explained in the example below.

Example: A grain hedging company hedges grain for white maize producers. The producers decided to hedge 2,000 tonnes of white maize on the SAFEX July delivery contract. For the producer to hedge their grain they must sell (short) the July WM futures contract. The producers sold 2,000 tonnes of white maize futures contract on 2015/04/24. During this period the IM was R13,000 per contract. A total of 20 (100 tonne) contracts were sold, initiating an IM of R260,000. On 2015/05/24 the IM increased from R13,000 per contract to R23,000 and then on 2015/06/24 to R33,000. The effect of this increase in IM on the grain hedging company was a capital requirement increase from R260,000 on 2015/05/24 to R660,000 on 2015/06/24. This example was only for one client; a company with many clients would have a dramatic effect on their capital requirements.

In the above example it was illustrated what the effect of an increase in IM could have on the capital requirements of a grain hedging company. The 2016 example below also clearly illustrates the effect to which the margin requirements increased. During 2016 South Africa had one of the worst droughts in history, resulting in a dramatic increase in grain prices. Because of the increase in grain prices the IM also increased from R10,000 per contract to R65,000 per contract.

Graph 4.3: Changes in IM requirements for 2016, compared to the closing price of the SAFEX July WM futures contract



Source: JSE, 2017

In periods when the July SAFEX WM price increased, the IM requirements increased. The examples above illustrate the effect this could have on a grain hedging company hedging grain for clients.

4.3 Background into a grain hedging company

A grain hedging company is a company specialising in the trading of grain in the agricultural derivatives market. Companies hedging grain usually do it for two types of customers, namely grain producers and grain processors. Grain producers are the farmers producing grain and grain processors are mills and crushers processing grain for human and animal consumption (JSE, 2013:6). Prior to 1995 all grain prices were controlled by the government, which led to very little price risk for grain processors and producers. At the beginning of the free market in 1995 grain futures contracts were traded on a regulated exchange where supply and demand in the different agricultural commodity contracts determined the price.

A grain hedging company would enter into a short position on SAFEX to hedge a grain producer against price movements. For a grain processor, the grain hedging company would enter a long position on SAFEX to hedge a grain processor against price movements.

Example: A grain producer wants to protect the commodity being produced from a possible drop in price. The producer then sells (short) a futures contract on SAFEX to cover their exposure against the drop in price. If the producer sells his commodity on SAFEX, for example at R2,500 per ton, and the market drops to R2,000 per tonne, the producer makes a profit of R500 per ton on SAFEX. In effect the value of his physical commodity drops as well, being now worth only R2,000 per tonne. Thus, the producer now can use the R500 per tonne profit to add it to the R2,000 per tonne price he will receive for his commodity in the physical market. The example explains how the producer could hedge the commodity for a decline in price. A position of a grain processor is the exact opposite. In the case of a grain processor, the commodity will be bought on SAFEX to protect (hedge) it from an increase in price.

The goal of a grain producer would be to hedge his grain at a high as possible price, whilst grain processors want to hedge their grain at a low as possible price. This results in a grain hedging company entering in both long and short positions on the agricultural derivatives market. The decision of entering into long and short positions lies with the client of the grain hedging company and the company could not use their own discretion when entering into these positions on SAFEX.

A large part of the service that a grain hedging company provides to their customers (producers and processors of grain) is providing on time and correct market information. This assists their clients in hedging their grain at the most profitable prices. In theory, there are different market indicators (trading strategies) that could assist market participants to hedge their grain at optimal price levels. A market indicator is a mathematical calculation used to determine the direction in which a market could move. These market indicators will be discussed later in the study. Market indicators form an important part in advising customers when to enter into long or short positions.

4.4 International research done by Scot Irwin

Professor Scot H Irwin is an international leader in the field of agricultural economics (ACE, 2017). The research of professor Irwin is widely cited in the academic world, market participants and policymakers. Professor Irwin researched the effect of how and at what price levels different market participants hedged their agricultural commodities. This research is based on the performance of market advisory services. A market advisory service specialises in advising their clients with different strategies on where to market their products and when to buy or sell their products (Irwin *et al.,* 2006:5). These strategies assist their clients on when to hedge their different commodities. According to the studies done by professor Irwin, market advisory services seldom perform better than benchmarks set out in his studies (Irwin *et al.,* 2006:4). These benchmarks are the 20 and 24-month average market prices in corn and soybeans on the Chicago Mercantile Exchange. Interesting enough is that professor Irwin illustrated in his studies that even though market advisory services did not perform better than the benchmarks, it provided clients with the possibility to improve performance with regards to average market prices (Irwin *et al.,* 2006:4). Professor Irwin also found that clients of market advisory services improve their marketing decisions by making use of the market advisories' trading strategies.

Example: A 20 and 24-month average market price was used as a benchmark. The aim was to determine if market advisory services could perform better than these benchmarks. If the 20-month benchmark for the US corn price was $3.50 and because of using trading strategies the advisory service could sell the grain processors' grain at a higher price, the advisory service would be considered successful. The opposite is true in the case of grain processor clients; these clients want to buy their grain at a lower price than the benchmark.

Further research done by Irwin also discussed the following:

In the research that professor Irwin did with regards to technical analysis he found that technical analysis did generate economic profits in a variety of speculative markets (Cheol-Ho & Irwin, 2004:1). Technical analysis makes use of a variety of techniques to forecast price movements. These techniques consist of identifying trading patterns and trends in the market. This could be done by using mathematical calculations, calculating buy or sell signals. The mathematical calculations are influenced by trading volume, the difference between high and lows of a defined period on a specific commodity and moving averages of prices of commodities. Even though technical analysis is widely used and did generate profits, there remains a large gap between different views of market participants. These views are split between academics, market participants and policy makers.

Professor Irwin did more research in 2010 with regards to the effectiveness of market advisory services. His results stated that even for the sceptical decision maker market advisory services did increase the clients' chance of receiving higher prices for their corn, soybeans and wheat (Cabrini *et al*., 2010:636). This research states the fact that grain hedging companies do have the ability to advice their clients to make better marketing decisions. This could be done by using specific trading strategies, of which the Slow Stochastic Indicator will be used for this study.

4.5 Implementing a hedging strategy which will assist in mitigating price risk

A grain hedging company also supplies market advisory services. Trading strategies provided by a grain hedging company should aim to advise both clients in making the correct decisions to optimise market performance and provide the grain hedging company to manage their margin requirements more optimally. The challenge therefore remains to implement a trading strategy which will assist market participants in mitigating price risk, whilst outperforming the market. As discussed in the research done by professor Irwin it was found that grain hedging companies do have the ability to advise its clients to make the correct marketing decisions. The study will aim to prove that, if market participants market their grain at the most optimal prices, it will have a positive effect on minimising margin requirements. For market participants to be able to market their grain at the most optimal prices, participants would have to make use of the recommendations from grain hedging companies.

The effect of market participants receiving more optimal prices and to what extend it will affect margin requirements could be explained as follows. Grain producers want to sell their products on the highest possible price, whilst grain processors want to buy their grain at the lowest possible price. The moment the grain hedging company enters into a long position for a processor, an IM should be settled by the company. If the long position is entered into at a low price and the market trades higher in the proceeding days, the company will earn a positive VM. As the market traded higher to levels where the grain producer wants to sell his product, the company enters into a short position. This short position results in an IM that needs to be settled.

Example: At the hand of the graph below margin requirements could be explained as follows. On 2015/11/16 the grain processor bought a grain contract (100mt July WM) at R2,000 per tonne. This transaction resulted in an IM of R10,000 to be settled by 11:00 the following day. From 2015/11/16 to 2016/01/18 the position should be settled daily. Resulting in the VM being earned or paid by the hedging company to the JSE clearing member. At 2016/01/18 the market traded at R2,500 per contract. In effect the grain hedging company had the following capital requirement for the client:

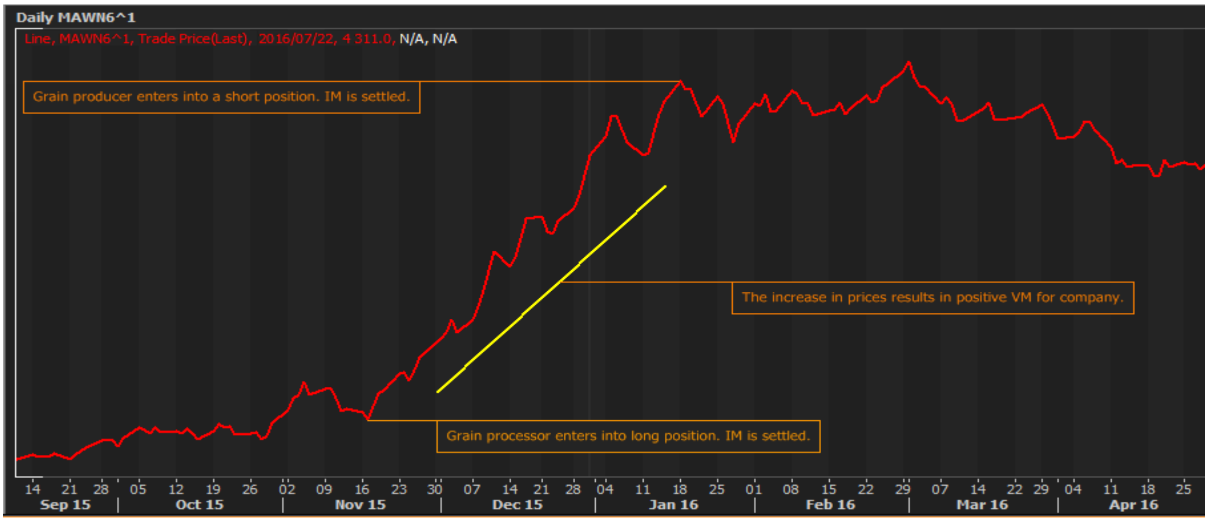
IM paid – R10,000 per contract

VM earned + R50,000 per contract (500 per tonne x 100 tonne contract)

<u>Net position + R40,000 per contract</u>

At 2016/01/18 a grain processor client of the hedging company sold his grain at R2,500 per contract. This resulted in the IM being R0 per contract, because there was a long position (processor buying grain) and a short position (producer selling grain). These two positions offset each other resulting in a net position of R0 per contract capital requirements.

Graph 4.4: Graph illustrating the effect of margin requirements the moment a grain hedging company enters into a futures position



Source: Thompsons-Reuters, 2017

The above graph illustrates the effect of margin requirements once market participants enter the market at the correct time. In the example the ideal is illustrated of a hedging company having a net position of zero contracts. The market hypothesis is to outperform the market whilst lowering margin requirements. A technical analysis trading strategy will be used to attempt to outperform the market and to decrease margin requirements. In an article written by professor Irwin a leading technical analyst defined technical analysis in the following way (Cheol-Ho & Irwin, 2004:6):

"The technical analysis approach to a trade is a reflection to the idea that market prices move in trends, and these trends are influenced by the changing attitudes of market participants towards a variety of monetary, economic, political and psychological forces."

The trading strategy that will be used to attempt to outperform the market and decrease margin requirements is the Slow Stochastic Technical Indicator. George C. Lane developed the Slow Stochastic Technical Indicator in 1954 (Lane, 1954:87). A stochastic indicator is an indicator that indicates momentum (Dinapoli, 1998:54). A stochastic indicator has two lines, namely a slow-moving line and a fast-moving line. This indicator uses the closing price of a futures contract and compares it with a range of prices over a certain period (Dinapoli, 1998:54).

4.6 Conclusion

Examples of cases when the capital to fund margins was so exhausted that it led to major companies and banks going bankrupt, were discussed. This highlighted the responsibility that a grain hedging company must manage their capital requirements. Research by professor Scot Irwin addressed the importance of market advisory services and that trading strategies could be used to perform better than benchmark prices (Irwin *et al.,* 2006:4). A detailed discussion with regards to margin requirements and hedging transaction explains the importance of making use of a trading strategy to limit capital requirements.

Chapter 5: Research design and data analysis

5.1 Research design

The primary aim of the research is to determine how to limit the capital requirement of a grain hedging company. For this to be possible the correlation between the different variables influencing the SAFEX July WM futures price will be tested. These variables consist of supply and demand, exchange rates, international grain prices and price parity. The reason for testing the correlation of these variables and the July SAFEX WM price was to illustrate what effect these variables have on the price. Once it is determined that these variables influence price it could supply reasons for the July WM price moving in a certain trend. Identifying a certain trend in the price could be used to determine the best possible trading strategy to hedge grain for producers and processors.

The data collected consists of the closing price of the July SAFEX WM contract trading on the JSE for 2010 up to 2016. July is the period when WM are harvested and therefore all variables influencing the price of the WM futures contract are priced into the July WM futures contract during this period. These closing prices were compared to the supply and demand, exchange rates, international grain prices and price parity. The method used for determining the supply and demand was the stocks-to-usage indicated as a percentage. The stocks-to-usage ratio is the amount of stock available in the current year expressed as a percentage of the total demand of the following year.

The data used was then processed and a statistical method was used to determine the correlation between the different variables and the price. The statistical method that was used was the coefficient of correlation. The results of the statistical method used are presented in the following section.

5.2. Statistical results

The coefficient of correlation in the statistical method used, measures the strength of a linear relationship between two numerical variables (Levine *et al*., 2014:167). Results of the values of the coefficient of correlation are only appropriate to use if the relationship between the two variables is linear. According to Levine *et al.* (2014:167) the following features are applicable:

- The values of the coefficient lies between -1 (perfect negative correlation) and +1 (perfect positive correlation).
- If values are close to 1 it indicates a strong linear relationship. In this case, if values of one variable increase, the values of the second variable will also increase.
- If values are close to -1 it indicates a weak linear relationship. In this case, if values of one variable increase, the values of the second variable will decrease.

A perfect correlation means that if the points were plotted on a scatter plot the different data points could relate to a straight line. The Spearman's rho coefficient of correlation was used to determine the correlation between the different variables and the July SAFEX price. According to Bryman and Bell (2015:323) unlike other coefficient of correlations, Spearman's rho is based on a rank order of variables and not on the assumption that data is normally distributed. The statistical significance was also tested to determine how the findings can relate to the data used in determining the correlation. This determines the degree of confidence that the data does influence the price of the SAFEX July WM contract (Bryman & Bell, 2015:325). The structure of the statistical significance test can be explained as follows:

- A P-value smaller than 0.05 indicates that there is a statistical significance that there is a relationship between the two variables examined. This means that there is less than 5% chance that the sample used illustrates a relationship that does not exist.
- If the findings of the statistical significance are 0.05, the null hypothesis will be rejected.

- The null hypothesis is when there is no relationship between the numerical variables.

In summary of the introduction into the statistical method used, the coefficient of correlation is an indication of the linear correlation between two variables. In the effect of a strong correlation, it does not necessarily imply a causation effect (Levine *et al*., 2014:170). A strong correlation only indicates tendencies that are present in data. The test for statistical significance determines the degree of confidence to which the results of the correlations between the different variables could be used to determine the effect it has on the SAFEX July WM price.

Table 5.1: Results generated by the statistical method used when the Rand / Dollar exchange rate were examined

Year	SAFEX July Closing Price	Rand/Dollar Exchange Rate
2010	1	-0.034
Statistical Significance		0.590
2011	1	-0.647
Statistical Significance		< 0.001*
2012	1	0.520
Statistical Significance		< 0.001*
2013	1	-0.061
Statistical Significance		0.317
2014	1	0.078
Statistical Significance		0.193
2015	1	0.835
Statistical Significance		< 0.001*
2016	1	0.878
Statistical Significance		< 0.001*
* Correlation is significant at the 0.01 level (2-tailed)		

Correlation between the different variables are provided in the following tables. It is important to notice that the effect of these variables will differ during different seasons.

Example: In a season when the South African maize trades at import or export parity, the effect of the exchange rate and CME prices will be more extreme. This is since South Africa must either export or import maize depending on the supply of maize. During 2016 South Africa had the worst drought in history and had to import grain from

Argentina, Brasilia and the United States. Therefore, the exchange rate had a correlation of 0.878 on the July SAFEX WM price.

The Rand / Dollar exchange rate is compared to the closing price of July SAFEX WM and is very closely correlated to the changes in price. It is only in 2010 and 2011 that there is not such a close correlation.

Table 5.2: Results generated by the statistical method used when the CME July closing price were examined

Year	SAFEX July Closing Price	CME July Closing Price
2010	1	0.512
Statistical Significance		< 0.001*
2011	1	0.911
Statistical Significance		< 0.001*
2012	1	-0.495
Statistical Significance		< 0.001*
2013	1	0.359
Statistical Significance		< 0.001*
2014	1	0.017
Statistical Significance		0.780
2015	1	-0.188
Statistical Significance		< 0.001*
2016	1	-0.552
Statistical Significance		< 0.001*
* Correlation is significant at the 0.01 level (2-tailed)		

The CME July closing price reported a strong correlation in certain years. It also supports the argument that in certain years when there is a shortage or surplus the price reacts more closely to the CME price. This could be seen in 2010 and 2013 when South Africa exported grain.

Table 5.3: Results generated by the statistical method used when the No 2 Yellow Corn FOB price were examined

Year	SAFEX July Closing Price	No 2 Yellow Corn FOB Price
2010	1	0.471
Statistical Significance		< 0.001*
2011	1	0.923
Statistical Significance		< 0.001*
2012	1	-0.320
Statistical Significance		< 0.001*
2013	1	0.463
Statistical Significance		< 0.001*
2014	1	0.465
Statistical Significance		< 0.001*
2015	1	-0.478
Statistical Significance		< 0.001*
2016	1	-0.419
Statistical Significance		< 0.001*
* Correlation is significant at the 0.01 level (2-tailed)		

It is also indicated that in most years both the CME price and the price of No 2 yellow corn in the US were closely correlated with price movements. The correlation between the No 2 yellow corn price and the closing price of SAFEX July WM supports the argument that a movement in export parity influences the SAFEX WM price.

The stocks-to-usage was calculated for SAFEX July WM contract for the six trading years. Below is an example of how the stocks-to-usage ratio was calculated in 2016:

Table 5.4: Calculation of stocks-to-usage ratio for 2016

2016	**Feb**	**Mrt**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**
Crop estimate	**CE1**	**CE2**	**CE3**	**CE4**	**CE5**	**CE6**	**CE7**	**CE8**
Opening stock (1 March)	2 861 883	2 861 883	2 861 883	2 861 883	2 861 883	2 861 883	2 861 883	2 861 883
Crop estimate	7255750	7065275	7065275	7160925	7160925	7261925	7297025	7536875
Imports	2644793	2644793	2644793	2644793	2644793	2644793	2644793	2644793
Total demand	11 112 382	11 112 382	11 112 382	11 112 382	11 112 382	11 112 382	11 112 382	11 112 382
Ending stock	1 650 044	1 459 569	1 459 569	1 555 219	1 555 219	1 656 219	1 691 319	1 931 169
Stock to usage %	14.78	13.07	13.07	13.93	13.93	14.83	15.15	17.30
AV SAFEX Price for CE Month	R 4 899.00	R 4 871.00	R 4 572.00	R 4 907.00	R 4 795.00	R 4 536.00	R 4 107.00	R 4 024.00

The South African Crop Estimate Committee releases 8 crop estimates per year, indicated as CE1 to CE8. At the beginning of each maize season the supply and demand are started with the stock that was carried over from the previous year (opening stock). The 8 crop estimates were then added each month with the crop estimate and imports to get the total supply. The demand for the year is then subtracted from the supply and the result is the ending stock. This ending stock is then calculated as a percentage of the following years' demand. Stocks-to-usage is a result of this calculation. This was done each month when the crop estimate was released and then compared to the average closing price of that month. Statistically there must be a negative relationship between the stocks-to-usage and price. The reason for this is the higher the stocks-to-usage the more maize is available. Using supply and demand it explains that the higher the supply the lower the price. This is illustrated below that as the stocks-to-usage increases the price of grain decreases.

Graph 5.1: Indication of Stock / Usage ratio compared to the SAFEX July 2016 WM av. price per month

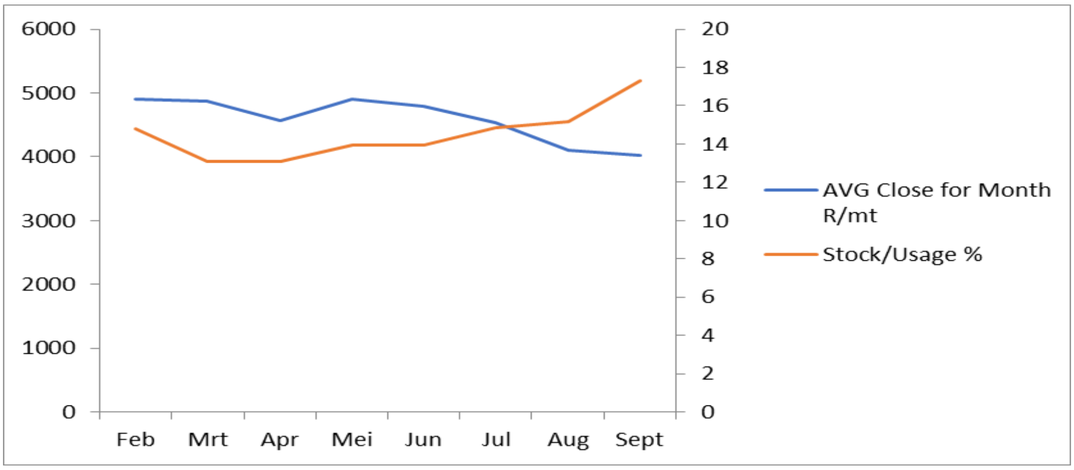


Table 5.5: Results generated by the statistical method used when stocks-to-usage ratio was examined

Correlations		
Year	**Av. SAFEX July closing price for month**	**Stocks –to- usage ratio**
2010	1	-0.683
Statistical Significance		0.062
2011	1	-0.905
Statistical Significance		0.002
2012	1	-0.060
Statistical Significance		0.888
2013	1	-0.071
Statistical Significance		0.867
2014	1	-0.929
Statistical Significance		< 0.001*
2015	1	0.443
Statistical Significance		0.272
2016	1	-0.639
Statistical Significance		0.088
* Correlations are significant at the 0.01 level (2-tailed)		

The table above illustrates the negative correlation that stocks-to-usage has on the average price of SAFEX July WM per month. As discussed, the reason for the negative correlation is due to the increase in stock resulting in a decrease in prices. In conclusion - during the theoretical discussion of the study it was explained that different variables influence the SAFEX WM price, thus resulting in the price trading in different trends. These trends, in which the price trade would be attempted to be used to generate a trading strategy, could assist grain producers and processors to buy and sell their grain at more optimal price levels. The effect of this will be examined in the application of the framework. In the application of the framework the goal would be to use the trading strategy to decrease the amount of capital required to fund the margins of the hedge positions of the grain producers and processors.

5.3 Application of framework

The research framework used to determine the capital requirement of hedging grain would consist of using the Slow Stochastic Technical Indicator. This technical indicator will serve as the trading strategy to determine the most optimal time for market participants to buy and sell grain. Once these optimal buy and sell levels are generated the IM and VM will be calculated on a daily basis. These calculations will then be used to determine the capital required to hedge grain using the Slow Stochastic Technical Indicator.

As discussed, the method that will be used to determine when market participants should enter the market, will be the Slow Stochastic Technical Indicator. The Slow Stochastic Technical Indicator is calculated as follows (Dinapoli, 1998:54):

When calculating the Stochastic Indicator two lines are used; the one line is the %K line and the other line is the %D line that follows the %K line. The %D line will indicate the major buy and sell signals. The mathematical formula of the %K line is illustrated as follows:

%K = 100 [(C – L5 close) / (H5 – L5)]

C = most recent closing price

L5 = the low of the five previous trading sessions

H5 = the highest price traded during the same 5-day period

The mathematical formula of the %D line is illustrated as follows:

%D = 100 x (H3 / L3)

L3 = the low of the three previous trading sessions

H3 = the highest price traded during the same 3-day period

The aim of the Stochastic Indicator is to indicate when the SAFEX WM futures contract is over bought or over sold. When the price of the SAFEX WM future contract is over bought or over sold a certain trend could be identified. According to Dinapoli (1998:20) a trend is classified as the reaction of prices during a certain period in a specific direction. Trends could be identified using trading strategies like the Slow Stochastic Indicator.

Example: An over-bought market describes a certain period when there have been a constant upward movement in prices. The same with an over-sold market is when there was a constant downward movement in prices. The result of an over-bought or over-sold market will be that the price will move in a trend. A trend could be upward in the case of an over-bought market or downward in the case of an over-sold market.

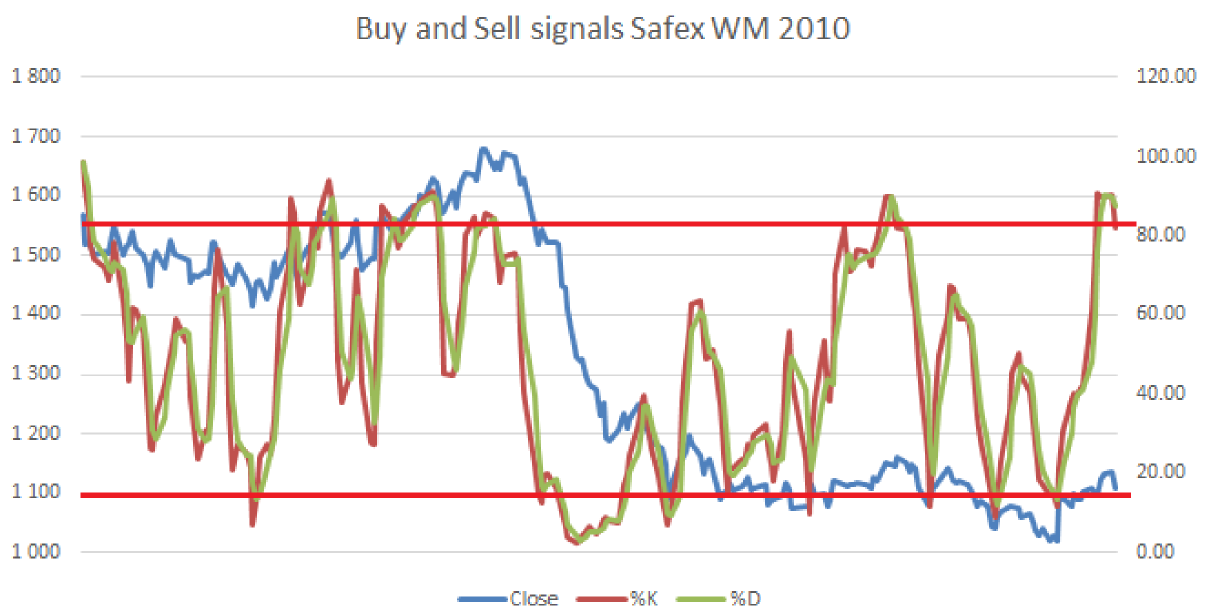
The two lines react at different periods; the %K line being the line that reacts to price movements much faster than the %D line. Reaction time of the different lines could be adjusted as wished; this is indicated through being a slow indicator or a fast indicator. The slow indicator makes use of more trading sessions, and thus will take longer before it indicates a signal, where the fast indicator uses less trading sessions to calculate the signal.

By using the Slow Stochastic Technical Indicator, the effect of it will be illustrated on the July SAFEX WM futures price. This will provide market participants with a signal to buy and a signal on when to sell their SAFEX WM futures contracts. The reason for using the Slow Stochastic Technical Indicator for determining when to buy and sell is because it uses price movements to determine a trend in the market. If the Slow Stochastic Technical Indicator sends a signal that the market is moving in an upward trend, it will signal a buy signal and vice versa. When the indicator signals the market moving in a downward trend, it will signal a sell signal. Thus, the methodological choice of using the Slow Stochastic Technical Indicator is a practical and feasible way of determining buy and sell signals. Once the information is generated on when market participants should have bought and sold their products, the margin requirements will be calculated. The calculation of the margin requirements is very important because this will help answer the research question of whether participants will be able to trade derivatives in a sustainable way with minimal capital funding for positions required.

The data was collected by using the prices obtained at the JSE for the 6 years from 2010 up to 2016. This information was then entered into the calculation of the Slow

Stochastic Technical Indicator. The different buy and sell signals were then derived from the Slow Stochastic Technical Indicator calculations. These different buy and sell signals were then plotted on the graphs of the different SAFEX July WM futures contracts. In the graphs below the buy and sell signals is indicated by the red percentage lines. Once the %K and %D line moves below the red 15% line a buy signal is triggered. A %K and %D line below the 15% red line indicates that the market is oversold. If the %K and %D line moves above the 85% red line a sell signal is triggered. This indicates that the market is overbought. The line indicating the market close will indicate where the SAFEX July WM futures price is when the specific buy or sell signal is triggered. Once the different buy and sell signals were determined, the margin requirements were calculated using the margin requirements used for those specific years. The table below will illustrate the different SAFEX July contracts and when the buy and sell signals were triggered.

Graph 5.2: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2010



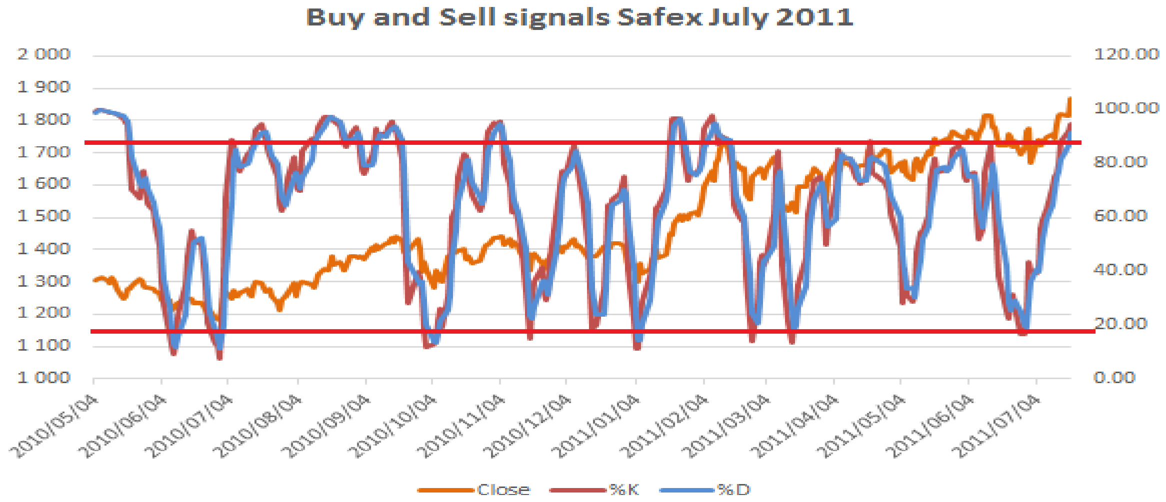
The graph above indicates the different buy and sell signals in 2010. In Graph 5.2 the %K and %D lines indicate the buy and sell signals, when they moved above the 85% red line a sell signal is triggered and below 15% red line a buy signal is triggered.

Table 5.6: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2010

SAFEX WM July 2010 Futures contract												
Buy Signals							Sell Signals					
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2009/09/29	2009/10/02	4	1441	1457		1	2009/07/16	2009/08/04	14	1443	1520
2	2010/01/06	2010/02/05	24	1543	1224		2	2009/10/26	2009/10/26	1	1570	1570
3	2010/02/16	2010/02/22	5	1175	1156		3	2009/11/30	2009/11/30	1	1629	1629
4	2010/03/11	2010/03/16	4	1119	1114		4	2010/07/19	2010/07/19	1	1135	1135
5	2010/03/26	2010/03/26	1	1091	1091		5	2010/07/19	2010/07/19	1	1135	1135
6	2010/05/19	2010/05/19	1	1110	1110		6	2010/07/19	2010/07/19	1	1135	1135
7	2010/06/08	2010/06/11	4	1043	1068		7	2010/07/19	2010/07/19	1	1135	1135
8	2010/06/25	2010/07/01	5	1042	1087		8	2010/07/19	2010/07/19	1	1135	1135
		av	6						av	3		

The table above serves as a summary of the different buy and sell signals in 2010. Information indicating the different buy and sell signals are obtained from the graph above. For each year the graphs indicating the buy and sell signals supplies the information used in the tables. In the table the signal day is indicated, explaining the amount of buy and sell signals for that year. The first day of a trading signal and the last of a trading signal is also indicated. This together with the number of days in signal indicates the beginning and end of a signal as well as the duration of the signal. Price of the SAFEX July WM future at the first day and the last day of the signal is also indicated. From 2010/01/06 to 2010/02/06 there was a sell signal. This was due to pollination being over that period and a drought effected pollination. Certain events effecting the price of grain could cause a sell or buy signal to be much longer than the average amount of days. During 2010 the average buy signal was at R1195.50 and the average sell signal was at R1289.62.

Graph 5.3: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2011



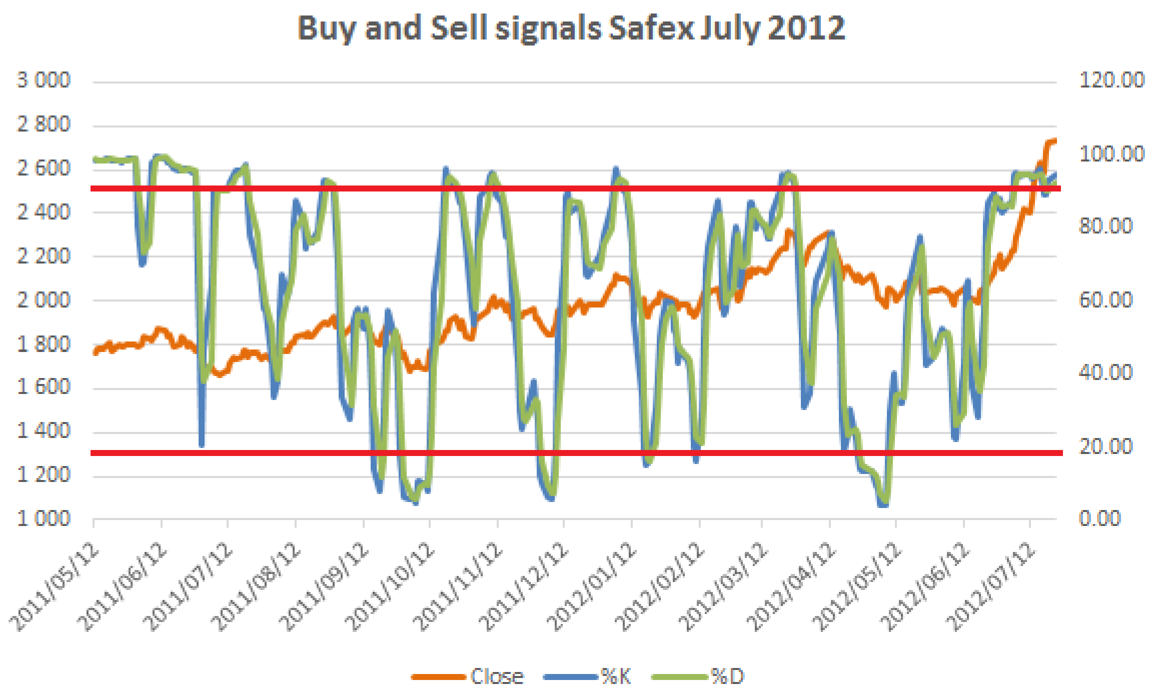
The graph above indicates the different buy and sell signals in 2011. The July WM futures contract price increased from the first part of the year, this was mainly due to higher US corn prices.

Table 5.7: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2011

SAFEX WM July 2011 Futures contract												
Buy Signals							Sell Signals					
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2010/06/08	2010/06/11	4	1212	1235		1	2010/05/04	2010/05/19	12	1306	1279
2	2010/06/25	2010/06/30	4	1214	1184		2	2010/07/19	2010/07/19	1	1295	1295
3	2010/10/01	2010/10/08	6	1340	1299		3	2010/08/13	2010/08/24	8	1322	1348
4	2010/11/17	2010/11/17	1	1336	1336		4	2010/08/30	2010/08/31	2	1382	1376
5	2010/12/17	2010/12/17	1	1380	1380		5	2010/09/10	2010/09/17	6	1408	1442
6	2011/01/04	2011/01/06	3	1321	1356		6	2010/11/01	2010/11/04	4	1439	1443
7	2011/02/25	2011/02/25	1	1625	1625		7	2011/01/21	2011/01/24	2	1480	1508
8	2011/03/16	2011/03/17	2	1525	1515		8	2011/02/07	2011/02/11	4	1643	1716
9	2011/06/27	2011/06/29	3	1698	1765		9	2011/07/19	2011/07/19	1	1866	1866
		av	3						av	4		

The table above serves as a summary of the different buy and sell signals in 2011. During 2011 the buy and sell signals was not for long periods of time, with the longest period in a signal being 6 days. The price level of the average buy signal in 2011 was at R1405.66 and the average sell signal was at R1460.11.

Graph 5.4: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2012



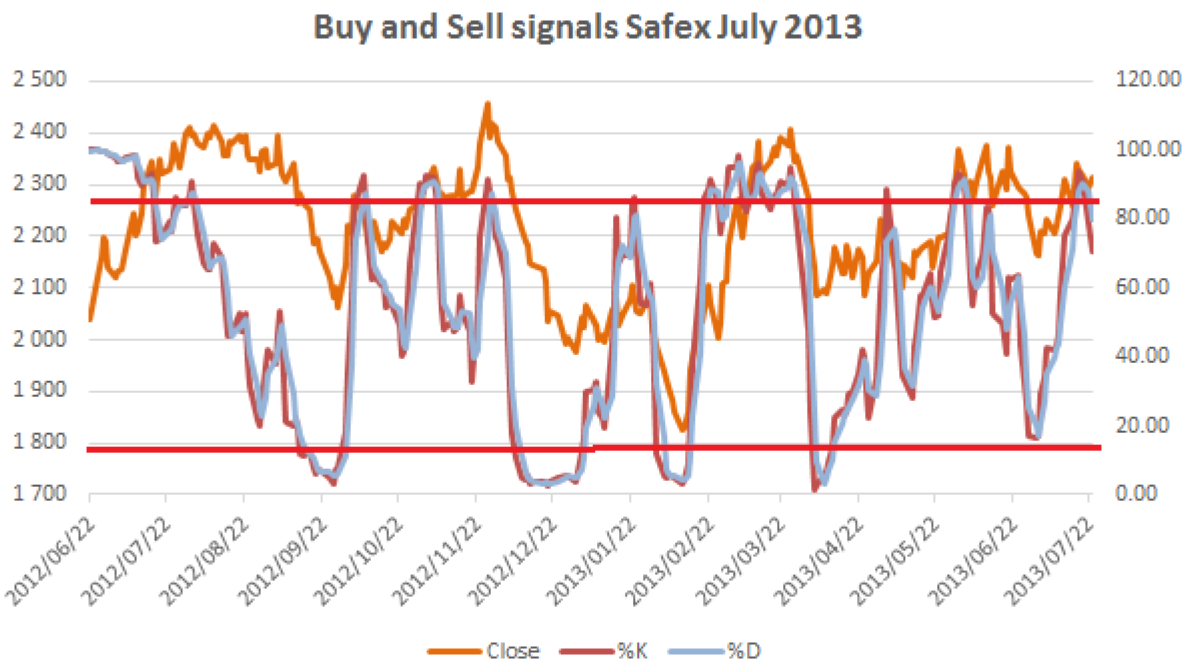
The graph above indicates the different buy and sell signals in 2012. For most of 2012 the July WM futures contract traded in a very narrow range of between R1800 per ton and R2300 per ton. Closer to the contract expiry the price drastically increased, resulting in a difference of R1079 per ton between the high and the low of the contract.

Table 5.8: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2012

SAFEX WM July 2012 Futures contract												
Buy Signals							Sell Signals					
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2011/09/19	2011/09/20	2	1798	1842		1	2011/06/08	2011/06/27	13	1834	1773
2	2011/09/29	2011/10/12	10	1742	1776		2	2011/07/07	2011/07/20	10	1670	1773
3	2011/12/01	2011/12/08	6	1905	1890		3	2011/08/25	2011/08/29	3	1900	1925
4	2012/01/18	2012/01/20	3	1941	1965		4	2011/10/20	2011/10/24	3	1867	1924
5	2012/02/10	2012/02/10	1	1935	1935		5	2011/11/08	2011/11/10	3	1985	2019
6	2012/04/19	2012/04/19	1	2159	2159		6	2012/01/05	2012/01/06	2	2121	2101
7	2012/04/24	2012/05/08	9	2119	2053		7	2012/03/22	2012/03/26	3	2244	2303
8	2012/07/23	2012/07/23	1	2738	2738		8	2012/07/05	2012/07/23	13	2295	2738
		av	4						av	6		

The table above serves as a summary of the different buy and sell signals in 2012. During 2012 there was large price movements of R1079 per ton between the high and the low. During 2012 the average buy signal was at R2042.13 and the average sell signal was at R1989.50. In 2012 the average sell signal was lower than the average buy signal.

Graph 5.5: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2013



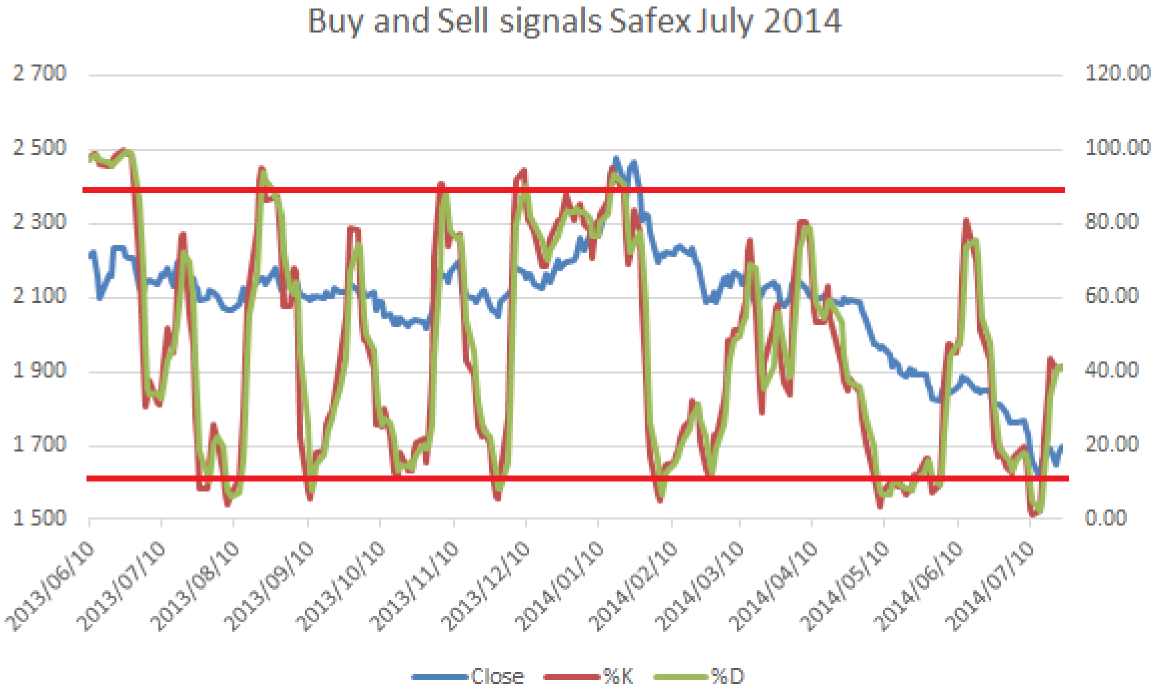
The graph above indicates the different buy and sell signals in 2013. During 2013 the July WM futures contract traded in a relatively narrow range of R635 per ton between the high and the low of the contract.

Table 5.9: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2013

SAFEX WM July 2013 Futures contract													
Buy Signals							Sell Signals						
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2012/08/28	2012/08/28	1	2325	2325		1	2012/06/22	2012/07/16	17	2040	2346
2	2012/09/11	2012/10/01	14	2307	2142		2	2012/11/02	2012/11/05	2	2298	2333
3	2012/12/07	2013/01/03	16	2252	2023		3	2013/03/04	2013/03/06	3	2264	2221
4	2013/01/11	2013/01/11	1	1996	1996		4	2013/03/13	2013/03/13	1	2382	2382
5	2013/02/04	2013/02/14	9	1938	1941		5	2013/03/26	2013/06/26	1	2408	2408
6	2013/04/04	2013/04/17	10	2138	2184		6	2013/06/03	2013/06/03	1	2318	2318
7	2013/07/01	2013/07/02	2	2168	2163		7	2013/07/19	2013/07/19	1	2318	2318
		av	8						av	4		

The table above serves as a summary of the different buy and sell signals in 2013. During 2013 buy signals was triggered for longer periods of time. The reason for this was that the July WM futures contract traded in a relatively close range of R635 per ton between the high and low. During 2013 the average buy signal was at R2160.57 and the average sell signal was at R2289.71.

Graph 5.6: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2014



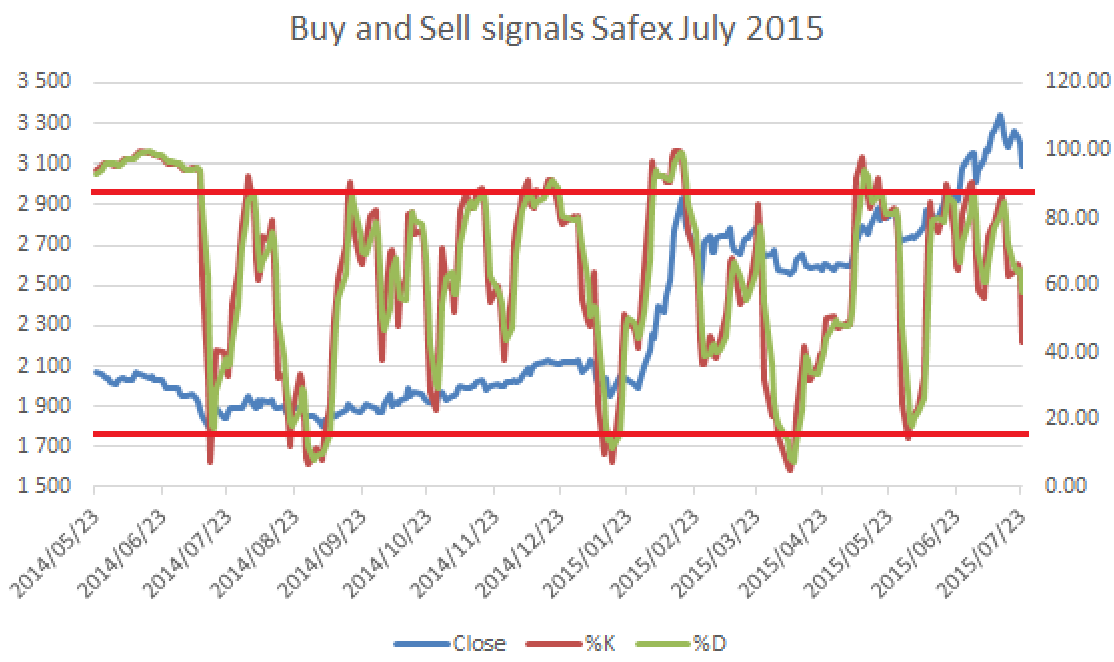
The graph above indicates the different buy and sell signals in 2014. The trading range in 2014 was R868 per ton between the high and the low. During 2014 the July WM futures contract had a big drop in price from the period when there was more harvest certainty.

Table 5.10: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2014

SAFEX WM July 2014 Futures contract												
Buy Signals							Sell Signals					
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2013/07/26	2013/08/12	11	2092	2081		1	2013/06/10	2013/06/28	14	2214	2205
2	2013/09/10	2013/09/16	5	2092	2096		2	2013/08/22	2013/08/22	1	2152	2152
3	2013/10/15	2013/10/30	12	2026	2033		3	2013/11/05	2013/11/05	1	2156	2156
4	2013/11/22	2013/11/29	6	2121	2085		4	2013/12/09	2013/12/09	1	2168	2168
5	2014/02/03	2014/02/14	10	2195	2227		5	2014/01/15	2014/01/15	3	2449	2479
6	2014/02/24	2014/02/28	5	2086	2089		6	2014/07/23	2014/07/23	1	1698	1698
7	2014/05/05	2014/06/03	21	1976	1849		7	2014/07/23	2014/07/23	1	1698	1698
8	2014/06/26	2014/07/16	15	1813	1672		8	2014/07/23	2014/07/23	1	1698	1698
		av	11						av	3		

The table above serves as a summary of the different buy and sell signals in 2014. During 2014 buy signals was triggered for long periods, this was due to the drop-in prices from middle of February 2014. During 2014 the average buy signal was at R2050.13 and the average sell signal was at R2029.13. The year of 2012, 2014 and 2016 was the only years in the 7 years used, where the average level of the sell signal is lower than the average level of the buy signal. This indicates that the level of a sell signal could be below the level of a buy signal.

Graph 5.7: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2015



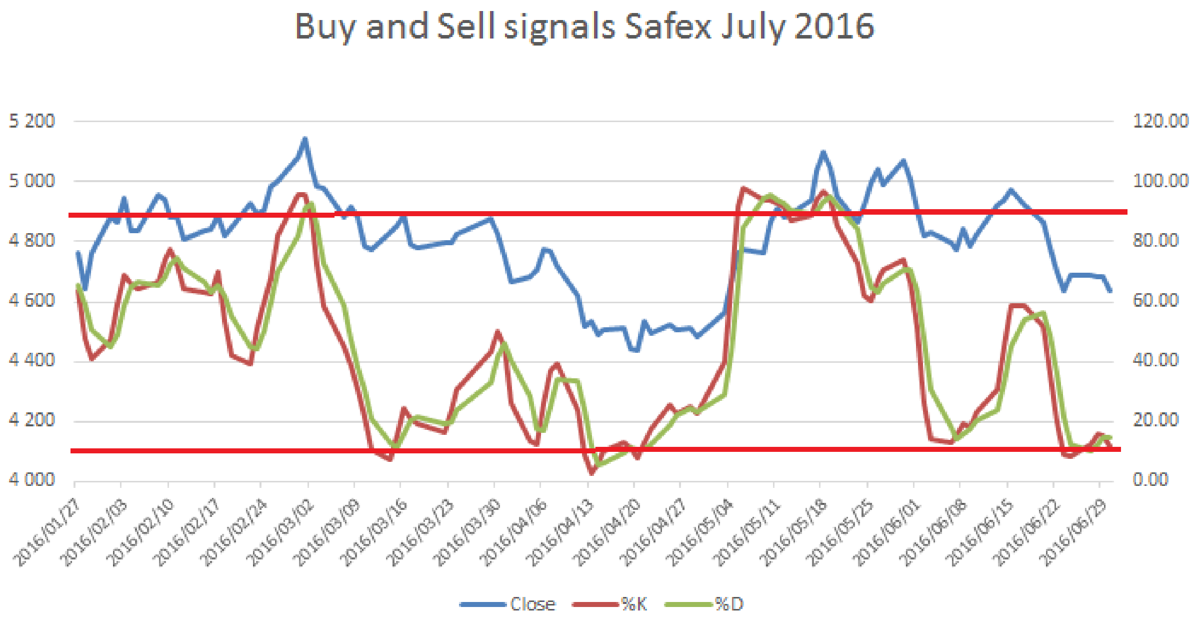
The graph above indicates the different buy and sell signals in 2015. The year of 2015 started of as a normal year and ten a drought hit the maize producing areas of South Africa. This resulted in a dramatic increase of up to a R1500 per ton from the start of the drought up to contract expiry.

Table 5.11: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2015

SAFEX WM July 2015 Futures contract												
Buy Signals							Sell Signals					
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2014/07/16	2014/07/16	1	1855	1855		1	2014/05/23	2014/07/10	34	2074	1885
2	2014/08/21	2014/08/22	2	1879	1890		2	2014/12/19	2014/12/19	1	2123	2123
3	2014/08/28	2014/09/08	8	1850	1831		3	2015/02/04	2015/02/18	11	2239	2856
4	2015/01/13	2015/01/16	4	2036	1969		4	2015/05/12	2015/05/12	1	2782	2782
5	2015/03/31	2015/04/10	7	2675	2624		5	2015/07/23	2015/07/23	1	3090	3090
6	2015/06/02	2015/06/05	4	2740	2751		6	2015/07/23	2015/07/23	1	3090	3090
		av	4						av	8		

The table above serves as a summary of the different buy and sell signals in 2015. During 2015 the average buy signal was at R2172.50 and the average sell signal was at R2566.33.

Graph 5.8: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2016



The graph above indicates the different buy and sell signals in 2016. The year of 2016 is known for the worst drought in the history of South Africa. This drought resulted in the highest July futures price in history.

Table 5.12: Buy and sell signals calculated by using the Slow Stochastic Technical Indicator for 2016

SAFEX WM July 2016 Futures contract													
Buy Signals							Sell Signals						
Signal day	Begin	End	Days in signal	Price day 1	Price last day		Signal day	Begin	End	Days in signal	Price day 1	Price last day
1	2016/03/14	2016/03/14	1	4 833	4833		1	2015/08/05	2015/08/11	4	2 674	2703
2	2016/04/13	2016/04/21	7	4 535	4537		2	2015/09/28	2015/10/06	7	2 819	2883
3	2016/06/06	2016/06/06	1	4799	4799		3	2015/11/04	2015/11/09	4	3 103	3137
4	2016/06/24	2016/06/27	2	4688	4688		4	2015/11/30	2015/12/23	16	3 414	4084
5	2016/06/30	2016/07/05	4	4640	4540		5	2016/01/18	2016/01/20	3	5 020	4965
6	2016/07/21	2016/07/21	1	4390	4390		6	2016/03/01	2016/03/02	2	5142	5042
7	2016/07/21	2016/07/21	1	4390	4390		7	2016/05/09	2016/05/20	10	4764	4951
		av	2						av	7		

The table above serves as a summary of the different buy and sell signals in 2016. Due to the market trading at such high levels the sell signals were over much longer periods of time. During 2016 the average buy signal was at R4611.00 and the average sell signal was at R3848.00.

During the 7 years researched it was found that in 2012, 2014 and in 2016 the average sell signal was lower than the average buy signal. This would not influence the margin requirements, because the objective of the study is only to reduce the capital required to fund margins. The objective is not to obtain the highest average market price for grain producers and processors. Even though in most of the years researched on average by using the signals producers would have sold their grain at higher price levels and processors would have bought their grain at lower price levels.

The above information was used to calculate the margin requirements. This calculation was made to calculate the amount of capital (margin) required to hedge WM futures contracts on SAFEX. Buy and sell signals for the different years are indicated in the tables above. These buy and sell signals were used to daily calculate the IM required and the VM on the different SAFEX July contracts. After the buy and sell signals of the different years were calculated, it was used to calculate the margin requirements.

Table 5.13: Calculation of capital required for funding margins when the Slow Stochastic Technical Indicator was used

	Risk when using Random Pricing			Information gained by making use of Stochastic Indicator					
Year	**Min Price**	**Max Price**	**Potential VM**	**Signals**	**AV Buy Level**	**AV Sell Level**	**Cumulative Margin Cost Maks**	**Cumulative Margin Income**	**AV Margin Requirements based on buy and sell signals**
Safex July 2010	R 1 019.00	R 1 680.00	R 661.00	8	R 1 195.50	R 1 289.62	-R 72.13	R 94.13	R 5.91
Safex July 2011	R 1 184.00	R 1 866.00	R 682.00	9	R 1 405.66	R 1 460.11	-R 37.67	R 54.44	R 12.89
Safex July 2012	R 1 659.00	R 2 738.00	R 1 079.00	8	R 2 042.13	R 1 989.50	-R 91.38	R 24.75	-R 25.89
Safex July 2013	R 1 824.00	R 2 459.00	R 635.00	7	R 2 160.57	R 2 289.71	-R 167.25	R 113.00	-R 14.87
Safex July 2014	R 1 611.00	R 2 479.00	R 868.00	8	R 2 050.13	R 2 029.13	-R 136.50	R 260.63	R 21.39
Safex July 2015	R 1 799.00	R 3 338.00	R 1 539.00	6	R 2 172.50	R 2 566.33	-R 18.50	R 274.93	R 85.05
Safex July 2016	R 2 074.00	R 5 142.00	R 3 068.00	7	R 4 611.00	R 3 848.00	-R 1 780.00	R 0.00	-R 806.18

In the table above the possible margin requirements when no trading strategy was used are compared with the margin requirements when the Slow Stochastic trading strategy was used. In the Potential VM column it is indicated that when no trading strategy is used and buying and selling takes place at the high and low of the market. The potential VM can be as high as R3,068 per tonne which was the case in 2016.

Example: If a grain producer decided to sell his grain at the minimum price on the July SAFEX WM of R2,074 per ton, a VM of R3,068 per ton would have been paid by the grain hedging company. This is an example of the major capital constraints ineffective hedging could have on a grain hedging company.

In the above the assumption was made that the producer sells at the lowest possible price and that the processor buys at the highest possible price. This is the worst possible scenario that is used to compare the Slow Stochastic Trading Strategy with.

In the case of a grain hedging company making use of the Slow Stochastic Indicator the grain hedging company would have had to fund a maximum of R806.18 per ton during 2016. In some years the trading company could have had a positive margin income in the case of using the Slow Stochastic Indicator. This does not only decrease the capital requirement, but also decrease the risk that large price movements could result in the inability to fund these margins.

Due to constraints on information of when real life buying and selling will take place, the approach of the study was to use minimum and maximum price ranges to compare the results of the slow stochastic technical indicator. The intent of the study was to illustrate that by using the trading strategy one can reduce the capital required to fund margin requirements. The ideal of the study would be to compare the trading strategy with real life buying and selling of grain producers and processors.

5.4 Conclusion

The coefficient of correlation was used to determine the relationship between two different variables. The variables compared was supply and demand, exchange rates, international grain prices and price parity. Different variables were compared because these variables influence price movements. It was found that the different production seasons had different effects on the amount the variables correlated. A research framework was used to determine different buy and sell signals on the SAFEX July WM futures contract. These buy and sell signals was then used to calculate the capital required to fund margins when using the Slow Stochastic Technical Indicator to buy and sell for producers and processors. This trading strategy was compared with the buying and selling at the minimum and maximum price ranges of the market. Capital requirement to fund the margins when buying and selling at the minimum and maximum was then calculated. The capital required was then compared and it was found that by making use of the Slow Stochastic Indicator less capital would be required to fund margin requirements.

Chapter 6: Conclusion and recommendations

6.1 Introduction

The funding of margin requirements for a grain hedging company is a day to day task. In volatile markets this task could be very challenging due to the increase in IM and price movements effecting VM. It is very important for a grain hedging company to effectively manage the funding of margin requirements. Failure to manage margin requirements could result in catastrophic consequences for a grain hedging company. This could result in the inability to fund these capital requirements. In effect, understanding the margin requirements and effectively managing it could result in a decrease in the amount of capital required.

6.2 Conclusion

The primary objective of the research was to determine whether a grain hedging company could limit the amount of capital required to hedge grain. Secondary objectives consisted of the following:

- To determine what effect the use of a trading strategy has on capital requirements of a grain hedging company;

- To determine what the effect of economic variables like supply and demand, exchange rates, international grain prices and price parity have on market volatility; and

- To determine the capital required to fund margin requirements for a grain hedging company.

The content of this research summarises the effect of volatile price movements on the SAFEX WM futures contract. These volatile price movements as a result have the effect of large amounts of capital required to fund these margin requirements associated with hedging grain for grain producers and processors. During the research certain focus points were identified. These focus points consist of variables that influence the volatility of the SAFEX WM futures contract and how these could be addressed by making use of a trading strategy to minimise the capital required to fund margin requirements. It was found that these variables had a statistical correlation on price movements, resulting in the price moving in trends.

Another important focus point addressed was calculating the margin requirements under two different circumstances; the one being hedging to take place at the high and low of the market and the other when hedging was done using a trading strategy. The Slow Stochastic Indicator was used as a trading strategy.

The findings of this research indicated that the different variables do influence the price of the SAFEX WM futures contract, resulting in the price of the SAFEX July WM trading in trends due to this. The Slow Stochastic trading strategy used during the period from 2010 up to 2016 had the result of a decrease in the capital required to fund margin. In the case of buying and selling at the high and low of the market, the amount of capital required was much higher.

6.3 Recommendations

The study found that a trading strategy could assist a grain hedging company with minimising its capital requirement to fund margins. Therefore, by making use of a trading strategy to assist clients on when to buy or sell their white maize, the grain hedging company could minimise the capital requirement. A grain hedging company must identify a grain trading strategy, for example the Slow Stochastic Indicator, and use this strategy to assist the company and its clients on when to hedge their grain.

Recommendations for further research will be to use other statistical methods to determine the effect of supply and demand, exchange rates, international grain prices and price parity on the price of the SAFEX WM futures contract. These statistical methods could be by making use of time series to determine the effect on prices. Further recommendations could be to compare the volatility of the SAFEX WM futures contract on an index basis with other indexes. An example of this will be comparing volatility of WM in terms of an index with the SATRIX Top 40 index.

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