The viability of re-enlisting potato commodity derivatives on the Johannesburg Stock Exchange

By

Julie Christy Hayward

A field study submitted to the UFS Business School in the Faculty of Economic and Management Sciences in partial fulfilment of the requirements for the Degree

Magister in Business Administration

At the

UFS Business School
University of the Free State
Bloemfontein

Supervisor: Dirk Strydom

November 2015

DECLARATION

"I declare that the Field Study hereby submitted for the Magister in Business Administration at the School of Management, University of the Free State, is my own independent work and that I have not previously submitted this work, either as a whole or in part, for a qualification at another university or at another faculty at this university. I also hereby cede copyright of this work to the University of the Free State"

_____

Julie Christy Hayward

DEDICATION

One cannot choose the life you are born into however you can choose how you want to live it. I therefore dedicated this dissertation to all the inspirational people who seize every opportunity, who make the impossible possible and who put others needs above their own because without our role models we do not know how far we really can go. Without my role models Peggy Stephenson, Linda Balona, Joan McNaughton, Loffie Brandt, Margot Hayward and Chris Hayward I would not be the woman I am today.

Acknowledgements

This study was made possible with the assistance, cooperation and patience of numerous individuals. I wish to humbly thank every person who contributed in some way towards this study, several of whom I would like to mention by name:

A thank you to my amazing Dad for initiating my dream to do an MBA. A very special thanks to my Godmother Linda Balona, my parents Chris and Margot, my siblings Ashleigh, Cindy and Clinton, my cousin Louise Hayward and my amazing friends Taryn Ford, Sharon Cross, Carmen Kingwill, Sylvi Basch and Marcill Venter for their on-going support on so many levels, their encouragement and continuous belief in me. Without them none of this would have been possible.

A big thank, to you My mentor Loffie Brandt, for his continuous encouragement, support and wisdom. A special thank you to my fellow colleagues Wessel Lemmer, Karabo Takadi, Natasha Janse van Rensburg and Ernst Janovsky at ABSA bank for their continuous support and encouragement.

My study leader, Dr Dirk Strydom, for his supervision, time and constructive criticism; Edna Cox and Elvira Oberholzer at the Business school for their kind assistance and efficiency; Prof Helena van Zyl for believing in me and giving me the opportunity to study a MBA. A special word of thanks to Duduzile Ndlovu who kindly assisted me with the statistics. I would like to extend a word of appreciation to the various role players in the potato industry who assisted me.

Finally, and most importantly, I thank Almighty God for giving me the opportunity, the inner strength and wisdom to complete this study.

Julie Christy Hayward
November 2015

ABSTRACT

A possible technique for all participants within the potato value chain to minimise their exposure to price risk is to use future contracts. The potato contract was enlisted on the South African Futures Exchange (SAFEX) in 1995 however due to market participants not trading the contract frequently enough the contract was removed within a year. The potato industry has changed over the years with the processing industry having expanded and producers facing new challenges. The main objective of this study was therefore to determine if the potato commodity derivative should be relisted on the JSE CDM.

In order to determine the viability of reenlisting the potato contract on the JSE CDM an industry analysis was first completed. The industry analysis highlighted the various sections in the industry and the factors that influence the potato industry. An important result was that only a third of the total potatoes produced are sold on the fresh produce market. Following the industry analysis five objectives were outlined to determine whether or not it would be feasible to reelist potatoes were investigated. The first objective was to determine if the potato can be standardised into a homogeneous product. The second objective was to establish whether or not potatoes can be transported and stored for a certain period of time. The third objective was to determine whether or not the potato is a free well-functioning market. The fourth objective was to determine the volatility of the potato price in the four main markets over the last 20 years. The last objective was to determine whether or not the potato contract would be traded by the role players within the industry.

The results concluded that the potato is a standardised homogeneous product and potatoes can be stored however the temperatures must not be extreme, the humidity should be around 90 to 95% and the potatoes should not be exposed to direct sunlight. There are numerous storage option avaliable for potatoes such as soil, brown bags and crates. Potatoes can therefore be stored for extended periods of time under the optimal conditions. When the potatoes are being transported and handled they are prone to mechanical damage therefore care must be taken at all times. In Johannesburg, Durban

and Cape Town there was a strong negative correlation between price and volume and Johannesburg had a weak negative correlation. Price and vloume were negatively correlated which implied that the conditions of supply and demand influence the market movements. In Pretoria the market did not show a relationship between price and volume, therefore further investigation needs to be done. These result indicated that the majority of the markets are influenced by supply and demand and that the fresh produce market moves freely in most of the markets. The medium potato price fluctuated in the markets of Johannesburg, Durban and Pretoria over time where Cape Town's volatility remianed constant over time. Therefore in the majority of the markets there was varying volatility. In the interviews it was evident that numerous players said no without having a full understanding of fundamentals of futures contracts.

In conclusion it was found that there is a need for the potato contract to be reenlisted on SAFEX however a measure to shirk the informal market needs to be investigated. Role players within the industry need to attend workshops on the concept of JSE CDM and its benefits in managing price risk.

Keywords: Potato commodity derivatives, JSE CDM, viability, risk, markets

Table of contents

Figures

Tables

CHAPTER 1

Introduction

"Striving for success without hard work is like trying to harvest where you havent planted"

- *David Bly*

1.1 Introduction and background

Potatoes (*Solanum tuberosum*) are the fourth most significant food crop in the world (Potatoes - Agricultural Marketing Resource Center, 2014). In South Africa, potatoes are planted on roughly 52 thousand hectares and yield nearly 222 million 10kg bags per annum (PotatoesSA, 2015). Potatoes are produced in 16 different regions, with the most prominent provinces being Mpumalanga, the Free State, Limpopo, the Western Cape, the Eastern Cape and Kwazulu Natal. Potatoes are planted throughout the year due to South Africa's unique topography and climate. Potatoes are classed according to the harvesting season, skin type, cultivar and intended market use. Market use categorization consists of processing, fresh market, seed potatoes and specialty varieties for the local farmer markets. Agricultural commodity prices, especially potatoes, are exposed to severe price fluctuations globally and domestically. Price risk is therefore an important variable that requires efficient management (PotatoesSA, 2015). Producers currently have a few options with regard to the prices of table potatoes; they can sell the commodity to the fresh market, processing industry or export the potatoes.

Potato prices can fluctuate widely between planting and harvesting, causing profits to be a major unknown for those in the physical trade. Price volatility is therefore an important component of potato production planning. The factors affecting the potato price and demand include: the availability of the potatoes, the quality of the produce, the

perceptions of the buyer, convenience for the end consumer, the culture of the consumer, the processing techniques, promotions and advertising of the product, the short-term inelasticity of supply and demand at marketing, prices of alternate products, weather conditions, and imports or exports (Cutts and Geyser, 2007). The more unstable the potato prices are during season, the more uncertainty the decision maker experiences (McGary and Zobell, 2012). Price risk is high and is increased at each stage of production as the commodity moves through the value chain. The potato industry experiences volatile prices and high transaction costs as a result of the marketing of potatoes (Strydom, Terblanche, Willemse and van Zyl, 2012). According to McGary and Zobell (2012) market prices can be better controlled through production and supply management strategies.

The overall variability of profits is largely influenced by volatile prices. Available commodity derivatives instruments such as forward contracts, future contracts and exchange traded options. Also price risk can be contained by efficiently managing the cost of carry, supply and demand dynamics and international trade of the commodity. . South Africa is a smaller producer of fresh potatoes when compared to the rest of the world and is therefore a price taker. This implies that the domestic price can only be between import and export parity. Agricultural commodity prices react swiftly to changes in the conditions of supply and demand. With regard to agricultural products there are numerous variations of marketing channels available to the producer such as cash market sales, storage, feed for livestock, forward contracts and future exchange contracts. The primary production and processing sectors have therefore been forced to find alternative ways to manage stochastic prices as a result of the retraction of various support systems. Contracts and marketing agreements have been formulated to shift price risk to other parties (Cutts and Geyser, 2007).

In 1995 the Agricultural Markets Division of the JSE was established with potato futures contracts being one of the pioneering instruments traded then. Subsequently SAFEX was bought out by by the Johannesburg Stock Exchange (JSE Limited) in 2001. Over the years the SAFEX the Agricultural Markets Division brand has been phased out and

replaced by the JSE Commodity Derivatives Market (JSE CDM). The requirements for a successful agricultural futures market, are liquidity in the primary spot market with regard to volume of production, multiple buyers and multiple sellers, a commodity that can be standardized, unpredictable price, no state intervention in the price making means and lastly there must be a certainty that the contracts will perform (clearing and financial system) and be delivered (infrastructure, grading regulations and warehouse receipts). The efficiency of forward pricing is dependent on the uncertainty of the potential yield, if the crop is insured and yield-price correlation (Cobble and Barnett, 1999). The main objectives of an agricultural derivatives exchange are to manage price risk and ensure a free market for price formation. The secondary objectives are price integrity, liquidity and secure settlement.

The 1995 potato futures market provided producers with a technique to manage their exposure to price risk. Potato producers who were worried about prices dropping at the time of harvesting could hedge by selling potato futures contracts. The producers were therefore able to ensure a stable profit margin regardless of the price on the spot market. Processors could likewise buy potato futures to avoid the risk of the potato price increasing. Potato wholesalers, agents and traders could use the futures market to protect themselves against price volatility. The futures contract was a cash sales agreement implying that no physical delivery would occur. The clearing house calculated the futures contract price using the National Potato Price Index (NAPPI) (SAFEX, 1995) to ensure that no one was able to influence the potato price. The NAPPI was determined by the three day weighted average price of a class 1 medium potato 10kg pocket which traded on the public fresh produce markets namely Pretoria, Johannesburg, Durban and Cape Town. The potatoes futures contract is considered to be one of the better contracts that has been listed on the JSE CDM, however it was never traded (Strydom, 2010). The producers (supply side) displayed a high level of interest in the potato contract since risk could be managed efficiently in an open market setting (Strydom, 2010). However the processors (demand side) stated that they needed a specific cultivar potato which created the need for a forward contract where the processor had a contract directly with the farmer. SAFEX obtained their input from wholesalers who usually purchase potatoes

from the fresh produce markets and concluded that the wholesalers do not bear any price risk, because the risk is shifted to the consumers through price increases. The potato futures were removed from SAFEX within a year of being introduced.

The last decade has seen a considerable increase in the volume of potatoes that are processed in South Africa from 70 000 tons in 1997 to 380 000 tons in 2014 (PotatoesSA, 2013). The option of reintroducing the potato futures contract needs to be analysed due to the expanded growth in the processing potato market. In terms of the fresh produce industry (table potatoes) there has been a lot of growth. The main contributing factors to this growth are improved technology, better cultivars and better production systems, with the largest of these contributors to this growth being the introduction of new cultivars. The main cultivar produced is the Mondial cultivar. It is a large potato which is attractive to consumers and produces high yields. According to PotatoesSA (2015) Mondial constituted 62% of the total market in June 2015. South African potato producers have two major marketing options. Firstly, the regular fresh market which is the spot market. The second marketing option is the processing market, which can be separated into two sub-sectors, namely crisps and frozen fries. This specific option is recognized as the contract market. With the change in the potato industry, farmers need to minimise their price risk in order to make efficient decisions within their volatile farming environment. Producers and processors need a way to minimise risk and the option of reintroducing potato future contracts onto JSE CDM needs to be investigated.

1.2. Problem statement

The problem that needs to be addressed is that the potato industry has evolved over the last 20 years where risks and markets have altered due to many contributing factors. Farmers farm in an unpredictable environment and profits are not a certainty. A technique to assist in managing price risk on the derivative market needs to be explored as an option to handling, price volatility.

Strydom, Willemse, Terblanche, and van Zyl (2012) identified factors hindering farmers from taking long-term contracts with processors, as most contracts are short-term

contracts in South Africa. It was found that processors prefer long-term contracts in order to minimize uncertainty and transaction costs. The main disadvantage for producing processing potatoes for the processing industry is the high transaction costs due to uncertainty and asset specificity. A price setting model was developed to determine long-term contracts that are viable for producers; this model is also capable of acting as a marketing tool due to the identification of a broad spectrum of qualities and the premiums paid for higher qualities having been established. The economic effect on processors using this model to determine producer friendly price premiums was not however determined in this research.

The marketing risk of producing table potatoes and processing potatoes was investigated by Grové and Strydom (2013). The price difference was determined using a support model which evaluated Gross Production Values (GPV), risk quantifications and utility weighted premiums for both channels considering different risk preferences. The model provided the producer with a range of production options that justified production as the producer can evaluate the enterprises current costs, the enterprises GPV's and benchmark enterprise against other producers in the same area. This research done by Grové and Strydom (2015) was a very good study to aid potato farmers. Seed potatoes were however not taken into consideration.

A weak negative price-yield correlation (natural hedge) for a particular crop entails that forward pricing by hedging in futures or by selling forward on a cash market is ceteris paribus more successful to decrease revenue risk than when a strong natural hedge persists (Harwood, 1999). The natural hedge therefore plays a significant role in decreasing revenue risk at farm level (El Benni and Finger, 2012). The main finding was that potatoes are a differentiated product and no longer a commodity. In terms of the derivative market on the demand side in South Africa there was also a need for risk administration (Strydom, 2010). The substantial commodity price disparity has made the choice of marketing strategies a critically important component of management according to Curtis, Lutgen, Frank and Pfeiffer (1987).

The following questions are therefore raised:

- Have the markets altered drastically over the years?
- Is price volatility a problem to the potato industry as a whole?
- Does the potato price contract need to be reenlisted on JSE CDM?

1.3 Aim

To evaluate the viability of reintroducing the potato futures price contracts on JSE CDM in South Africa.

1.3.1 Objectives

1. Establish that the potato is a homogenous commodity that can be classified into a standardized quantity and quality

   A homogeneous product ensures that all market participants know exactly what quality commodity is being traded without needing to see the commodity being sold.

2. Determine if potatoes can be stored and transported cost effectively in mass over extensive distances.

   If the physical product cannot be stored and/or transported, then only a cash settlement contract may have to be considered. These are similar to the financial futures contracts. When potatoes were briefly traded on SAFEX only a cash settlement contract could be considered however a very well established underlying cash market needs to be working for this approach to be successful. When the potato futures contracts were briefly traded, a five-day average was determined on the four main markets in South Africa. The outcome was taken as the primary commodity price (SAFEX, 2010).

3. Analysis of the market is determined by supply and demand factors as then the prices move freely on a well-functioning cash market.

   No threat of big participants manipulating the market or price must be present.

4. The price volatility needs to be ascertained.

   There is no price risk, if potatoes are not exposed to price movements and therefore no reason to hedge against price variations. Potential speculators will also then be deterred from participating in the contract.

5. Determine if the potato contracts will be traded regularly, as then a high degree of liquidity is present.

   If there is not sufficient liquidity in a market it would not be possible to take a position that is required to hedge. This situation would add risk, not minimize risk as intended. The danger of low liquidity is the likelihood that a position cannot be closed quickly enough, thus causing monetary losses.

1.4 Outline of the study

This research is presented in the following layout: Chapter 2 is an industry analysis of the potato. Chapter 3 is a literature review on value chains done on various commodities, pricing systems of the potatoes and various contract options available in the market for agricultural products. Chapter 4 describes the methodology used to obtain the results of the value chain and price volatility. Chapter 5 presents the results of the study and concludes the findings as to whether or not potatoes should be reenlisted on JSE CDM. Chapter 6 covers the conclusion, limitations and recommendations of the study.

CHAPTER 2

Industry analysis

"Always do your best, what you plant now you will harvest later."

- *Og mandino*

2.1 Introduction

This chapter focuses on an industry overview of the potato industry. An industry overview provides an understanding on the current market and the main factors affecting the feasibility of the industry. The potato supply chain in Figure 2.1 provides a visual representation of the value chain of potatoes which includes the links between the potato growers, inputs, logistical service providers, transporters, middlemen and traders. The flow of the potato in the market is depicted, the activity at each stage, the structure of the operators and the support involved in the value adding process are shown. There are numerous market segments available to the producer such as table potatoes to the end consumer and potato for processing.

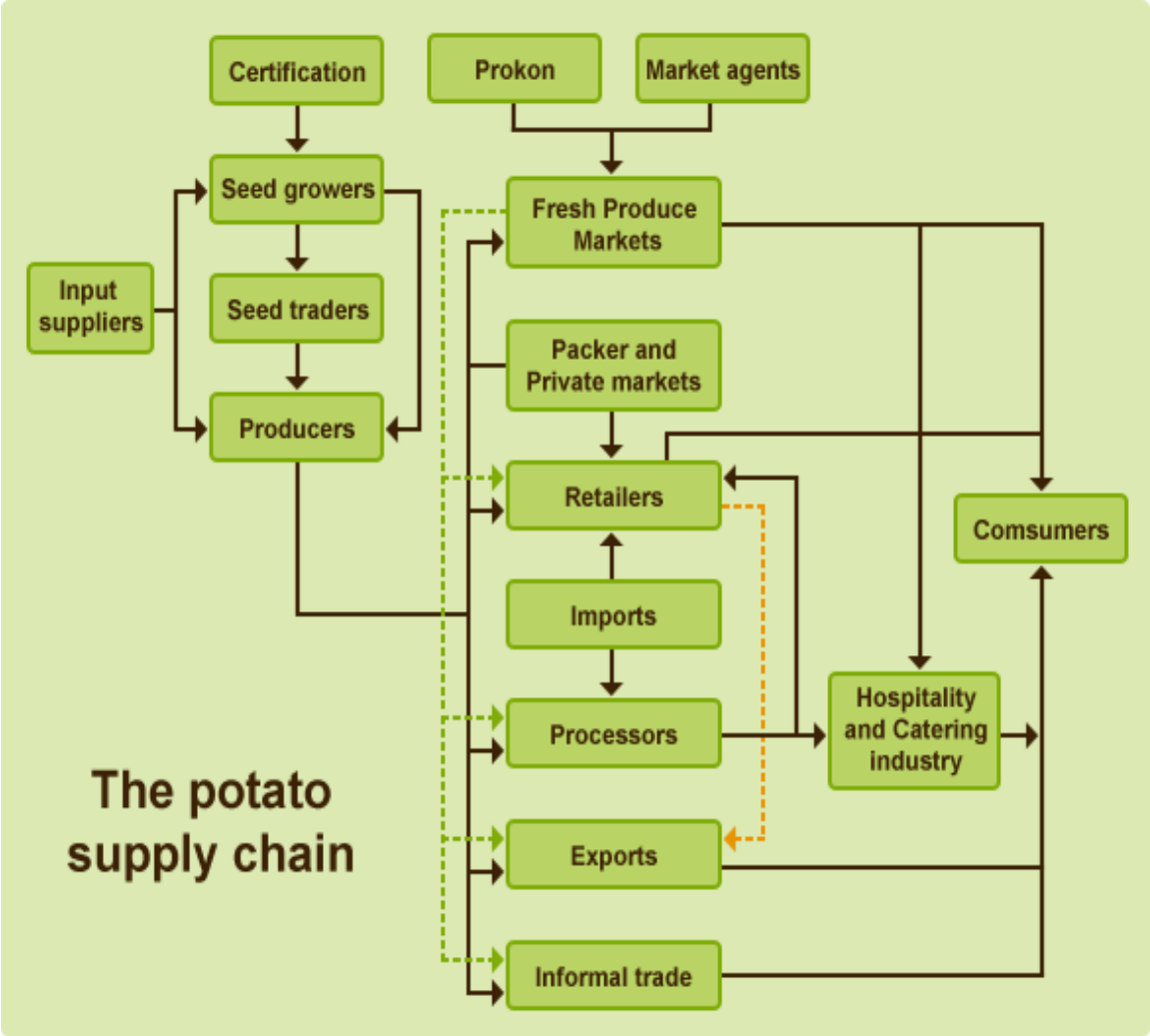
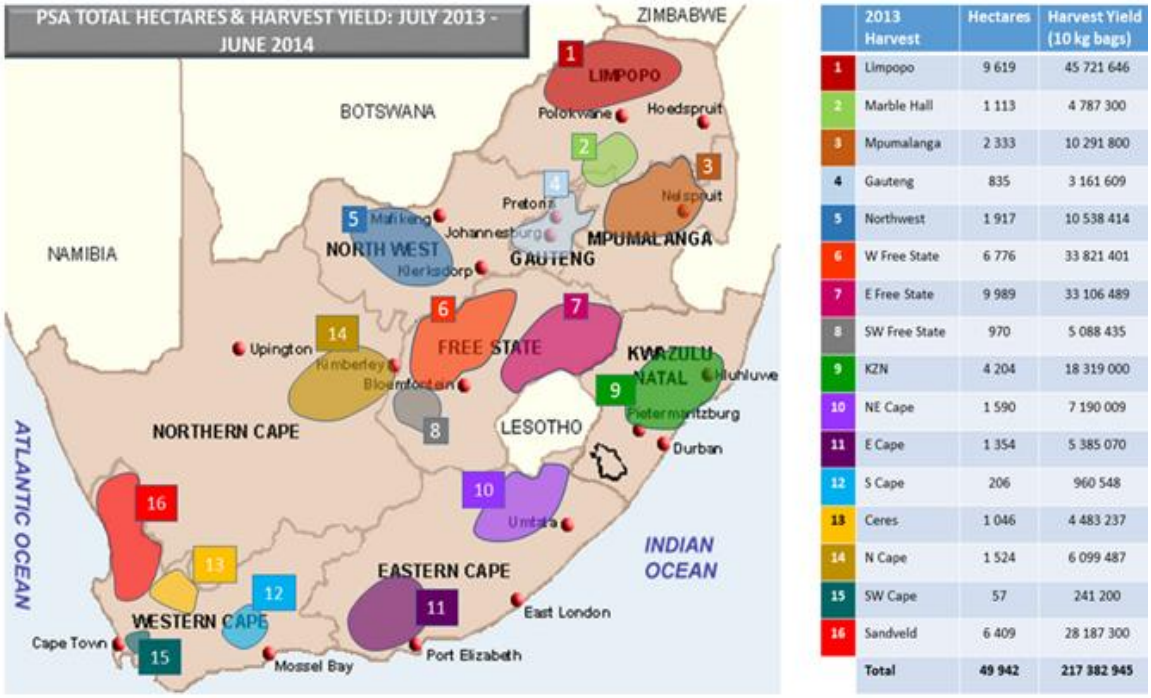


Figure 2.1: The potato supply chain

Source: PotatoesSA, 2015

2.2 Production analysis

In South Africa potatoes are produced in 16 different regions. The main producing areas are situated in Limpopo, Free State, Western Cape, Mpumalanga, Kwazulu Natal and Eastern Cape as indicated in Figure 2.2. This ensures a steady supply of potatoes throughout the year. The average price in 2014 for potatoes was R3 428/ton (Abstract of Agricultural statistics, 2015).



	2013 Harvest	Hectares	Harvest Yield (10 kg bags)
1	Limpopo	9 619	45 721 646
2	Marble Hall	1 113	4 787 300
3	Mpumalanga	2 333	10 291 800
4	Gauteng	835	3 161 609
5	Northwest	1 917	10 538 414
6	W Free State	6 776	33 821 401
7	E Free State	9 989	33 106 489
8	SW Free State	970	5 088 435
9	KZN	4 204	18 319 000
10	NE Cape	1 590	7 190 009
11	E Cape	1 354	5 385 070
12	S Cape	206	960 548
13	Ceres	1 046	4 483 237
14	N Cape	1 524	6 099 487
15	SW Cape	57	241 200
16	Sandveld	6 409	28 187 300
	Total	49 942	217 382 945

Figure 2.2: Potato production regions in South Africa

Source: PotatoesSA, 2015

2. 3 Market analysis

2.3.1 Market share and production potentials

The quantity of potatoes used for processing has gradually increased over the years as is evident in the decline to the fresh produce market in Figure 2.3. This increase has been mainly due to the elevated average income of the population, the growth in the fast-food industry, the rapid pace of urbanization and the flood of international processing firms into South Africa. The fast-food industry expansion is mainly due to dry crisps, frozen fries and fresh chips. Of the processed potato products 98% are used for the production of dry, frozen and fresh chips while the outstanding 2% are used for mixed and canned vegetables (Potatoes South Africa, 2012).

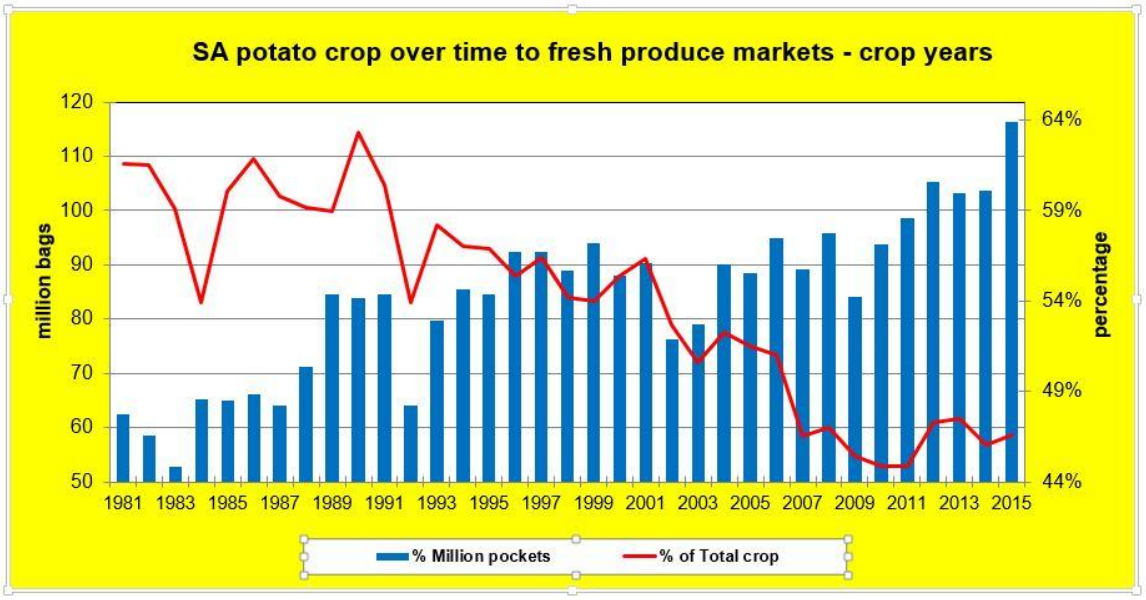


Figure 2.3: Potato crop going to the fresh produce market in South Africa

Source: PotatoesSA, 2015

2.3.2 Domestic production and market

There has been an increase in average yields over the years mainly due to the use of higher yielding cultivars, a larger production under irrigation, better seed quality and improved production practices. The average yields under irrigation are currently averaging 40 t/ha. Figure 2.4 indicates this increase in yield over time by depicting the South African hectares and crop size over an average of 20 years.

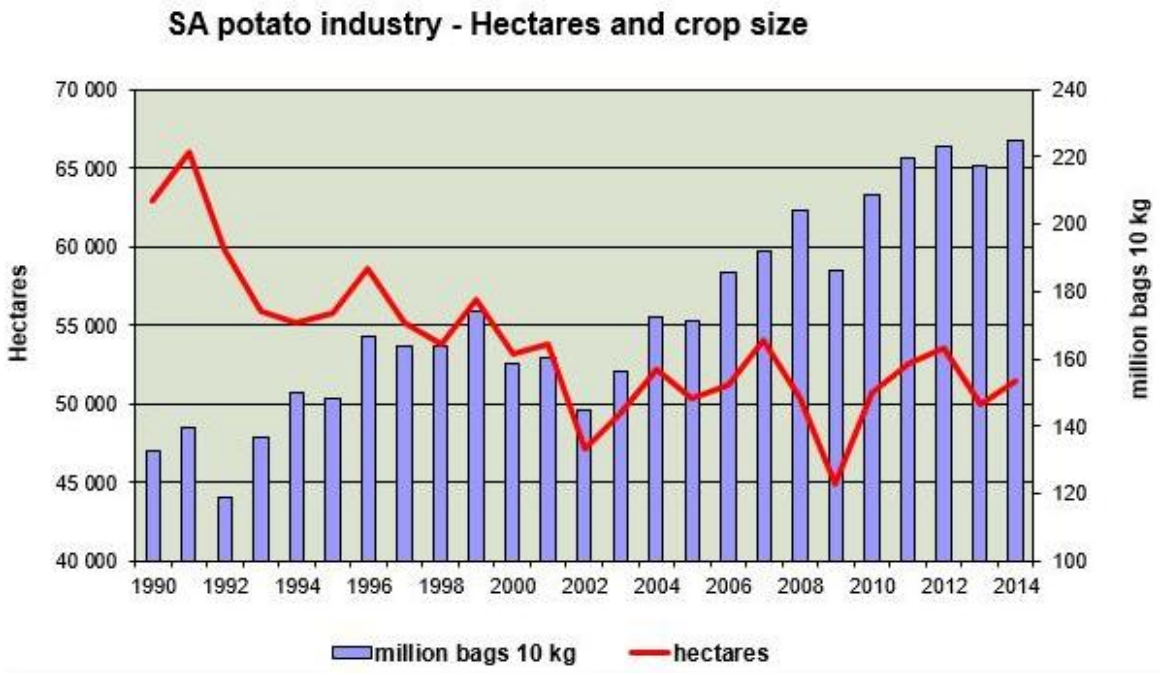


Figure 2.4: South African hectares and crop size

Source: PotatoesSA, 2015

2. 4 Export market

Potatoes are perhaps the most appropriate vegetables for the export market because they are simple to grade, easy to pack under the right conditions and their shelf life is much longer than most other vegetables. As a result of the country's small export contribution of 0.49%, South Africa is not a major exporter of potatoes. Nearly 95.3% of South African potato exports go to the Southern African Development Community (SADC) countries such as Angola, Mozambique, Zambia and Zimbabwe. With low import levels, South Africa can sustain itself in terms of potato production, therefore potato imports into South Africa are minor (PotatoesSA, 2013). There is a high demand for potatoes in South Africa and the production is able to sustain the demand and few imports are brought in for processing however frozen potato chips are brought in when the import parity is favourable.

2.5 Marketing channels

Potatoes are sold through various marketing channels in South Africa namely the informal trade, national fresh produce market (NFPM) and directly to processors and retailers. Figure 2.5 indicates that in 2013 the informal trades had the largest percentage of the fresh market sales with 53%, followed by the formal traders with 31% then the processors with 8% and then lastly the exporters with 7%. Over the years the National Fresh Produce Markets (NFPMs) sales of potatoes have declined. However, for the trade of fresh potatoes in South Africa the NFPMs remains a significant channel. The largest potato market is Johannesburg where the fresh produce market has a 32% share followed by Tshwane with 18%, Cape Town with 10% and Durban with a 10% share (PotatoesSA, 2013). The key reason for the decrease in growth of potato sales have been due to the departure from the NFPMs by the potato producers to processors, wholesalers and retailers. Potatoes are exported to other counties through marketing companies and export representatives (Department Agriculture, Forestry and fisheries, 2012). From a marketing perception however, the weakening of the South African rand positively affects the export of potatoes, including areas in the Southern African Development Community (SADC) region.

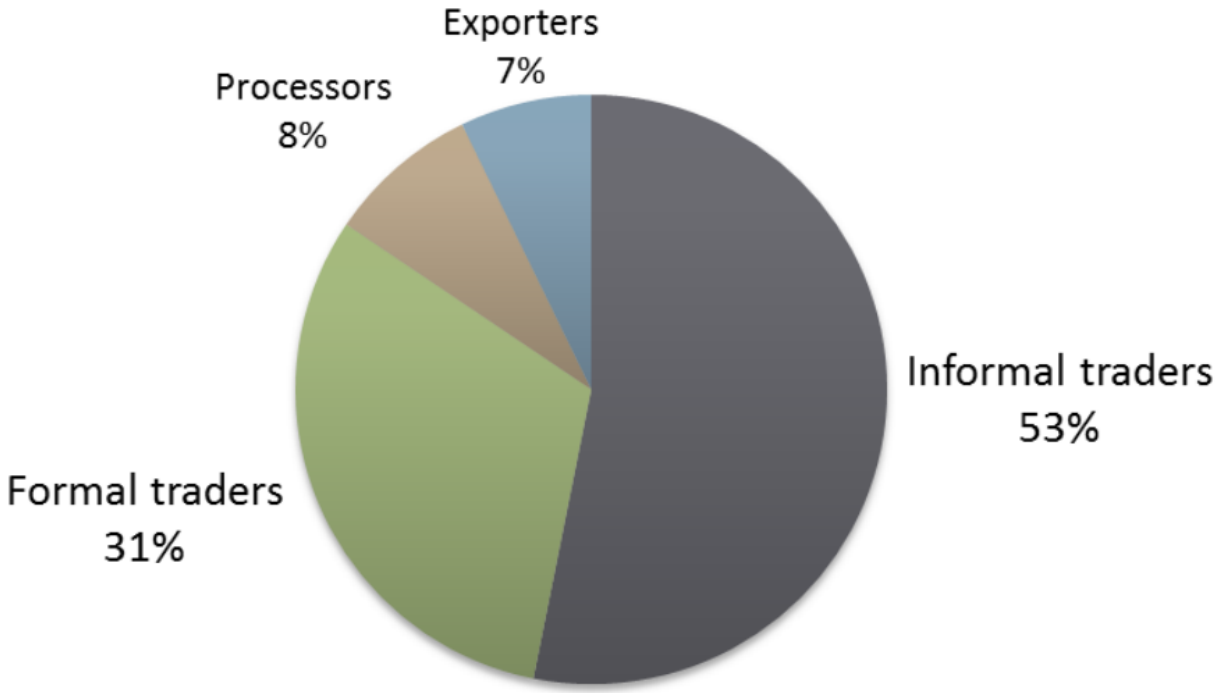


Figure 2.5: Buyers of potatoes on the fresh produce markets in 2013

Source: PotatoesSA, 2015

According to PotatoesSA (2012) (Department Agriculture, Forestry and fisheries, 2012) the allotment of 53% of all fresh potatoes sold on the fresh produce markets were through the informal traders and 30% of all potatoes sold in 2011. Presently the number of informal traders who acquire 10kg pockets from fresh produce markets is unknown. The informal traders also buy directly from producers, repackage the potatoes into small plastic bags and sell them in both the countryside and in the city. The increase of this type of trading in urban areas has occurred due to changes in urban eating patterns and urbanization.

The formal segment comprises mainly of the large retailers in South Africa, for example Shoprite-Checkers, Pick 'n Pay, Fruit and Veg City, Spar and Woolworths. The large retailers purchase roughly 38% of all fresh potatoes produced, apart from any processed potato products that are also sold through the regular trading channels. The formal trade in potatoes normally concentrates on the trade of excellent quality fresh potatoes, either in smaller packaging or loose. A few of the formal traders assume their own branding, packaging and marketing through the direct purchases from producers.

2.6 Production costs

The increase in fuel expenses and other inputs have a direct effect on the cash flow. According to Breytenbach, Meiring and Oosthuizen (1996) at an enterprise level electricity overheads account for one of the main variable cost items therefore the amount of irrigation, the design of the system and the electricity usage must be managed efficiently in order to mitigate the high cost of electricity. With the current shortage of electricity in South Africa this expense is expected to increase substantially. As the input prices increase, producers start to enter into a cost-squeeze situation. Therefore in order to mitigate their risk of financial loss, producers can improve their yields, reduce their costs or manage their prices.

2.7 Volumes sold

The variation in the sales volumes of potatoes over a 14 year period has widened substantially over time as seen in Figure 2.6 where the four largest markets are depicted. Pretoria has had the largest percentage increase and Cape Town has had the least (PotatoesSA, 2015). In Table 2.1 the sales on the fresh produce market are indicated for 2014. Johannesburg has the largest sales followed by Pretoria, then Cape Town and finally Durban.

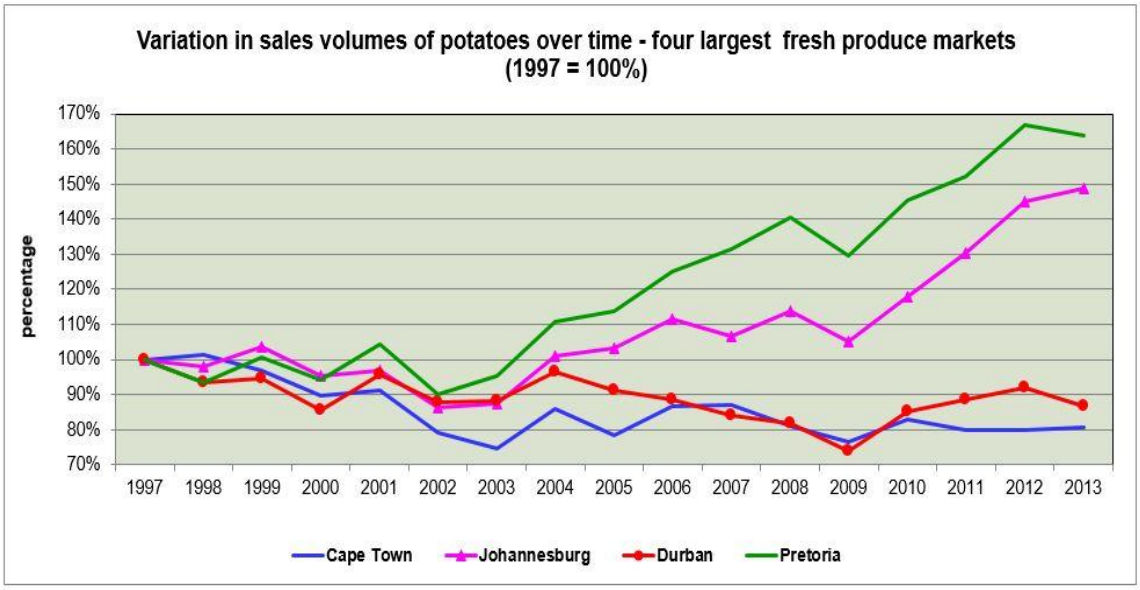


Figure 2.6: Variation in sales volumes of potatoes over time for the four largest markets

Source: PotatoesSA, 2015

Table 2.1: The sales on the fresh produce markets 2014

Fresh produce market (cities)	Total pockets	% of total	Average price	Percentage of sales / supplies			
				Class 1	Class 2	Class 3&4	Class 1 Medium
Johannesburg	37 204 288	36%	34,55	82%	14%	5%	51%
Pretoria	18 666 450	18%	34,76	74%	19%	7%	48%
Durban	9 896 224	10%	33,50	75%	18%	7%	55%
Kaapstad	9 862 290	10%	33,68	74%	22%	3%	44%
Springs	3 682 811	4%	33,67	73%	16%	11%	44%
Port Elizabeth	3 569 952	3%	32,29	69%	20%	12%	45%
Pietermaritzburg	3 487 517	3%	29,45	59%	27%	14%	36%
Oos London	3 023 702	3%	35,87	69%	17%	13%	46%
Klerksdorp	3 021 237	3%	34,34	74%	18%	8%	47%
Bloemfontein	2 378 118	2%	36,79	73%	20%	8%	49%
Mpumalanga	2 297 363	2%	38,94	75%	22%	4%	46%
Welkom	1 690 241	2%	36,45	74%	15%	11%	48%
Vereeniging	1 230 666	1%	35,26	74%	20%	6%	45%
Witbank	791 960	1%	36,99	74%	21%	5%	40%
Uitenhage	615 648	1%	32,18	63%	23%	14%	33%
Kimberley	510 334	0%	36,24	74%	15%	11%	51%
George	471 118	0%	33,61	66%	24%	10%	28%
Umtata	458 836	0%	30,82	59%	29%	13%	35%
Nelspruit	354 262	0%	33,87	73%	23%	4%	58%
Total	103 213 016	100%	34,33	76%	17%	7%	48%
* Also based in Nelspruit							

Source: PotatoesSA, 2014

2.8 Challenges affecting the potato industry

The key challenge to the potato industry is to preserve the quality of the potato for exports on long distance expensive refrigerated transport (PotatoesSA, 2015). Another problem facing the potato industry is the need to increase the quantity of potatoes for the supply to international markets while trying to minimise production cost. Climatic conditions do affect production and must always be considered. Of all the potatoes produced in South Africa's 70% to 80% of the potatoes are produced under irrigation which is a problem due to the country's limited water and high dependency on water for irrigation. The rapid increase in production costs (particularly fuel) and the lack of infrastructure in remote rural areas for small-scale producers in accessing markets are threats to the industry (PotatoesSA, 2015). If the domestic potato price exceeds that of the

import parity price then there is the potential that the domestic processing industry could be left vulnerable.

Barriers to trade in the potato industry can be divided into tariff barriers which include ad valorem tariffs, quotas, entry price systems and specific tariffs and non-tariff barriers which include phytosanitary and sanitary labels and measures. The key markets for potatoes make use of both tariff and non-tariff measures to shield the local potato industry. The main aspects that effect the consumption of potatoes and various marketing strategies are supply (availability), price/value for money, processing, quality (trust in the product), ethics (preference and taste) health, convenience, traditions, exports, promotions/advertisements/packaging and perceptions. PROKON (Product Control for Agriculture) is an article 21 company which establishes and maintains product quality control (PotatoesSA, 2015). The processing market of potatoes is growing due to the growth of the fast food industry, the enlargement of processing facilities, the higher average income of the population and the fast rate of urbanization. The processing industry uses 380 000 tons of fresh potatoes where French fries, frozen and chilled products and crisps comprise the majority of the market.
Devastating

2.9 Summary

The potato industry is comprised of numerous sectors that are all interlinked. A change in one sector can have ripple effects further along the potato value chain. There are numerous producers spread all over the country which lengthens marketing months of potatoes. There is a relatively long distance from production to the main markets which does pose a logistical issue. The production costs are expected to increase with time causing the producer to seek less risky options otherwise facing a cost-squeeze predicament. The processor can benefit from physical contracts.Overall the fresh potato industry can only benefit from a reduced exposure to price risk through the use of a futures contract.

CHAPTER 3

Literature review

"Don't judge each day by the harvest you reap but by the seeds you plant"

- *Robert Louis Stevenson*

3.1. Introduction

Understanding what other people have researched in the field with regard to the problem proposed assists one to investigate with more knowledge and insight. According to Leedy (1993) the significance of a background on all related literature is the start to solving any problem. This study includes an overview on literature related to the potato market within South Africa and then the JSE CDM.

3.2 Marketing conduct

3.2.1 Pricing

The overall variability of profitability is largely influenced by volatile prices therefore price risk can be managed in various ways namely using a derivative instrument, storage, supply and demand and international trade and supply contracts.. Price risk is affected by commodity stocks levels and export demand (Cobble and Barnett, 1999). The substantial commodity price disparity has made the choice of marketing strategies a critically important component of management according to Curtis, Lutgen, Frank and Pfeiffer (1987) therefore the potential returns generated by any given marketing strategy must be carefully considered. As markets have changed so has the potato industry shifted to processing potatoes.

Commodity prices, especially agricultural prices, are exposed to serious price fluctuations globally and domestically, therefore price risk is high. This fluctuation is largely due to

the short-term inelasticity of supply and demand for agricultural products (Cutts and Geyser, 2007). In the short-term production is set and is dependent on the environmental conditions. Demand is more constant than supply because any environmental factor could occur thereby deterring harvesting.

3.2.2 Pricing system for crops

The South African Grain Information Service (SAGIS) compiles essential market information in order to assist farmers with their market planning. The local prices in South Africa for field crops are established by numerous interlinked factors (Department of Agriculture, forestry and fisheries, 2011). There are a variety of marketing channels available to the producer (Department of Agriculture, forestry and fisheries, 2012).

3.2.3 Pricing system for potatoes

Potato prices are mainly ascertained by market forces of supply and demand in the NFPMs (National Fresh Potato Market), which is a favoured marketing channel for potatoes. A vital part of price determination in the market is product grading. Potatoes are still formally graded at the NFPMs. The price obtained by the primary producers on the NFPMs is a foundation for the price received when the consumer buys directly from the producer. Figure 3.1 shows the consumer spending on potatoes and potato products in SA compared to the gross income of the producer over the last eight years. Producer incomes have not increased dramatically over the years but consumer expenditure has (PotatoesSA, 2015).

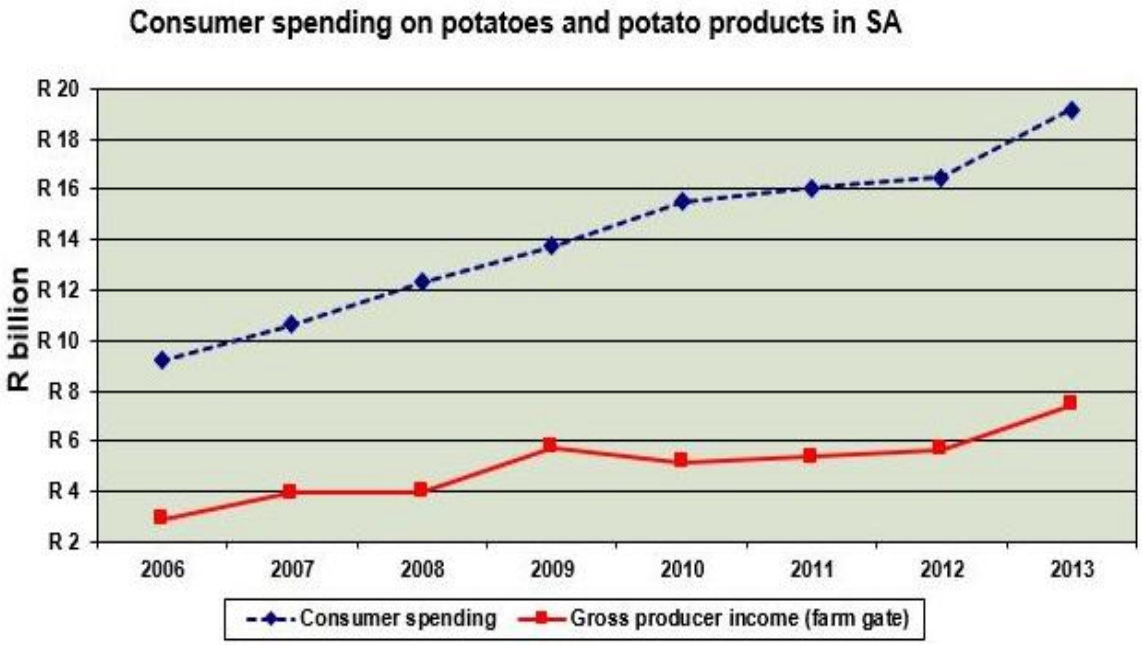


Figure 3.1: Consumer spending on potatoes and potato products in SA

Source: PotatoesSA, 2015

Figure 3.2 indicates the weekly average price for all markets and all classes of potatoes over the last four years. During most of South Africa's main holidays the price peaks for potatoes. The potato price therefore increases as consumers demand more potatoes thereby potentially having insufficient volumes.

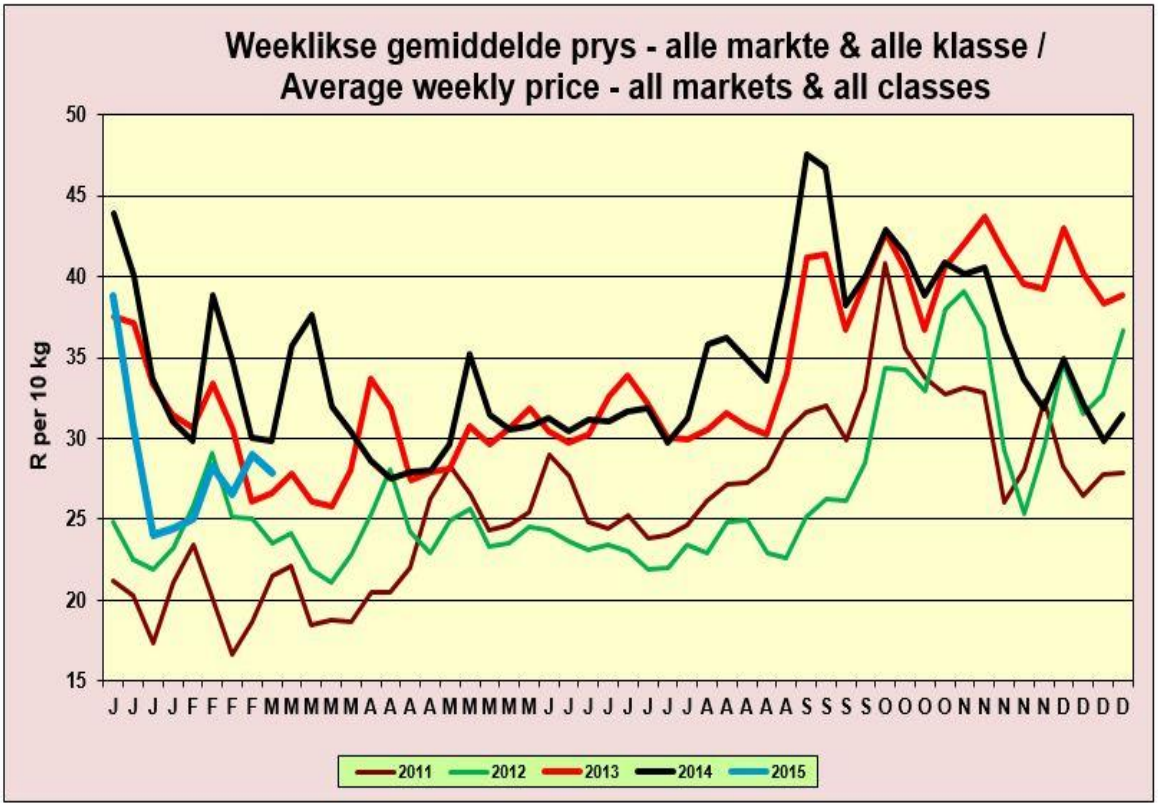


Figure 3.2: Weekly average price for all markets and all classes of potatoes from 2011 to 2015

Source: PotatoesSA, 2015

There is a high risk with regard to producer income due to the large variations in prices and yields of potatoes (Jordaan, Grové, Jooste and Alemu, 2007). It is important to ascertain price volatility because this is an important part of profit variability and farmer's risk management, especially for the table potato market (Du Preez and Van Zyl, 2010). The increase in irrigated potatoes over the years has reduced the yield risk slightly due to a more constant supply.

The potential magnitude of returns generated by any given marketing strategy must be carefully considered. The market influencing factors are fluctuations in production levels in the country, variations in weather conditions, prices of competitive vegetables, demand level from the various areas of the country, development stages of the crop, transportation

charges and informal markets. The South African market is more affected by weather due to the variable climate than the USA Market (Cutts and Geyser, 2007).

Price risk can be managed in numerous ways. The derivatives market is a platform to manage price risk, however there is no derivative market in South Africa currently for potatoes (Strydom, 2010). Contracting is another technique, however only the processing industry is currently making use of this system. Retailers such as Pick n Pay and Woolworths contract their potato supply directly from producers. Contract marketing however, contains price risk, due to the shift of uncertainty from the supplier to the buyer (Perry, MacDonald, Nelson, Hahn Arnade and Plato, 2005; Rhodes, Dauve and Parcel, 2007; Kirsten and Sartorius, 2002).

3.2.4 Price volatility quantification

There are numerous methods to measure volatility including the standard deviation of prices, the coefficient of variation and the Black-Scholes-Merton model. Unconditional standard deviation and the coefficient of variation assume that past realisations of price and volatility do not affect present or future realisations (Jooste, Jordaan, Alemu, and Spies, 2006: Jordaan *et al*., 2007). Therefore neither method distinguishes between the known and unknown components of price series and consequently overestimates the degree of uncertainty. The Black-Scholes-Merton model assumes that the price varies in a deterministic way, therefore the model is unable to account for periods of changing volatility (Jooste *et al.*, 2006: Jordaan *et al.*, 2007).

From the brief overview of various models it is evident that none of them are suitable to quantify price volatility precisely. A model that accounts for the predictable and unpredictable components in the price process, which meets the requirements, as stated by Moledina, Roe, and Shane (2003) and Just and Pope (2002) is the Autoregressive Conditional Heteroscedasity (ARCH) or Generalised Autoregressive Conditional Heteroscedasity (GARCH) approach. This approach was used in recent studies by Du Preez and Grove (2010). The model concentrates on homoscedasticity and treats

heteroscedasticity as a variance to be modelled. This results in the correction of the deficiencies of least squares and the computation of the prediction for the variance of each error term (Engle, 2001). The ARCH model has short-comings of not having a longer memory and a more flexible lag structure therefore the GARCH is used to extend this model.

The GARCH approach generalises the purely autoregressive ARCH model to an Autoregressive moving average model. The weights on past squared residuals are understood to decline geometrically at a rate approximated from the data (Engle, 2002). Engle further states that the GARCH prediction variance is a weighted average of three different variance forecasts. The first forecast is a constant variance that corresponds to the long-term average. The second forecast is the forecast made in the prior period and the third prediction is the forecast that is made with the new information that was not available in the previous period. The weights of these three predictions determine how quickly the variance changes with new information and how rapidly it goes back to the long-term mean. Due to these reasons the GARCH approach is better than other models for the information on volatility contained in the time series.

3.2.5 Behaviour in the market

In future the South African potato industry is expected to be affected by two key shifts within the production and processing of potatoes. The first shift is the persistence of the transition from dry land production to irrigated production. The conversion will ensure an increased and constant supply of potatoes, thereby creating a better price consistency within the subsector. The second change that has started occurring, is that with time, the domestic demand for potatoes has increased, due to the increase in sales of potatoes on the fresh produce markets, and the growth in the volume of potatoes used for processing. The local growth in the demand for potatoes may mean that people, especially in the urban area, are moving away from traditional foods such as maize and opting for potatoes instead. In Sub-Saharan Africa an increasing number of countries are relying on South Africa as a dependable source of food (Potatoes South Africa, 2012). An increase in the

possible market size for South African potatoes will occur as exports into Africa. The South African potato market is large and varied with the producer having several options to sell their produce to the fresh produce market, the processing market, informal trade, retail, processing, exports and seed markets as Figure 3.3 depicts in the schematic representation of the South African potato supply chain.

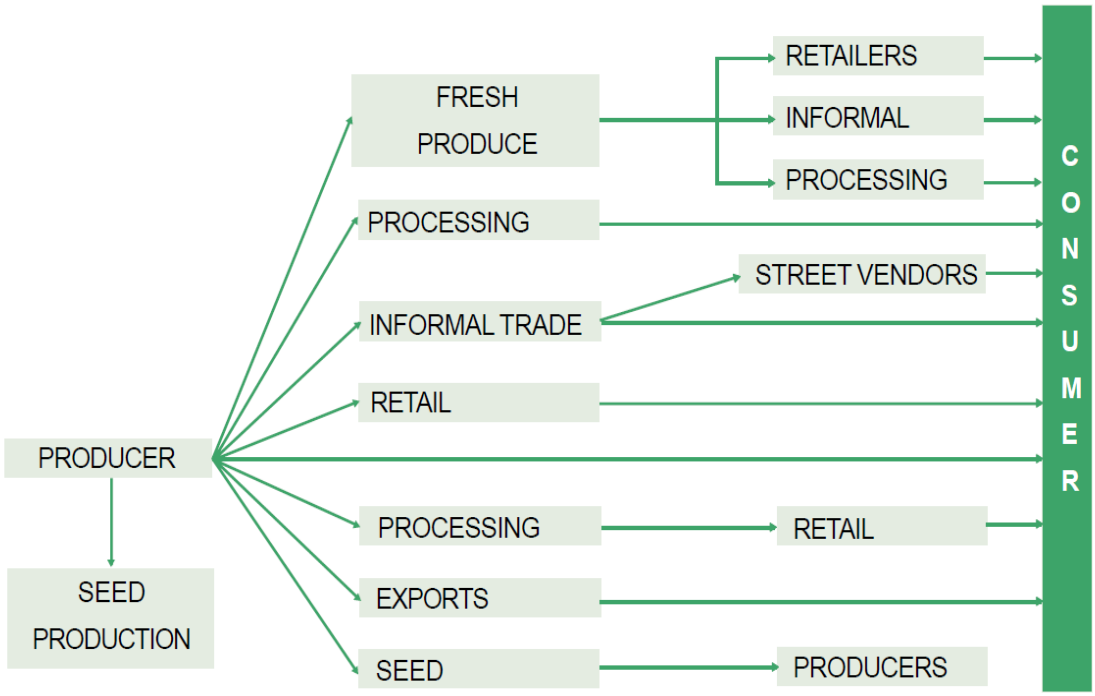


Figure 3.3: Schematic representation of the South African potato supply chain

Source: PotatoesSA, 2013

3.3 Contracts

There are numerous reasons why farmers are moving to agricultural contracts. The first reason is that the contracts provide a way to diversify both price and production risk among participants in a specific contract thereby decreasing the transaction cost (Kirtsten and Sartorius, 2002). Other added benefits are fewer barriers to entry into the market, new marketing techniques (an amalgamation of the spot and contract market) and

available distribution channels (Kirtsten and Sartorius, 2002). Farmers normally have knowledge from their assorted input suppliers; however, contracts give farmers the chance to access the technical expertise of the buyers' field officers and innovative levels of administrative skills (Kirtsten and Sartorius, 2002). The processors can also gain from getting a product of an excellent quality and an increased certainty of supply of potatoes. Agribusinesses use contracts as a way to control the quality of the product (Rhodes, Dauve and Parcell, 2007). Over the previous decade there has been a considerable increase in growth of 143% in the volume of potatoes processed into frozen fries from 70 000 tons in 1997 to 170 000 tons in 2007 (PotatoesSA, 2015).

Agricultural contracts have three key characteristics according to Rhodes, Dauve and Parcell (2007) specifically the allocation of decision rights, allotment of value and allocation of risk. In agricultural commodities there are two key types of contracts used for transactions. The first type of contract is a production contract which handles a specific farmer and contractor who are accountable for production inputs and practices, as well as a technique for determining the imbursement (Strydom, 2010). This form of agreement frequently identifies particular inputs to be used, production plans and permits the contractor to provide technical suggestions and make field visits (MacDonald, Perry, Abern, Chamber, Dimitri, Key, Nelson and Southard, 2004). The next kind of contract is usually recognized as a marketing contract. Marketing contracts stipulate a price and an outlet for a specific commodity. This normally occurs before the commodity is harvested and is set to be marketed. The pricing mechanisms often restrict a farmer's exposure to extensive price fluctuations and the contract must be delivered at a specific quantity, quality and period of time (MacDonald *et al*, 2004). Potato processing firms in South Africa use both of these contracts but the major focal point is on marketing contracts. A marketing contract can be fragmented into more complex set-ups. Slangen (2005) and Peterson, Wysocki, and Harsh (2001) recognized the following contracts: relationship contracts, classical contracts and neo-classical contracts. The most frequently used contract in the potato industry is a neo-classical contract (Slagen, 2005 and Peterson *et al*, 2001). A neo-classical contract is a contract that has price and safeguard coordinate

actions whilst fulfilling contact terms. Transaction disagreements are renegotiated by the parties involved and a arbitrator is sometimes included.

As a result, domestic consumers have nearly continuous access to fresh potatoes. Quality influences the consumer's first choice and the ability to sell the product. High-quality potatoes are uniform in shape and size, clean, have an unmarked skin and firm flesh, have shallow eyes and are free of internal defects. Consumers don't enjoy having to waste the potato by cutting out deep eyes and surface imperfections (Strydom, 2010). Greening, growth cracks, *Rhizoctonia spp. Sclerotia*, storage rots, internal black spot, scab, secondary growth, skinning, bruising and skinning or additional mechanical damage are other tuber defects that may negatively affect quality. Potatoes are harvested throughout the year in South Africa in numerous regions unlike Europe's one season. Table potatoes are graded, brushed or washed, packaged and sold to buyers.

Agricultural contracts can minimise numerous transaction costs in the vegetable industry by limiting price and yield uncertainties (MacDonald et al, 2004). Goodhue and Hoffman (2009) found that longer term contracts can lessen transaction expenses to a larger extent. In 2001 nearly 36% of the value of USA agricultural production was governed by production and marketing contracts which increased significantly from roughly 12% in 1991 (MacDonald *et al*, 2004). The type of farm determines how the contracts are used. On commercial farms 42% of the production value is under contracts, compared to 24% and 13% of production values on intermediate and rural residence farms respectively in the USA. Equally, the quantity of USA crop production sold under contract is increasing with time (Paulson, Katchova, and. Lence, 2010).

3.4 Derivatives Market

Commodity markets are volatile and role players in the markets seek ways of hedging and trading risk. As a result of this, the need for commodity risk trading grew. The main risks of futures contracts are prepayment risk, credit risk, liquidity risk, basis risk and market risk (Madura, 2008). In order to maximise the benefits of the derivative market, three prerequisites must be met namely the derivative market must be efficient,

innovative and the trading and clearing platforms must be safe (Kotze 2011). Commodity futures prices, spot prices and changes in inventories are determined by the equilibration of supply and demand in two interrelated markets namely a market for storage and cash market for spot sales (Pindyck, 2001). A futures market is where buyers and sellers gather to trade and for price discovery and price risk management. Futures contracts are legal agreements traded on futures markets which stipulate a standardized commodity, place, quality, quantity and delivery date. Through the continuous global flow of information influencing the present and future supply and demand expectations of the seller and buyer, the futures market's price is determined. Futures markets are mainly used. A forward contract is an agreement negotiated among two parties for the deliverance of a physical product at a specified time in the future, for a specific fixed price. The contract stipulates the amount, quality, type of product and location of delivery. Forward contracts are often less uniform than futures contracts and precise conditions may differ (JSE, APD Dealers Examination Material March, 2010).

The "cash" or "spot" agricultural commodities market portrays the marketplace where suppliers sell and users buy a physical product based on negotiated conditions including quality, quantity, delivery date and location. An option contract provides the owner with the choice to buy or sell an underlying instrument at a predetermined price in a certain time frame or date. If the buyer exercises the option, the seller will be obliged to buy or sell an underlying futures contract at a pre- set price which is the strike price. Call options provide the buyer with the choice to buy futures contracts at a specific time and price in the future. A Put option gives the buyer the choice to sell futures contracts at a particular price and time in the future.. A long hedger (buyer) would want to pre-price to avoid rising futures prices and vice versa. A hedge is a way to decrease the price risk of holding the actual product by taking an offsetting position in the futures market. A hedge counteracts the investment of a position in the cash market and invests in the opposite position in the future markets (JSE APD Dealers Examination Material March, 2010). Therefore farmers with high leverage will be more inclined to hedge (Cobble and Barnett, 1999). The price volatility fluctuates over time where it can either be bearish and diminishing, bullish and advancing or remaining in a constant horizontal array (JSE APD

Dealers Examination Material March, 2010). The estimation of the amount to be hedged and risk reduction is more difficult in the environment of volatile yields (Cobble and Barnett, 1999).

Grové and Jordaan (2007) sought to find the factors affecting the Vaalharts maize producers' adoption of forward pricing techniques in volatile price management. A logistic regression was used to determine the factors influencing the choice to use forward contracting or not in the 2004/2005 season. Forward pricing techniques integrated cash forward contracting and using SAFEX for hedging with futures contracts and/or options. Forward pricing was linked to lower levels of risk aversion and elevated levels of human capital. Farmers were found to be reluctant to use forward pricing. Cobble and Barnett (1999) in their study found that production is worthwhile when the forward price covers the variable costs.

3.5 Value chain analysis

A value chain analysis is a technique to represent the value that is created in a product as it is transformed from raw inputs to a final product that can be consumed (Joshi and Gurung, 2009). A value chain systematically considers all steps of a production process into perspective, analyses the links and information flows, reveals the strengths and weaknesses, ascertains the boundaries between national and international and strengthens the production relationships in trade (Richter, 2005). The people performing the basic functions of a value chain are operators and they can be grouped into production, post harvesting, processing and trading operators. The value chain supporters remain outsiders to the regular process and only partake in temporary facilitating of the chain. The business development services are offered to the value chain which can be in the form of tangible (transport, machinery or storage) or intangible (technical assistance, training etc.) support.

Joshi and Gurung (2009) did a value chain analysis on the potato in Bhutan, South Asia in order to identify the bottleneck which needed to be addressed in order to improve

competitiveness. A critical overview of the existing production system, product delivery and trading practices was done. Gyeltshen, Griffith , Dorji and Lakey (2015) took this study further to analyse the current literature on the citrus value chain in Bhutan to determine the current restraints in the value chain and suggest strategic interventions for sustainable expansion of the citrus value chain. They used Value chain mapping, which is a visual illustration of the chain and defines all the linkages and activities between the value chain operators and supporters (FIAS, 2007 and Joshi and Gurung, 2009). It was found that future research needs to analyse the performance and strategic objectives of the citrus value chain and the barriers to incorporating the chain drivers. It was concluded that future studies need to be incorporated in the value chain analysis of the potato commodity.

The UNIDO (2012) did a value chain analysis on Tanzania's Red Meat industry. The UNDIO methodology of industry value chain diagnostics was used to draw findings from existing data and analyses. It was found that there was room to increase productivity. CARE-Ethiopia conducted a milk and milk product value chain in order to identify key factors and the different relationships. Both secondary and primary data was used from the five major milk producers and the policy, regulatory and institutional framework was considered within which the sub-sector operated (Yonad business promotion and consultancy PLC, 2010)

3.6 Empirical studies

Risk transfer and price discovery are two key factors of futures contracts. Under the right market conditions these factors can assist numerous participants in the fresh potato markets. Farmers have to make investment commitments where future outputs are uncertain thereby creating a trade-off between risk and expected income (McKinnon, 1967). Turnovsky (1983) analysed the effect of futures trading on a market for storable commodities where producers and speculators are risk averse. The study analysed the price equilibrium, before and after the introduction of futures, because these have different effects on production and inventory decisions. The long-term spot price was

also analysed with and without futures. It was found that the futures market stabilises the spot price and lowers the long-term average.

Hung, Lin, Huang and Chou (2011) used the Black (1986) framework to determine the success of a contract looking at trading volume. Using a regression model with panel data, the relationship between success and explanatory variables was examined. The explanatory variables were cash market volatility, market competition, contract size, first-mover effect and the trading platform size of exchange. It was found that the structure of the exchange and the size of the contract affect the trading on futures. Pinduck (2001) did a study on how the equilibrium of demand and supply in a cash market for spot sales and market storage determine commodity spot prices, future prices and changes in inventory. In the study it was found that a large portion of the commodity pricing is based on the fundamentals of demand and supply with a smaller portion being comprised of herd behaviour or speculative "noise trading". Speculative behaviour in the error terms of the model was incorporated. The model of "fundamentals" was able to explain a large portion of the short-term dynamics of prices and other variables. The model helps clarify how commodity markets respond to changes in numerous exogenous variables.

3.7 Summary

In the literature review, the potato market and pricing was done to ascertain the current potato pricing system and the reasons of the existence of price risk. The potato market and the behaviour of the participants were then examined. Agricultural contracts and the different types were examined within the agricultural sector and the fresh potato sector. The fundamentals behind JSE CDM and the impacts on commodities were examined. A value chain analysis of the potato industry was analysed as this is a good way to review the industry as a whole. To conclude empirical studies on the feasibility of enlisting commodities on the futures exchange was conducted in order to gain an understanding of the viability of reenlisting potato commodities on JSE CDM.

CHAPTER 4

Research Methodology

"From a small seed a mighty trunk may grow"

- *Aeschylus*

4.1 Introduction

This chapter explains the methodology used to answer the five objectives outlined at the beginning of the study, in order to ultimately ascertain whether or not the potato contract should be re-enlisted on JSE CDM. An explanation of the data collection strategy, research design, measurement and data analysis plan is elaborated on in this chapter. The results presented in chapter 5 will use the methodologies explained in chapter 4.

4.2 Data collection strategy

The data used in this study was collected from various sources. PotatoesSA provided the weekly price and volume data for the 4 major markets namely Cape Town, Johannesburg, Pretoria and Durban from 1995 until 2015. These four cities were selected as they have the highest quantities of trade so their prices best reflect the market's prices. These prices and volumes were needed to in the test to determine if the potato is a homogeneous commodity, determine the price volatility of the markets and if the market is a well-functioning cash market.

In order to ascertain if there will be liquidity in the market various role players in the market were interviewed through telecoms. Secondary data through a comprehensive literature review was conducted to determine if the potato could be stored and transported over extensive distances.

Lastly the liquidity of the market needs to be ascertained through interviews with various stakeholders with in the industry through telecoms, emails and face to face meetings. The stakeholders include producers, processors, on-line trading platforms and retailers.

4.3 Demarcation of field study

An in-depth industry case study with a value-chain combined with a comparative study will be the most suitable design for this particular study according to Bryman and Bell (2007). This is primarily due to the fact that this study focuses only on the potato industry and not the whole vegetable industry. Quantitative components, using secondary data collection strategies and models will be used in the case study. This research layout will be used to ascertain the market changes, volatilities and price changes. The case study design is important for the reason that it will be used to conclude if there is a need for potato future contracts to be reintroduced onto JSE CDM (SAFEX). With the information gained through the case study layout it will be possible to formulate an understanding of the potato market and the impact of introducing futures contracts. Motivations for the chosen design will be further elaborated on.

4.4 Research ethnics

In order to gain assistance and approval for the research, the study will be presented to the JSE, which is a futures exchange. Confidentiality and predilection in terms of non-disclosure concerns will be considered during the discussion with roles player in the potato industry and will be implemented into the proposed study with the guidance of the study leader. The conclusions drawn from the study will remain the opinion of the researcher and no contributors to the study will be responsible for any disagreements.

A letter of thanks will be sent to all the people who assisted, to acknowledge all their expertise and time on the finishing of the study.

4.5 Standardisation of the potato commodity

4.5.1 Introduction

There are numerous classes of potatoes with their own prices on the formal market in South Africa. Therefore to ascertain whether or not the potato commodity can be standardised is very important because if the potato can be standardised a reference class's price can be used to derive the prices for the other classes on the futures market. Potatoes are supplied onto the market as class 1 large, class 1 medium, class 1 small, class 1 baby, class 2 and class 3. In the initial potato contract that was enlisted on SAFEX in 1995, the medium potato was used as the reference potato, so this study will use the medium potato as the reference potato. In order to ascertain whether or not the medium potato is reliable as the reference potato class, a correlation of the prices between the different classes of potatoes and the medium potato for each market area namely Cape Town, Durban, Pretoria and Johannesburg needs to be completed. Correlation refers to the statistical relationship involving the dependence between two random variables (Dietrich, 1991). This predictive relationship can be used to determine if the prices for the various classes of potatoes can be derived from the reference class 1 medium potato. The most common test of dependence between two variables is the correlation coefficient or Pearson's correlation coefficient. If there is a high correlation then the medium potato can be used as the reference class in obtaining the prices for the other classes. If the potato commodity cannot be standardised then there cannot be a potato contract on the futures exchange.

4.5.3 Methodology

The main structure that is followed to determine if the potato can be a standardised commodity is firstly to perform the Kolmogorov-Smirnov normality test. If the test indicates that the data is not normally distributed then Spearman's rho correlation coefficient must be performed to determine the relationship between the two variables. Spearman's rho correlation coefficient (ρ) is a nonparametric version of the Pearson

correlation coefficient. An important underlying assumption of the Spearman's correlation is a monotonic relationship. A monotonic relationship is where two variables constantly both increase/decrease or when one variable increases and the other variable decreases. The Spearman's rho correlation coefficient is therefore less restrictive than the linear relationship of Pearson correlation (AERD Statistics, 2015).

In order to determine the correlation between the various classes of potatoes a test of normality needs to first be conducted. The normality test ascertains if the data set is well-modelled by the means of a normal distribution. The test also establishes if a random variable underlying the data set can be normally distributed. The Kolmogorov-Smirnov normality test compares the empirical cumulative distribution function of the sample data to the anticipated distribution, to determine if the data was normal. The test will reject the null hypothesis of population normality if there is a large difference (Minitab, 2015). If the normality test has p-values less than 1 then the price variables are not normally distributed. If the normality test was not normally distributed then Spearman's rho correlation coefficient must be performed. Spearman's rho correlation coefficient is used to measure the statistical dependence between two variables and is indicated in equation 1.

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \qquad (1)$$

Where $d_i = x_i - y_i$ is the difference between the ranks and n = the sample size. The x variable is the independent variable and y is the dependent variable.

The Spearman correlation coefficient is positive if *Y* increases when *X* increases, and the Spearman correlation coefficient is negative if *Y* decreases when *X* increases. When the Spearman correlation is zero it indicates that there is no trend for *Y* to increase or decrease when *X* increases. The Spearman correlation's value becomes larger in magnitude when *X* and *Y* merge towards perfect monotone functions of each other. The Spearman correlation coefficient becomes 1 when *X* and *Y* are perfectly monotonically

related (Foster and Grassberger, 2011). The null hypothesis of the Spearman correlation coefficient is that there is no correlation between two variables. A low p-value implies that one can reject the null hypothesis. If all the p-values are less than 0.1 it implies that the correlation coefficients are positive and high. This means that the price of medium potatoes is highly and positively correlated with the prices of other classes of potatoes.

4.6 Storage and transportation of potatoes

In order to determine if potatoes can be stored and transported a comprehensive study needs to be performed by the means of secondary data. Literature needs to be thoroughly studied and accurately relayed as to how perishable the potato is and the extent to which the commodity can be stored and transported.

4.7 Price movement in the cash market

4.7.1 Introduction

When setting up a futures contract there must be price movement in the cash market as this implies liquidity in the market. Open interest is the number of contracts or outstanding contracts in futures trading on an official exchange at any one time which has an effect on the liquidity within the market (CME, 2015). In order for an exchange between buyers and sellers to work there needs to be a free market. A free market is when a market is determined by supply and demand which in turn allows cash prices to move freely (Rothbard, 1989). The relationship between supply and price can therefore be ascertained by determining the relationship between the volumes and prices on the fresh produce potato market. The correlation for the reference class 1 medium potato's prices and volumes on the four main markets namely Cape Town, Durban, Johannesburg and Pretoria over 20 years can therefore be determined to see if there is a relationship.

4.7.3 Methodology

To determine if there is a strong correlation between price and volume a normality test needs to first be performed. A normality test will determine whether or not the variables

are normally distributed. The Kolmogorov-Smirnov (KS) test as explained in section 4.5 is the best test to use. The significance level of 0.1 is best for this study.

If some of the variables were not normally distributed then Spearman's rho correlation coefficient or Pearson's correlation coefficient has to be performed. The Spearman's rho correlation coefficient is a better fit for the data than the Pearson's correlation coefficient as explained in section 4.5. The p-values must be compared to the significance level of 0. 1. If the p-value is less than 0.1 it can be concluded that a relationship exists between the variables and that volume does have an effect on price.

4.8 The price volatility

4.8.1 Introduction

Quantifying price variability on the fresh potato market is very important because price variability is a very important part of the overall profitability within the industry. Price volatility refers to the amount of unpredictable change in prices over time. The error terms acquired from the prediction of prices are therefore linked to volatility (Jordaan, Grové, Jooste and Alemu, 2007). Volatility is measured using conditional standard deviation. The presence of discrete spikes and the secular increase in such spikes in the data are two conditions for the occurrence of price volatility (du Preez and Grové, 2010). When policy decisions are based on overestimated risk or inaccurately measured risk, the costs can land up being larger than the benefits hence the importance of accurately measuring price volatility. If there is a large amount of price volatility an exchange would enable participants in the potato market place to protect themselves against high risks.

4.8.2 Methodology

The fundamental structure that is followed to quantify the volatility in prices of potatoes on the four main fresh markets Johannesburg, Durban, Pretoria and Cape Town are depicted in the flow chart in Figure 4.1. The first step is to test for stationarity by doing the unit root test. The second step is then the application of the Box-Jenkins method to

determine the order of the ARIMA process. The Box-Jenkins must be performed on data made stationary by means of differencing. The presence of Auto Regressive Conditional Heteroscedasity (ARCH) effect was then determined with the ARCH-LM test. ARCH models are used to illustrate and model observed time series. They are used when there is anticipation that the error terms will have a distinctive size or variance (Engle, 1982). ARCH models assume the variance of the current error term to be a function of the actual sizes of the previous time periods' error terms. If the ARCH effect was detected then a GARCH approach was used.

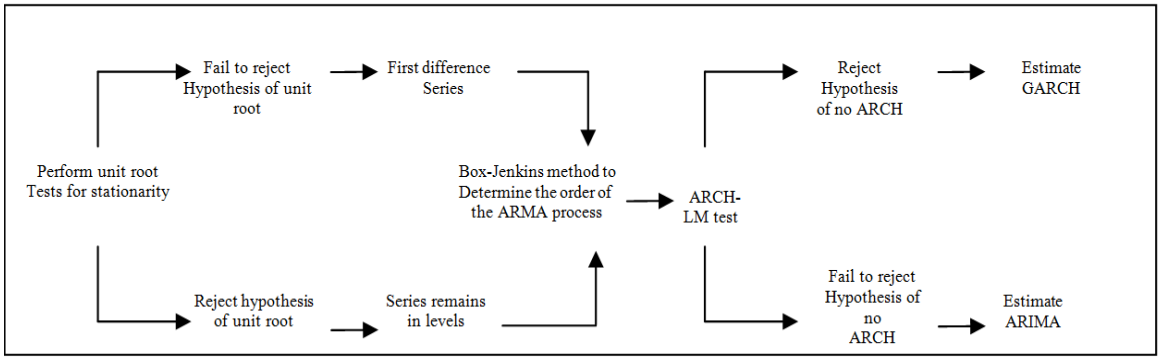


Figure 4.1: Flowchart of methodology to compute conditional volatility

Source: Moledina, Roe and Shane, 2003

The predictable components such as inflation, trend and seasonality of the pricing process need to be removed in order to leave only the stochastic component, then only the stationarity of the time series using the root test can be tested (Moledina *et al*, 2003). The seasonal effect is removed by using seasonal dummy variables. Seasonality is eliminated once the real prices are regressed on the seasonal dummy variables and the residuals from the regression are used as the deseasonalised prices in further analysis. From the twelve months within a year eleven seasonal dummies were included. The inclusion of only eleven months is to avoid falling into the dummy variable trap, which is a situation of perfect collinearity. In this research January was highlighted as the base dummy variable for potatoes in the four main markets. The effect of inflation is removed by deflating the

nominal prices with the consumer price index (CPI) (Richardson, Schumann and Feldman, 2004).

The incidence of a unit root and to ascertain how many times a series must be differenced, to make it stationary, was tested using the Augmented Dickey Fuller (ADF) test. The number of times a series needs to be differentiated indicates its order of integration and consequently the value of d in ARIMA (p,d,q) process. The Box-Jenkins methodology was then used to determine the values of p and q in the ARIMA (p,d,q) (Jordaan *et al*, 2007). The Box-Jenkins approach assumes that the residuals are homoskedastic therefore the standard error is a measure of volatility thereby implying volatility remains the same over time. In the ARIMA (d) is therefore 0.

According to Jooste *et al*., (2006) and Jordaan *et al*., (2007) the ARIMA process is presented by equation 2.

$$y_t = \alpha_0 + \sum_{p}^{p\max} \phi_p y_{(t-p)} + \sum_{q}^{q\max} \theta_q \varepsilon_{(t-q)} + \sum_{n}^{n\max} \eta_n D_t \qquad (2)$$

From the computation of (AR 0-6) by (MA 0-6) forty-nine combinations were obtained based on equation 1. The largest value of either AIC or SBC is considered to theoretically determine the values of *p* and *q*. An ARIMA (*p,d,q*) process indicates that the intercept has to be lagged *p* times, to yield a stationary series the series needs to be differenced *d* times, and to generate the desired results the error term is going to be lagged *q* times. The components of the GARCH model needs to be significant, therefore the largest AIC or SBC value serves only as a guideline (Jooste *et al*., 2006; Jordaan *et al*., 2007).

If a series is found to vary over time it indicates that the GARCH approach should be used. The rejection of the null hypothesis of no ARCH effect indicates a time varying series. The Box-Jenkins approach is based on the assumption that the residuals stay constant over time, in other words are homoskedastic. The homoskedastic assumption has

the insinuation that volatility (uncertainty) remains steady over time since the standard error of equation 1 is used as a measure of volatility (Jooste *et al*., 2006; Jordaan *et al*., 2007).

According to Jooste *et al*., (2006) and Jordaan *et al*., (2007) the presence of ARCH effect has to be tested in the conditional variance of:

$$h^2 = Var(u_t / \Omega_{t-1}) \quad (3)$$

$$h^2 = \rho_o + \rho_1 u^2{}_{t-1} + \rho_2 u^2{}_{t-2} + ,,, \rho_q u^2{}_{t-q} \quad (4)$$

Where u_t^2 is the squared residual in period *t*, and ρ_o, ρ_1, ρ_2, ρ_q are the parameters to be estimated.

Lagrange Multiplier (LM) and F-tests were used to test the null hypothesis of no ARCH effect when the ARCH equations were fitted. Volatility is said to vary over time if the null hypothesis is rejected at the 5 percent level of significance indicated by probability values lower than 0.05 or at the 10 percent level of significance indicated by probability values of less than 0.10 (McIntosh, Muthusamy and Patterson, 2008).

The GARCH approach is applied when the hypothesis of no ARCH effect is rejected. The univariate GARCH (1,1) model is presented as:

$$\sigma_t^2 = \gamma_0 + \gamma_1 \varepsilon_{(t-1)}^2 + \gamma_2 \sigma_{(t-1)}^2 \quad (5)$$

Where σ_t^2 is the variance of ε_t conditional upon information up to period *t*.

The conditional standard deviation is the measure of volatility when using the GARCH approach and is given by the square root of each of the fitted values of σ_t^2 (equation 4). Contrasting to the volatility in the absence of ARCH effect, the conditional standard

deviation varies over time. Due to the volatility varying over time it impossible to present the conditional volatility as a single value over a period – therefore it is presented graphically instead.

4.9 Trading regularity of potato contracts

4.9.1 Introduction

The potato industry as discussed in the industry overview is comprised of producers, retailers, processors and wholesalers. The need for each of these key players to make use of the potato futures contracts needs to be investigated. The best method to investigate the need of future contracts in the potato industry was to have one on one discussions with the key industry represntatives at various stages within the potato value chain. If a large number of the members in the potato industry make use of the potato contracts, then there could be a high degree of liquidity present as a result of regular trading. Qualitative research methodology structured interviews were the best way to determine if role players will use the potato contract (Kvale and Brinkman, 2008). There are five different types of interviews that can be conducted in a study according to Warren and Karner (2005), namely focus groups, informal interviews, unstructured interviews, structured interviews and semi-structured interviews. For this study semi-structured interviews is the best technique to use because informants are given the freedom to express their own views through the researcher being able to deviate from the formal interview questions should the need arise whilst still following standard questions (Bernard, 1988).

4.9.2 Methodology

Within the potato industry at least two prominent role players from the producers, processors, retailers and online platforms need to be interviewed telephonically. Semi-structured interviews are when an interview guide is used in an interview with more or less open-ended questions to allow flexibility (Flick, 1998). This interview style enables the participant not be restricted by closed-ended structured answering and standardised answers. There are set questions with varying levels of standardisation and flexibility.

The participant is encouraged to expand on his/her answer with more details thereby providing additional perspectives. The interview can include open-end questions and closed-ended questions. The questions in Table 4.1 are the standardised open-ended and closed-ended questions that were established to be the best questions to ask the participants.

Table 4.1: Questionnaire for participants

Question	
1.	What part of the potato value chain do you operate in?
2.	How long have you been in the industry and how long has your business been operating for?
3.	How do you buy or sell your potatoes?
4.	What markets do your buy/sell from/to and why?
5.	How often do you obtain a price that does not result in positive returns?
6.	What do you understand about the purpose of SAFEX?
7.	How do you mitigate your exposure to price risk?
8.	Would a futures contract minimise your exposure to price risk?
9.	Would you make use of a futures contract and why?
10.	What is your opinion of the size of the informal market on the liquidity within the formal market?
11.	What is your overall opinion of reintroducing the potato contact onto SAFEX?

4.10 Chapter summary

The researcher has identified various appropiate methods and models in order to accurately answer the objectives outlined at the beginning of the study. In order to determine if the potato can be standarised into a homogeneous product and if the market moves freely, a correlation test as identified. The best test to use was a normality test and then Spearman's rho correlation coefficient.

A comprehensive study of literature was identified as the best way to determine if the potato can be stored and transported over extensive distances. The ARCH/GARCH model was identified as the best model to determine the price volatility in the four major markets. This model also identifies if the volatility is changing or constant. Telephonic semi-structured interviews were identified as the best way to obtain an understanding of whether or not role players within the industry will use the potato futures contract.

CHAPTER 5

Results

"The ultimate goal of farming is not the growing of crops, but the cultivation and perfection of human beings."

— Masanobu Fukuoka, The One-Straw Revolution

5.1 Introduction

Agriculture operates in a volatile enviroment resulting from numerous unknowns that have a ripple effect on the markets. The potato industry is no exception to the susceptibility of the numerous unknowns. Producers have the option to reduce costs and increase yields in order to improve profits, however they are price takers when it comes to price. Incorporating potato contracts could help the producer to minimise his/her exposure to price fluctuations and help him/her to have more control over the ultimate profits. Processors establish their prices from the fresh markets and are severly impacted by the factors that reduce yields such as rain when their contracted producers are not able to deliver. Retailers seek to buy their potatoes at the cheapest price in order to make their profits in a mark-up, if the price of potatoes spikes the ability to make profits diminishes because the consumer will switch to substitutable goods. Throughout the potato value chain the different role players could potentially make use of potato contracts in order to mitigate against the risks resulting from the specific factors causing them. In this study the researcher wants to establish if a futures contract for participants within the potato value chain should be reintroduced to assist role palyers in minimising their risk to price volatility.

This chapter applies the procedures explained in Chapter 4, to obtain the results for the objectives outlined at the beginning of this thesis. Firstly the homogenity of the potato with regard to the various classes needs to be determined secondly the ability of the

potato to be stored and transported needs to be determined. Thirdly liquidity within the potato market needs to be ascertained. Fourthly the price volatility in the main markets in South Africa will be determined and lastly the interviews with the role players will also be discussed and analysed to determine if role players will make use of the contracts.

5.2 Standardisation of the potato

In this section it was tested whether or not the potato could be standardised into a homogeneous commodity. The Kolmogorov-Smirnov normality test indicated that all the price variables were not normally distributed, due to the p-values being less than 0.1. Because the normality test was not normally distributed the Spearman's rho correlation coefficient was then performed. For all cities the p-values were less than 0 which is less than 0.1 which implies that the correlation coefficients were positive and high as seen in Table 5.1. This means that the price of medium potatoes is highly and positively correlated with the prices of other classes of potatoes.

Table 5.1: P-values of the various cities using Spearman's rho correlation coefficient

City		Class 1 Large	Class 1 Small	Class 1 Baby	Class 2	Class 3
Cape Town	**rho**	0.986	0.986	0.952	0.984	0.960
	p-value	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***
Pretoria	**rho**	0.988	0.960	0.883	0.992	0.970
	p-value	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***
Johannesburg	**rho**	0.986	0.969	0.851	0.989	0.959
	p-value	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***
Durban	**rho**	0.990	0.977	0.929	0.988	0.947
	p-value	***0.000***	***0.000***	***0.000***	***0.000***	***0.000***

The regression had to be performed separately for each price due to the prices being highly correlated with each other, which resulted in a spurious regression with a multicollinearity problem. The medium potato was therefore the dependent variable with the other classes were the independent variables respectively in each regression. In regression analysis, the regression model should have significant variables and high R-squared values. The low P value and high R^2 grouping indicates the model explains the

majority of the response variability and that changes in the predictors are related to changes in the response variable (Minitab, 2015). A Kolmogorov-Smirnov normality test was run for South Africa's four main fresh potato market cities namely Cape Town, Johannesburg, Durban and Pretoria.

For the Cape Town market the P-values for all the classes were 0 and the R^2 values for class 2, class 3, class 1 large, class 1 small and class 1 baby were all near one with values of 0.966, 0.915, 0.971, 0.969 and 0.895 respectively as indicated in Table 5.2. The high R^2 values and significant p-values indicate that the class 1 medium potato in the Cape Town market can be used to correlate the prices of the other classes.

Table 5.2: Regression analysis for Cape Town

City	Variables	Coefficient	t-statistic	P-value	R Square
Cape Town	**Class 2**	0.926	175.954	0.000	0.966
	Class 3	0.821	109.004	0.000	0.915
	Class 1 Large	0.964	190.885	0.000	0.971
	Class 1 Small	0.934	186.022	0.000	0.969
	Class 1 Baby	0.803	96.817	0.000	0.895

For the Pretoria market the P-values for all the classes were 0 and the R^2 values for class 2, class 3, class 1 large and class 1 small were all near one with values of 0.982, 0.937, 0.976 and 0.927 respectively as indicated in Table 5.3. The class 1 baby R^2 value was 0.798 which was still high, however it is lower than the other classes, which means its correlation is slightly less than the other classes but still strong. The high R^2 values and significant p-values indicate that the class 1 medium potato in the Pretoria market can be used to correlate the prices of the other classes.

Table 5.3: Regression analysis for Pretoria

City	Variables	Coefficient	t-statistic	P-value	R Square
Pretoria	**Class 2**	0.902	243.313	0.000	0.982
	Class 3	0.868	125.036	0.000	0.937
	Class 1 Large	0.945	213.555	0.000	0.976
	Class 1 Small	0.970	117.996	0.000	0.927
	Class 1 Baby	0.845	65.794	0.000	0.798

For the Johannesburg market the P-values for all the classes were 0 and the R^2 values for class 2, class 3, class 1 large and class 1 small were all near one with values of 0.979, 0.915, 0.974 and 0.943 respectively as indicated in Table 5.4. The class 1 baby R^2 value was 0.752 which was still high, however it is lower than the other classes, which means its correlation is slightly less than the other classes but still strong. The high R^2 values and significant p-values indicate that the class 1 medium potato in the Johannesburg market can be used to correlate the prices of the other classes.

Table 5.4: Regression analysis for Johannesburg

City	Variables	Coefficient	t-statistic	P-value	R Square
Johannesburg	**Class 2**	0.918	225.351	0.000	0.979
	Class 3	0.869	109.155	0.000	0.915
	Class 1 Large	0.942	202.031	0.000	0.974
	Class 1 Small	0.936	135.484	0.000	0.943
	Class 1 Baby	0.867	57.711	0.000	0.752

For the Durban market the P-values for all the classes were 0 and the R2 values for class 2, class 3, class 1 large, class 1 small and class 1 baby were all near one with values of 0.976, 0.900, 0.980, 0.954 and 0.858 respectively as indicated in Table 5.5. The high R2 values and significant p-values indicate that the class 1 medium potato in the Johannesburg market can be used to correlate the prices of the other classes.

Table 5.5: Regression analysis for Durban

City	Variables	Coefficient	t-statistic	P-value	R Square
Durban	**Class 2**	0.948	212.073	0.000	0.976
	Class 3	0.853	99.400	0.000	0.900
	Class 1 Large	0.950	234.970	0.000	0.980
	Class 1 Small	0.987	151.573	0.000	0.954
	Class 1 Baby	0.867	81.545	0.000	0.858

All the markets revealed that the class 1 medium potato can be used as a base potato to derive the prices for the other classes because there was a high correlation between the class 1 medium potatoes prices and that of the other classes.

5.3 Storage and transportation of potatoes

The main objective of this section was to ascertain whether or not potatoes can be transported and stored for a certain period of time. Agricultural commodities are perishables commodities in their raw form if they are not handled and stored properly and are subject to various environmental elements. An important requirement for listing potatoes on the exchange is that the agricultural commodity must be able to be stored for a certain period of time and be transported. Due to potatoes having a high water content they are susceptible to mechanical damage, animal damage (ie rats), temperature fluctuations and humidity. Potatoes require a specific range in temperature, humidity and ventilation conditions (Transport Information services, 2015). Potatoes must not be exposed to excessive sunlight because if the potato is exposed to too much light the skin becomes green as a result of a buildup of Solanine chemicals. A shortage of oxygen can cause anaerobic respiration and fermentation. If the potato is not kept in cool, dry and dark environments it will start sprouting. If the potato is stored in very cold environments such as refrigeration the starch is converted to sugar making the potato taste sweeter and discolour (Potatogoodness, 2015). If potatoes are damp before storage they spoil as a result of rotting or diseases. The optimal carrying temperature and humidity of potatoes is 7^{o}C and 90-95% respectively. In order for potatoes to be transported and stored they must

be clean, smooth, have no bruises or discoloration and be firm-textured. Perforated plastic bags and paper bags can extend the shelf life of potatoes. Potatoes can be kept in the soil as a way to store them. Potatoes can be stored for 2 to 12 months under the optimal conditions (Cargo Handbook, 2015). Potatoes must be handled with care throughout the value chain in order to prevent cracking and tearing. It can therefore be summarised that potatoes can be stored and transported if kept in the right conditions for specified self-life of a potato.

5.4 Price movement in the cash market

This section analysed the reltionship between volume and price in order to ascertain if prices move in a free market. The Kolmogorov-Smirnov test (KS-test) was found to be the best normality test in the methodology. The p-values were compared to the significance level of 0.1. From the results in Table 5.6, the variables Volume (CPT) and Volume (DBN) are normally distributed whereas all other variables were not normally distributed.

Table 5.6: Kolmogorov-Smirnov test (KS-test)

Variables		
	Statistic	**P-value**
Price_CPT	0.079	0.000
Vol_CPT	0.021	0.200
Price_DBN	0.091	0.000
Vol_DBN	0.017	0.200
Price_JHB	0.084	0.000
Vol_JHB	0.092	0.000
Price_PTA	0.081	0.000
Vol_PTA	0.101	0.000

Because some of the variables were not normally distributed Spearman's rho correlation coefficient had to be performed. The results of the Spearman's rho correlation are displayed in Table 5.7, where Cape Town (CPT), Durban (DBN) and Johannesburg (JHB) had p-values less than 0.1. This implied that the volume and price have a

significant relationship. Additionally, the correlation coefficients were negative, which means that price is negatively related to volume. For Pretoria (PTA) volume is not related to price because the p-value is 0.138 which is greater than 0.1. This result implies that volume does not have a significant effect on price in the Pretoria market.

Table 5.7: Spearman's rho correlation coefficient

City	Volume	P-value
CPT	-0.637	0.000
DBN	-0.589	0.000
JHB	-0.140	0.000
PTA	-0.047	0.138

For the regression, the volume and price variables are first logged because they were not normally distributed. For Pretoria no regression was done because Pretoria had an insignificant correlation. The regression tested whether or not volume influences the price for Cape Town, Durban and Johannesburg. The p-values of each coefficient were compared with a significance level of 0.1. Cape Town had a coefficient of -0.663 and Durban had a coefficient of -0.712 which were both significant, strong and negative showing that volume had an inverse relationshipon price. Johannesburg also had a negative coefficient of -0.197 however the negative between price and volume is not very strong as shown in Table 5.8.

Table 5.8: Regression for the volume and price variables

City	Variables	Coefficients	t statistic	P-value	R Square
CPT	Constant	11.417	32.385	0.000	0.350
	Volume	-0.663	-23.063	0.000	
DBN	Constant	11.884	30.614	0.000	0.333
	Volume	-0.712	-22.226	0.000	
JHB	Constant	5.884	10.956	0.000	0.023
	Volume	-0.197	-4.815	0.000	

Note: the dependent variable is price

A negative Spearman correlation coefficient relates to a decreasing monotonic trend between price and volume. Figure 5.1 and Figure 5.2 indicates that Cape Town and Durban respectively have a relatively strong decreasing monotonic trend, therefore as the volumes decrease, price will start to increase and vice versa. This result implies that when there are large quantities of potatoes on the Cape Town and Durban market the price is most likely to be pulled down as a result of the abundant supply.

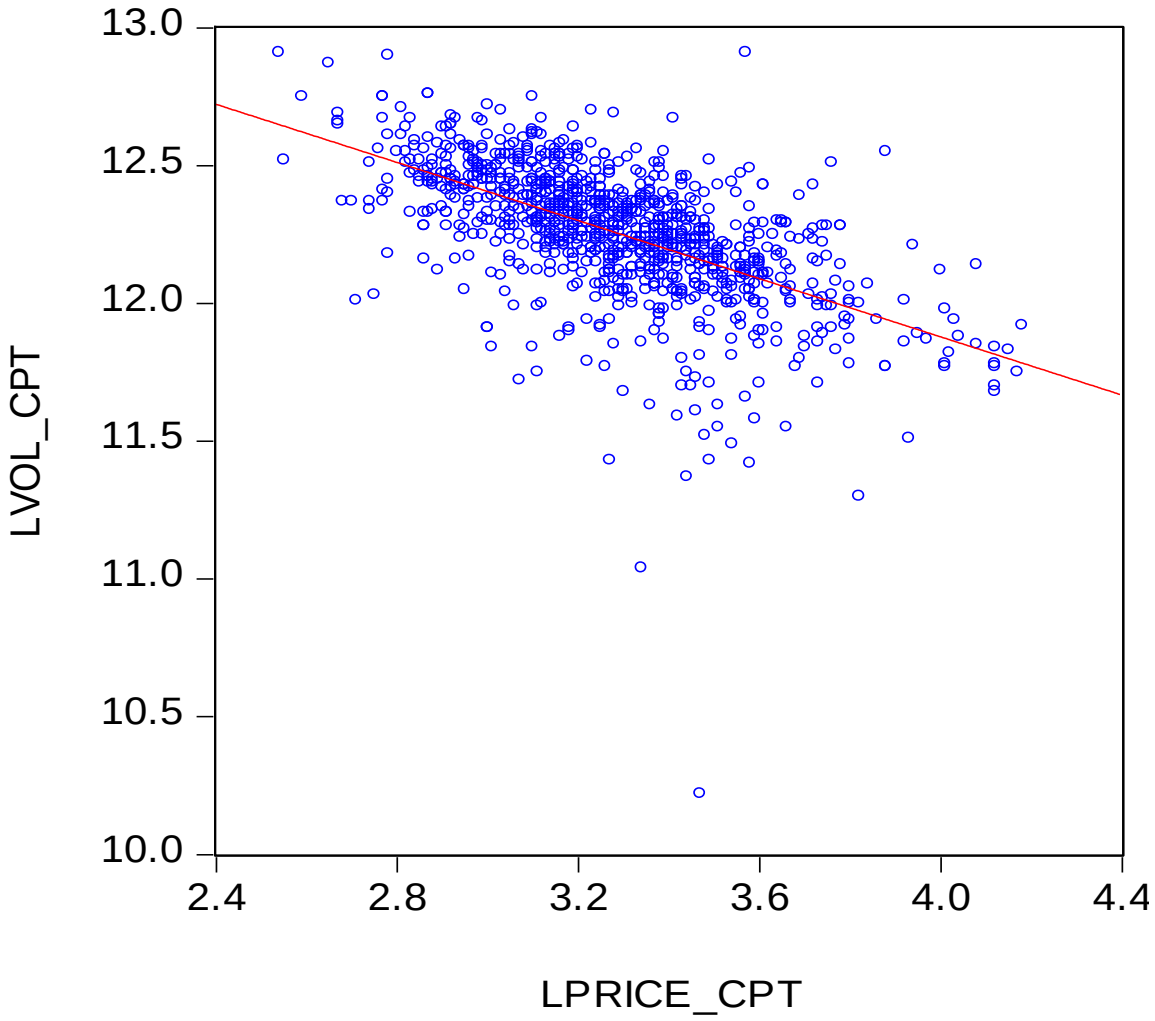


Figure 5.1: Correlation between Cape Town's price and volume

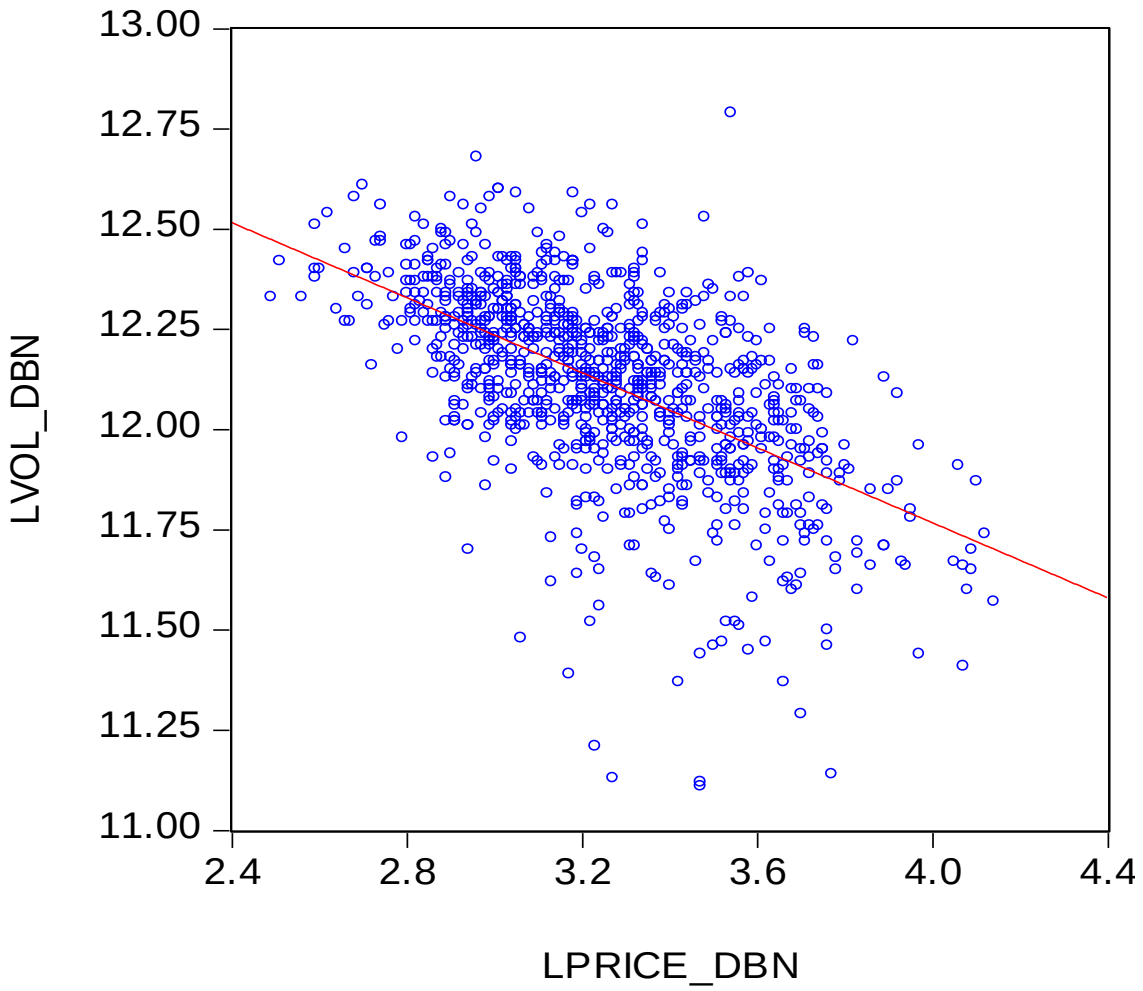


Figure 5.2: Correlation between Durban's price and volume

The Johannesburg does not have a strong correlation between volume and price therefore the data is roughly elliptically distributed with no prominent outliers as illustrated in Figure 5.3. This means that the quantity of potatoes on the Johannesburg market does not significantly affect the price of potatoes.

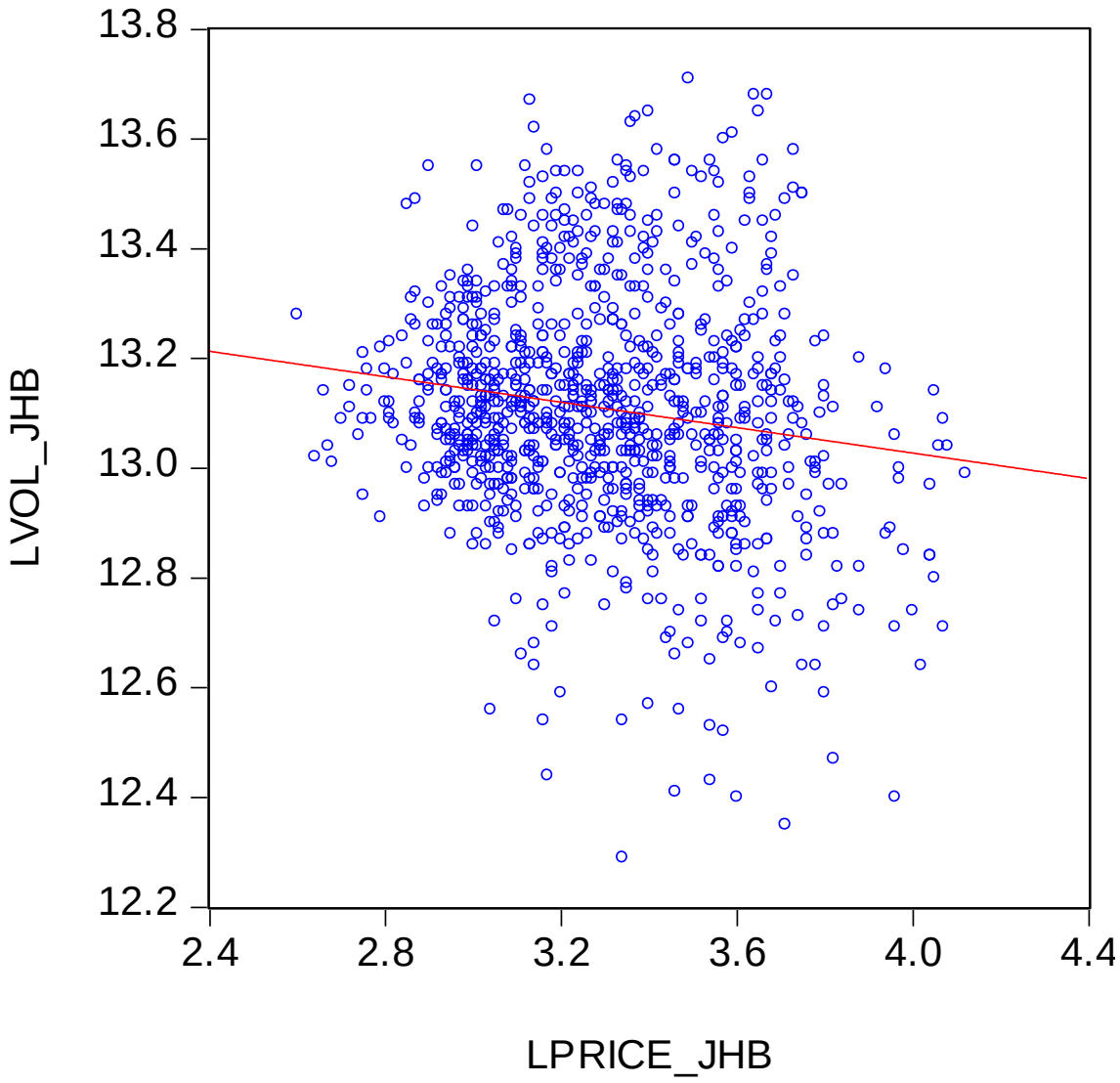


Figure 5.3: Correlation between Johannesburg's price and volume

Of the four main markets in South Africa only two of the markets namely Cape Town and Durban have a significant negative relationship between price and volume, which means that an increased supply of potatoes has an adverse effect on price. Johannesburg has a weak negative reltionship between price and volume and Pretoria's market does not statistically show a relationship between price and volume. The prices of Johannesburg and Pretoria are therefore mainly affected by factors other than the supply of potatoes on the market.

5.5 Price volatility

The aim of this section was to quantify the true stochastic components in the prices of potatoes in the four main markets as acurately as possible by removing some of the known components like the seasonal. The ARCH/GARCH approach was found to be best suited for the quantification of volatility. The approach allows new information to influence volatility and thus allows volatility to move over time. The ARCH/GARCH approach also distinguishes between known and unknown components in the price process. The effect of seasonality and inflation were removed as known variables from the price data before the approached was applied. The GARCH approach also makes better use of the information on volatility contained in the time series in comparison to the other models.

The incidence of a unit root and to ascertain how many times a series must be differenced to make it stationary, was tested using the Augmented Dickey Fuller (ADF) test. The number of times a series needs to be differenced indicates its order of integration and consequently the value of d in ARIMA (p,d,q) process. The d value indicates the degree of differencing, p indicates the order of the autoregressive model and q indicates the order of the moving average model. The Box-Jenkins methodology was then used to determine the values of p and q in the ARIMA (p,d,q) process (Jordaan *et al*, 2007). The Box-Jenkins approach assumes that the residuals are homoskedastic therefore the standard error is a measure of volatility thereby implying volatility remains the same over time. In the ARIMA (d) is therefore 0. From the computation of (AR 0-6) by (MA 0-6) forty-nine combinations were obtained. From the Box-Jenkins it was found that the values in Table 5.9 were the best fit for the respective markets. The components of the GARCH model needs to be significant, therefore the largest AIC or SBC value serves only as a guideline (Jooste *et al*., 2006; Jordaan *et al*., 2007).

Table 5.9: Values of p and q in the ARIMA (p,d,q) process determined using the Box-Jenkins methodology and the d using the Akaike information criterion.

Market	p	d	q
Durban	7	0	7
Johannesburg	6	0	7
Pretoria	6	0	7
Cape Town	7	0	5

Lagrange Multiplier (LM) and F-tests were used to test the null hypothesis of no ARCH effect when the ARCH equations were fitted. Table 5.10 shows the results for the heteroscedasticity test for ARCH. The test for the presence of ARCH effect confirmed the presence of ARCH (2) in the Johannesburg market, ARCH (3) in the Pretoria market and ARCH (6) in the Durban market. The results indicate that the volatility in the prices in these three markets is time varying and therefore the GARCH approach must be used instead. In the Cape Town market no ARCH effect was detected and therefore no need to apply the GARCH approach. The measure for volatility for the Cape Town market is therefore the standard error of the ARIMA process which is 0.086062. Cape Town market's price volatility remains constant over time.Both the mean and variances are important determinants of future decisions.

Table 5.10: ARCH-LM test results

Market	F-statistic	Probability
Cape Town (ARCH7)	1.315654	0.2393
Durban (ARCH6)	2.330697	0.0306
Johannesburg (ARCH2)	3.122634	0.0445
Pretoria (ARCH3)	3.543344	0.0142

The GARCH approach was then applied when the hypothesis of no ARCH effect was rejected. Contrasting to the volatility in the absence of ARCH effect, the conditional standard deviation varies over time. Due to the volatility varying over time it impossible to present the conditional volatility as a single value over a period – therefore it is presented graphically instead.

Highly leptokurtic behavior was found in the standard deviation graphs of Johannesburg, Durban and Pretoria as shown in Figures 5.4 to 5.6. Leptokurtic behavior is a statistical distribution where the points are clusted resulting in a higher krtosis than in a normal distribution. In Figure 5.4 the conditional standard deviation as a measure of volatility in the price of potatoes in the Johannesburg market indicated the mean to be around 0.0056. Figure 5.6 indicates the conditional standard deviation as a measure of volatility in the price of potatoes on the Pretoria market. There weren't many notable spikes in recent years, which implies that there weren't any increased variations. Figure 5.5 depicts the conditional standard deviation as a measure of volatility in the price of potatoes in the Durban market, were cyclic deviations did not pass the 2+ standard deviation line except for 3 exceptions. The volatility in the Durban market fluctuates with in the acceptable 2+ standard deviation bracket except for the increase in variations which were most likely rare infrequent events like an early hail or drought in the main producing areas.

The presence of leptokurtic behavior indicates the need for traders to use different marketing/hedging strategies during the various parts of the year in order to account for the various levels of risk they are exposed to. The frequency in which the Johannesburg, Durban and Pretoria markets exceed the two standard deviation boundaries indicates that the volatility associated with the price of the potatoes in the respective markets is inconsistent and unforeseen events could have occurred in the market. In the Johannesburg market there is a sharp spike in the middle of 2007 in Figure 5.4 and this can be due to an unexpected event out of the ordinary.

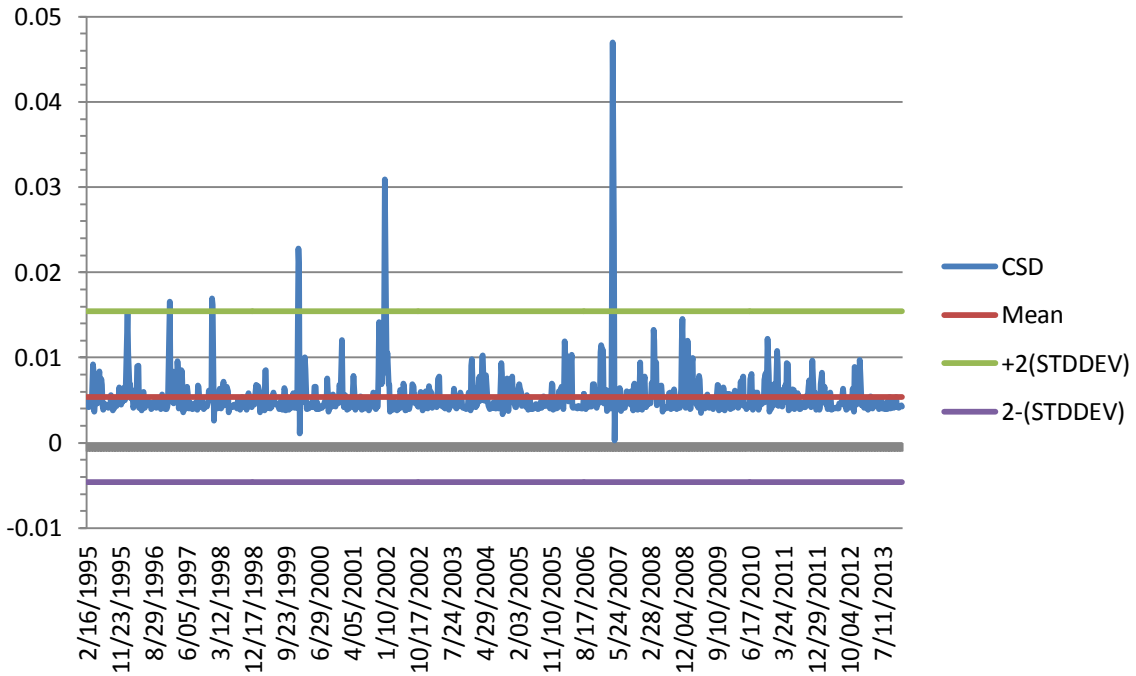


Figure 5.4: Conditional Standard Deviation as a measure of volatility in the price of potatoes in the Johannesburg market

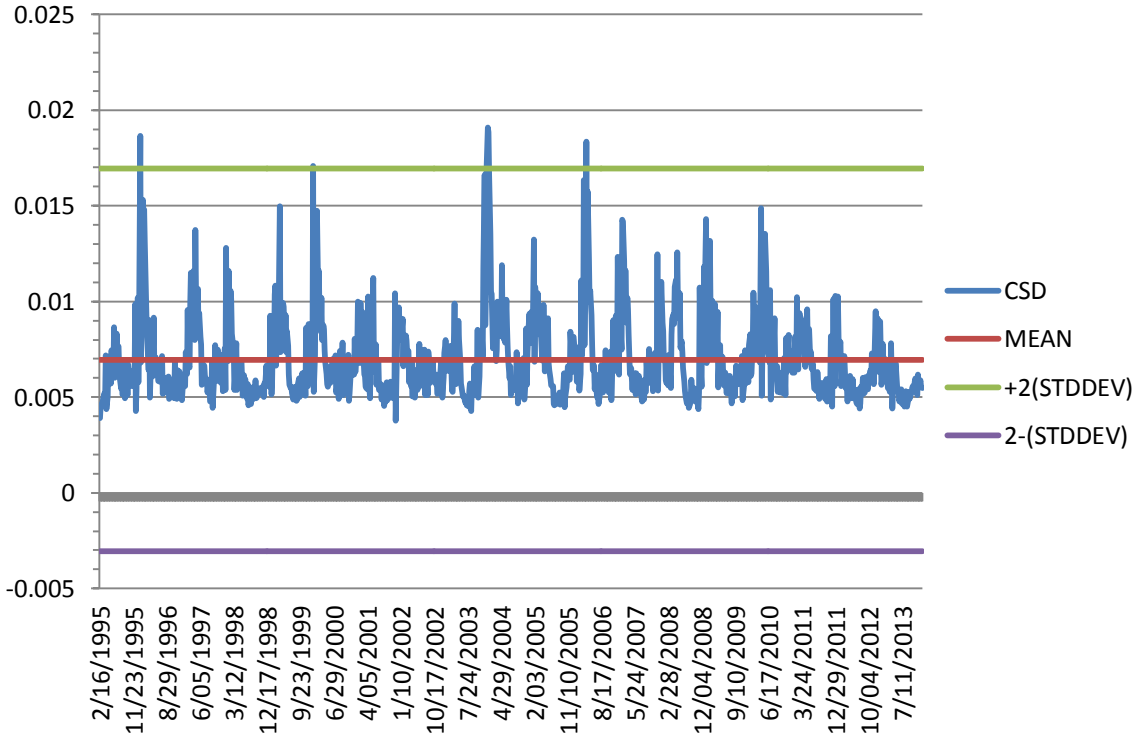


Figure 5.5: Conditional Standard Deviation as a measure of volatility in the price of potatoes in the Durban market

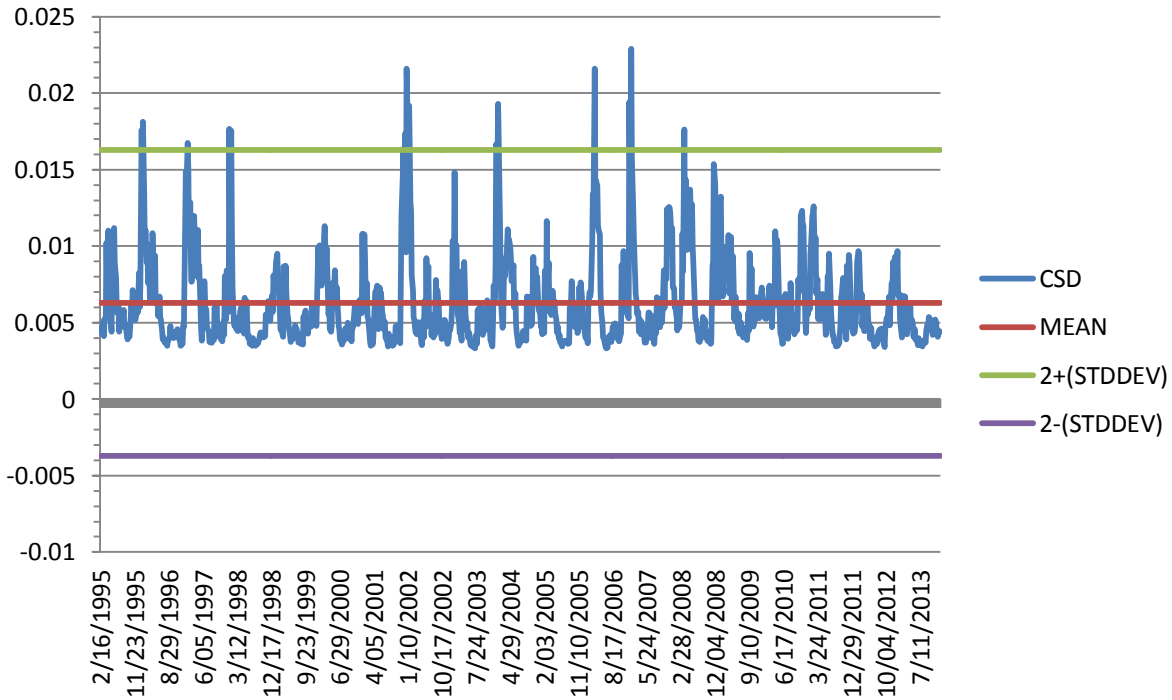


Figure 5.6: Conditional Standard Deviation as a measure of volatility in the price of potatoes in the Pretoria market

The price risks associtated with Durban, Johannesburg and Pretoria markets are higher than the Cape Town market. The high frequency of spikes in the conditional standard deviations in the Durban, Johannesburg and Pretoria markets that exceed the 2 standard deviation boundries suggest that these markets experience higher price risk. Volatility is tricky to predict therefore price management tools such as forward pricing methods, put options or hedging may need to be used. For the seller a put option will provide a benefit from positive price movements while guaranteeing a floor price. Key role players in the potato industry could use potato contracts to safe guard themselves against any future fluctulations in prices or occurances like drought.

5.6 Trading regularity of potato contracts

5.6.1 Key role players

In this section the various role players within the potato industry opinions were analysed as to whether or not re-enlisting the potato contract on the JSE would be viable. Potatoes produced for human consumption are comprised of two main divisions, namely the processing potato sector and the table potato sector. The spot market is the main governance structure in the table potato sector as it is the only formal structure. The processors receive their price derived by the fresh produce market (Strydom, 2010). There are roughly 560 farmers who produce 2.2 million tons of potatoes, however not all these potatoes flow into the fresh produce market where they can be traded in a formal market. The informal market takes 53%, the processing market consumes 8%, and the export market takes 7% which leaves the formal market with 31%. Of this 31% many big retailers contract directly with the producers, which leaves less than third of the total potatoes produced annually to be sold on the fresh market. According to various role players in the industry the informal market is believed to be larger than the figures indicate.

The potato industry in South Africa is composed of numerous roles players. The researcher interviewed at least two industry role players at each stage of the potato value chain. The producers are scattered all over South Africa with a producer organisation representing them, PotatoesSA. There are processors who currently contract their potatoes directly from producers as they all require a specific quality. The retailers in South Africa contract their potatoes from farmers and buy on the fresh market. The informal market currently buys their potatoes directly from the farmers and the frsh produce market.

There is currently one online trading platform in South Africa where fruits and vegetables are traded. The platform makes use of a service provider that facilitates the transaction between the producer and buyer of fresh produce. The business model differs from that of

a typical fresh produce marketing model in that the fresh produce is transported directly from the producer to the buyer, which removes the additional handling cost a physical market usually results in. The business model's flow of funds is however similar to that of a typical fresh produce marketing model, in that the money flows from the buyer, to a single joint trust account which is held by both the platform and the service provider, before being paid over to the producer of the fresh produce (FGX platform, 2015).

A representative from PotatoesSA indicated there are currently about 560 potato producers in South Africa, of which there are 500 producers who sell to the fresh market. The processors only contract a small portion of the market as a result. Representatives from processing companies said they would not trade on JSE CDM due to the fact that they make use of proprietary varieties that belong to their own companies, and that are only planted for the respective company for processing. The processing companies also contract all their potatoes well in advance, in order to avoid the open market exposure. Representatives from retailers said that they contract their potatoes directly from the producers as they require a certain cultivar and size. The informal market buys more than 50% of the potatoes sold on the fresh produce market. The informal sector is usually a cash based marketed with limited resources to electronic platforms.. This sector removes a large portion of the markets volumes that could potentially have been traded thereby shrinking the market size.

All members in the potato value chain will be able to make use of the potato contract on JSE CDM however it will just require a shift in thinking and perception of risk from producers, processors and retailers. All the role players operate in a risky environment and no matter what cultivar they require they can manage their price risk using futures contracts. The online trading platform can be used to bring the sellers and buyers together once their contracts have been closed.

CHAPTER 6

Conclusion

"To plant a garden is to believe in tomorrow."

- *Audrey Hepburn*

6.1 Introduction

Potato producers farm in conditions of uncertanty and they have to continuosly find ways in which to reduce their exposure. Processors and retailers are in the middle of the potato value chain where they are exposed to the risk of the insufficient yields by producers and consumers buying substitute goods. A possible technique for all participants within the potato value chain to minimise their exposure to price risk is to use future contracts. In this study the researcher aimed to determine the viability of reelisting the potato contract on the JSE. This was done by firstly doing an industry analysis in order to understand the factors that influence the potato industry. Following the industry analysis the five objectives laid out at the beginning of the study to determine whether or not it would be feasible to reelist potatoes were investigated.

The first objective was to determine if the potato can be standardised into a homogeneous product and aregression analysis was found to be the best approach. The tests indicated that there is a high correlation between the prices of the various potato classes, using the medium potato as the base. The medium sized potato can therefore be used to derive the prices of the other classes of potatoes. It can be concluded that the potato is a standardised homogeneous product.

The second objective was to establish whether or not the potato commodity can be transported and stored for a certain period of time. The literature reviewed indicated that potatoes can be stored however the temperatures must not be extreme, the humidity

should be around 90 to 95% and the potatoes should not be exposed to direct sunlight. There are numerous storage options avaiable for potatoes such as soil, brown bags and crates. Potatoes can therefore be stored for extended periods of time under the optimal conditions. When the potatoes are being transported and handled they are prone to mechanical damage therefore care must be taken at all times. The secondary data used for this section therefore established that potatoes can be stored and transported.

The third objective was to determine whether or not the table potato market is a free well-functioning market. The best way to determine the potato market was to do a regression analysis between price and volume in each of the four main markets. In Johannesburg, Durban and Cape Town there was a strong negative correlation between price and volume and Johannesburg had a weak negative correlation. Price and vloume are negatively correlated which implies the conditions of supply and demand influencing the market movements. In Pretoria the market did not show a relationship between price and volume, therefore further investigation needs to be done. These result indicated that the majority of the markets are influenced by supply and demand and that the fresh potato price moves freely in most of the markets.

The fourth objective was to determine the volatility of the potato price in the four main markets over the last 20 years. The ARCH/GARCH model was found to be the best model for this study. The results indicated that the medium potato price fluctuated in the markets of Johannesburg, Durban and Pretoria from 1995 until 2014 where Cape Town's volatility remianed constant from 1995 until 2014. In the majority of the markets there was varying volatility.

The last objective was to determine whether or not the potato contract would be traded by the traders. Semi-structured interviews were found to be the best approach when interviewing the respective role players, as there was structure but the participant was given the freedom to explain hs/her opinion further. The results indicated that only a third of the total potatoes produced are sold on the fresh produce market. In the interviews it was evident that numerous players did not think potato futures should be re-enlisted and

this was mainly because they did not have a full understanding of fundamentals of futures contracts. There may not be suficient buyers and sellers in the formal market to ensure a the functioning of a futures market, with the main problem being resistance to change by role players. The potato industry needs to find ways to include the informal market in order to increase the formal markets volumes and inform market participants about the future exchange.

6.2 Limitations and recommendations

Over the last 20 years the potato industry has evolved to such an extent that future contracts could benefit role players within the industry. Possible participants of the potato contract need to attend workshops regarding derivative platforms as there is a degree of apprehension towards the contracts.

The factors affecting price in the markets especially the Pretoria and Johannesburg markets need to be further investigated. In this study it was highlighted that volume does not have a significant effect on the prices in these two markets.

7. Reference

Abstract of Agricultural statistics. 2015. Department: Agricultural, forestry and fisheries. Republic of South Africa.

AERD statistics. 2015. *Spearman's Rank-Order Correlation*. [Online] Retrieved from https://statistics.laerd.com/statistical-guides/spearmans-rank-order-correlation-statistical-guide.php [Accessed on 20 August 2015].

Black, D. G. 1986. *Success and failure of futures contracts: Theory and empirical evidence.* Monograph No. 1986-1, Graduate School of Business Administration, New York University.

Bernard, HR. 1988. *Research methods in cultural anthropology*. Sage Publications.

Breytenbach, P. Meiring, JA. and Oosthuizen, LK. 1996. Die belangrikheid van elektrisiteitskoste by besproeiingsboerdery. (Afrikaans). *Water SA*, 22: 333-338.

Bryman, A. and Bell, E. 2007. *Business Research Methods*. (2nd edition). Oxford: Oxford UniversityPress.

Cargo Handbook. 2015. *Potatoes.* [Online]. http://www.cargohandbook.com/index.php/Potatoes [Accessed 13 August 2015]

CME Group. 2015. *Daily exchange volume and open interest.* [Online]. Retrieved from http://www.cmegroup.com/market-data/volume-open-interest/exchange-volume.html. CME Group. [Accessed 20 September 2015]

Cobble K.H and Barnett B.J. 1999. The role of research in producer risk management. *Professional paper series* 99-001, Department of Agricultural Economics, Mississippi State University

Curtis, CE, Lutgen, LL, Frank SD and Pfeiffer, GH. 1987. A Target MOTAD approach to marketing strategy selection for soybeans. N. Central J. *Agr. Econ*, 9:195-206.

Cutts, M. and Geyser M. 2007. SAFEX maize price volatility scrutinised *Agrekon*, Vol 46, No 3

Dietrich, C. 1991. *Uncertainty, Calibration and Probability: The Statistics of Scientific and Industrial Measurement* (2nd Edition), A. Higler. Page 331

Department of Agriculture, forestry and fisheries. 2012. *Field crop marketing*. [Online] Retrieved from http://www.nda.agric.za/docs/GenPub/5Fieldcrops.pdf [Accessed September 2014]

Du Preez. L, and Grové. B. 2010. *Investigation into the price volatility for potatoes in selected South African produce markets*. Report for Potatoes South Africa (PotatoesSA).

Du Preez, L. and van Zyl, P. 2010. *Chips magazine* Vol 24 no 3 May-June 2010

Engle, RF. 1982. Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica* 50 (4): 987–1007. JSTOR 1912773

Engle, R. 2001. GARCH 101: The Use of ARCH/GARCH Models in Applied Econometrics. *Journal of Economic Perspectives*, Volume 15, Number 4. Pages 157–168

El Benni, N and Finger, R. 2012. *Where is the risk? Price, yield and cost risk in Swiss crop production.* Selected Paper prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24.

FGX platorm, 2015. *FGX business model*. [Online] Retrieved from http://www.fgxplatform.co.za/Website/About [Accessed 16 August 2015]

FIAS. 2007. *Moving Towards Competitiveness: A Value Chain Approach.* The World Bank Group 1818 H Street, NW, Washington.

Flick, U. 1998. *An Introduction to Qualitative Research.* SAGE Publications Ltd., London.

Foster, D.V. and Grassberger, P. 2011. *Lower bounds on mutual information*. Physical Review

Goodhue, R.R. and Hoffman, S. 2006. Reading the fine print in agricultural contracts: Conventional contract clauses risk and returns. *American Journal of Agricultural Economics,* 88(5): 1237–124

Grové, B and Jordaan ,H. 2007. Factors Affecting Maize Producers Adoption of Forward Pricing in Price Risk Management: The Case of Vaalharts *Agrekon,* Vol 46, No 4

Grové, B. and Strydom, DB. 2010. *Stochastic efficiency analysis of alternative basic maize marketing strategies*. Poster presented at the Joint 3rd African Association of Agricultural

Gyeltshen, S. Griffith, G. Dorji, L. and Lakey, L. 2015. Assessment of the Citrus Value Chain in Bhutan: A Review. *Australasian Agribusiness Perspectives* – 2015 Paper 107 ISSN: 1442-6951

Harwood, JL. 1999. *Managing Risk in Farming: Concepts, Research, and Analysis.* Agricultural Economics Report No. 774. Washington, DC: U.S. Dept. of Agriculture, Economic Research Service

Hung, M. Lin, B. Huang, Y. and Chou, J. 2011. Determinants of futures contract success: Empirical examinations for the Asian futures markets. *International review of economics and Finance 20.* pg 452-458.

JSE APD Dealers Examination Material March. 2010. [Online]. Retrieved from https://www.jse.co.za/redirects/safex. [Accessed 18 February 2015].

Jordaan, H., Grové, B., Jooste, A. and Alemu, Z.G. 2007. *Measuring the price volatility of certain field crops in South Africa using the ARCH/GARCH approach*. Paper. University of the Free State.

Jooste, A. Jordaan, H. Alemu, ZG. and Spies, D. 2006. Investigation into price trends and market integration in selected fresh produce markets in South Africa. *Report prepared for the National Agricultural Marketing Council.* University of the Free State.

Joshi, S. and Gurung, B. 2009. *Citrus in Bhutan: Value Chain Analysis.* Department of Agricultural Marketing and Cooperatives, Ministry of Agriculture and Forests, Royal Government of Bhutan, Thimphu.

Kirtsten, J. and Sartorius, K. 2002. *Linking Agribusiness and Small-scale Farmers in Deploying Countries: is there a new role for contract farming?* Development Bank of Southern Africa. ISSN 0376-835X

Kotze, A. A. 2011. Foreign exchange derivatives: Effective Theoretical and Practical Techniques for Trading, Hedging and Managing FX Derivatives Financial Chaos Theory Pty. Ltd. March 2011 http:\\www.quantonline.co.za

Kvale, S. and Brinkman, S. 2008. *InterViews,* (2nd Edition). Thousand Oaks: SAGE. ISBN 978-0-7619-2542-2

Leedy, PD. 1993. *Practical Research. Planning and Design*. (5th Edition). McMillan. U.S. p.18

MacDonald, J. Perry, J. Abern, M. Chamber, W. Dimitri, C. Key, N. Nelson, K. and Southard, L. 2004. *Contracts, Markets, and Prices: Organizing the Production and Use of Agricultural Commodities*. USDA-ERS Report No. 837

Macneil, I.R.1977. *Contracts: adjustment of long-term economic relations under classical, neoclassical, and relational contract law.* Northwestern University Law Review vol:72 pg:854

Madura, J. 2008. Financial institutions and markets. 8th edition. Thomson China. 742p.

McGary, SD. and Zobell, GH. 2012. *Fresh Potato Price Volatility and Efforts of a Potato Growers Association to Reduce the Volatility through Production Controls.* Selected Paper, 22nd International Food and Agribusiness Management Association Symposium, Shanghai, China.

McIntosh CS. Muthusamy, K. and Patterson, P. 2008. *Price Volatility of Idaho Fresh Potatoes: 1987–2007.* Potato Association of America 2.

McKinnon, RI. 1967. Futures markets, Buffer Stocks and Income stability for Primary producers. *Journal of political Economy*, Vol 75. No 6. Pg 844-861.

Minitab. 2015. *Test for normality*. [Online] http://support.minitab.com/en-us/minitab/17/topic-library/basic-statistics-and-graphs/introductory-concepts/normality/test-for-normality/ [Accessed on 20 August 2015].

Moledina, A.A., Roe, T.L. and Shane, M. 2003. *Measurement of commodity price volatility and the welfare consequences of eliminating volatility*. Working Paper at the Economic Development Centre, University of Minnesota.

Paulson, ND. Katchova, AL. and Lence, SH. 2010. An Empirical Analysis of the determinants of Marketing Contract Structures for Corn and Soybeans. *Journal of Agricultural and Food Industrial Organization*, 4: 1-23.

Perry, J. MacDonald, J. Nelson, K. Hahn W. Arnade, C. and Plato G. 2005. *Did the Mandatory Requirement Aid the Market? Impact of the Livestock Mandatory Reporting Act*. Economic Research Service. US Department of Agriculture.

Pinduck, RS. 2001. The dynamics of commodity Spot and Futures markets: A Primer. *The energy journal*. Volk 22. No3 2001. Pg 1-29

Peterson, HC. Wysocki, A. and Harsh, SB. 2001. St*rategic choice along the vertical coordination continuum.* International Food and Agribusiness Management Review 4:149-166.

Pope, RD. and Just, RE. 2002. Random Profits and Duality. *American Journal of Agricultural Economics.*Vol. 84, No. 1, pp. 1-7.

PotatoesSA. 2012. *Processing industry*. [Online] Retrieved from http://www.potatoes.co.za/home.asp?pid=43 [Accessed September 2014]

PotatoesSA. 2013. *Industry.* [Online] Retrieved from http://www.potatoes.co.za/home.asp?pid=43 [Accessed September 2014]

PotatoesSA. 2015. *Markets.* [Online] Retrieved from http://www.potatoes.co.za/home.asp?pid=43 [Accessed September 2015]

Potatoes South Africa. 2012. *Potato Industry Report 2012/13.* [Online] Retrieved from http://www.hdesign.co.za/Bedryfsverslag.pdf [Accessed August 2015]

Potatogoodness, 2015. *Buying and storing.* [Online]. Retrieved from http://www.potatogoodness.com/all-about-potatoes/buying-storing/. [Accessed August 2015]

Rhodes, VJ. Dauve, JL. and Parcel, JL. 2007. *The agricultural marketing system*. (6th edition). Holcomb Hathaway publishers

Richardson, JW. Schumann, K. and Feldman, P. 2004. *SIMETAR Simulation for Excel to Analyze Risk*. Department of Agricultural Economics, Texas A and M University. United States of America

Richter, P. 2005. *The application of the value chain methodology in Development projects: reporting on the Sri Lankan Experiences*, GTZ-Integration, Sri Lanka.

Rothbard, M, 1989. *Free market*. [Online]. Retrieved from http://www.econlib.org/library/Enc/FreeMarket.html. [Accessed 16 August 2015].

Slangen, LHG. 2005. *Institutional Economics and Economic Organization Theory Syllabus.* Agricultural Economics and Rural Policy Group, Social Science Department, Wageningen University.

South African Futures Exchange (SAFEX). 1995. *Agricultural Commodity Futures, Contract specifications, Potato contracts.*

South African Futures Exchange (SAFEX), 2015. *Agricultural Commodity Futures, Contract specifications, Potato contracts.*

Strydom, D. 2010. *The establishment of long-term contracts for the potato processing industry in the Eastern Free State*. Department of Business Management. Faculty of Economic and Management Sciences

Strydom, D B, Terblanche, L. van Zy, H. and Willemse, BJ. 2012. Reduction of transaction cost within the South African potato processing industry. *African Journal of Agricultural Research* Vol. 7(47), pp. 6265-6273

Turnovsky, SJ. 1983. The determination of spot and futures prices with storable commodities. *Econometrica*, Vol. 51. No.5. Pg 1363-1365.

Transport Information services. 2015. [Online] Retrieved from *Potato transportation.* http://www.tis-gdv.de/tis_e/ware/gemuese/kartoffe/kartoffe.htm [Accessed 13 August 2015]

UNIDO. 2012. *Tanzania's Red Meat Value Chain: A Diagnostic. Africa Agribusiness and Agroindustry Development Initiative (3ADI) Reports*. United Nations IndustrialDevelopment Organization (UNIDO). Vienna, Austria

Warren, CAB. and Karner, TX. (2005). *Discovering qualitative methods: Field research, interviews and analysis.* Los Angeles, CA, Roxbury Publishing Company.

Yonad business promotion and consultancy PLC. 2010. *Value Chain analysis of milk and milk products in Borana Pastoralist area*. Addis Ababa, Ethiopia