



**Determining the viability of the beef carcass
commodity derivatives on the Johannesburg Stock
Exchange**

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Mini-dissertation submitted in partial fulfilment of the
requirements for the degree *Master of Business Administration*
at the North-West University

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Graduation May 2018

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DECLARATION

I herewith declare that the mini-dissertation entitled: *Determining the viability of the beef carcass commodity derivatives on the Johannesburg Stock Exchange*, which I herewith submit to the North-West University, Potchefstroom Campus, in partial compliance with the requirements set for the Master of Business Administration degree, is my own work, has been language edited in accordance with the requirements and has not already been submitted to any other university.

I understand and accept that the copies that are submitted for examination become the property of the University.

Jurre Hartwigsen

Acknowledgements

First of all I would like to thank God for giving me the ability to complete this thesis.

I would also like to thank my supervisor, Mr TP Venter, for his advice and supervision and for assisting me in completing this thesis. I would like to extend my gratitude towards the various agri-businesses, abattoirs, feedlots and producers who were interviewed; thank you for your compliance and input.

I would like to extend my appreciation towards my team members.

Lastly I thank my family for all their support they gave me and the sacrifice they made to enable me to complete this mini-dissertation.

I will be forever grateful.

ABSTRACT

In the agricultural sector price risk is closely assorted with the climate conditions. In the South African beef market this was very evident in the harsh drought experience in the 2014 to 2015 seasons. The beef price rose with 30 % as the national herds' size declined due to producers having to cull breeding cows. This price volatility led to losses and role players struggled to mitigate risk. The beef carcass future contract was re-enlisted in 2015 by the JSE in hopes that the new cash-settled method will ensure liquidity of the contract. The contract provides role players a way to hedge against price risk. The focus was on the abattoirs and retailers/wholesalers in the beef market. On 19 July 2017 the JSE released a notice where it was confirmed that the trading volume was less than optimal and providing some reasons for this. The solution they proposed was to change the settlement price of the contract to include feedlots.

This study aims to understand the South African beef market and why the re-enlisted beef carcass future contract is not trading. The study considers the beef market and prerequisite of a commodity to be successfully traded on a derivative market. The first objective was to investigate the beef commodity and determine whether it can be standardised into a homogenous product. Using the correlation between the beef grades, it was found that it could be. Secondly it was determined by using correlation between price and demand that the beef market operated as a free market. A literature review found that the cash settlement method of the contract did overcome the physical delivery problems. Standard deviation on prices concluded that there is ample risk in the market and therefore a need for a future contract. Lastly, the objectives and the beef market and the newly proposed change to the future contract were tested using semi-structured interviews.

In the study the beef market were analysed. The study also found that there is a need for a future beef carcass contract and that the commodity can be traded on a derivative market.

The interviews confirmed that the JSE had focussed on the wrong role players when re-enlisting and the change to the contract should include feedlots that indicated that they are going to use the contract. The biggest recommendation was that training should be provided to new users. A limitation of this study is that commercial feedlot owners were not interviewed.

Keywords: Beef carcass commodity derivatives, JSE CDM, viability, risk, markets

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Chapter 1: Exploring a beef carcass future contract

1.1 Introduction

Agriculture contributed about 2 to 3 % of South Africa's GDP in 2016; this is around R66 million (Stats SA, 2017). From this amount around 24 % is contributed by cattle and calves making it an important agricultural commodity. Cattle provide livelihood to small-scale farmers across South Africa and diversify profit margins for many commercial farmers at relative low risk compared to grain. There are about 13.7 million cattle in South Africa. Around 3,476,000 cattle and 21,000 calves are being slaughtered each year (South Africa, 2016). Beef is an important source of protein and its consumption increases yearly.

The marketing of cattle as well as all agricultural commodities in South Africa has changed over the last few decades. The Meat Board was established in accordance with the 1968 Marketing Act (NAMC, 2001:3-5). The board ensured that producers received a minimum price for their cattle via a price scheme. This was to mitigate price risk and ensure that the producers received a favourable gross margin. If an auction was held and the minimum price set by the Meat Board was not reached, the auction would be held again and a board representative would buy the cattle. This influenced the demand of the market and ensured fixed minimum prices. As in all prices not set by market forces, inefficiencies in the beef market arose. The price risk was mitigated on a national level and the producer only had to focus on production that was in most cases well below profitable norms.

In December 1997 the Meat Board was abolished (NAMC, 2001:3-5) and it meant that supply and demand now determined the price of beef. Producers were no longer protected against adverse price movements. Price risk mitigation had become important to ensure

that producers still made a profit and be sustainable in the long term. To hedge against price risk the South African Future Exchange (SAFEX) was established in 1995 and launched the agricultural commodity derivatives (Sturgess, 2016:3). SAFEX initially listed physical deliverable future contracts for agricultural commodities. This enabled producers to hedge against price risk and speculators to lock in a profit; by doing so contract liquidity was ensured. The initial contracts included beef, potatoes, white and yellow maize, wheat, sunflower seeds, soya and sorghum.

Unfortunately the beef carcass contract failed due to a lack of liquidity (GroCapital, 2016). This means that there were not enough buyers and sellers of the contract, leading to low trading activity. In 2015 the Johannesburg Stock Exchange (JSE) re-launched the beef carcass contract on the Commodities Derivative Market (CMD) (JSE, 2015:2). The beef carcass contract was now cash settled. This solved the issue of physical delivery at specific points and the transportation of the beef. Buyers or sellers did not have to make or take physical delivery, making the settlement less costly. The contract was now cash settled using a final settlement price (FSP), calculated by the South African Future Exchange (SAFEX). The difference between the cash/spot price received by the buyers/sellers and the final settlement price is therefore paid to the contract holder or vice versa. The JSE hoped that this would ensure liquidity of the contract; initial feedback indicated that the cash settlement method seemed to overcome the intrinsic commodity limitations of transport and storage.

However, a year later after the launch of the contract, liquidity was still not as hoped for (JSE, 2017b:2). There were not enough buyers and sellers of the contract and this made one wonder if the contract was doomed to fail. The JSE issued a notice on 19 July 2017, indicated that trading volume was below what was expected. The intended users of the contract were abattoirs and retailers/wholesalers. It seemed that they did not trade the contract and the JSE provided some reasons why. The JSE proposed a change on the settlement price from the “selling” price to the “purchase” price. This means that the focus will shift to feedlots and abattoirs, with the hope to improve trading volume.

There are two reasons for low trading activity of a future contract. First, as indicated by Hayward (2015:1-4), is that the commodity has to have sufficient price risk in the market, making it necessary to hedge against it to ensure profitability. The study also indicated that the underlying commodity needs to have some properties to make the contract viable (a homogenous product; storable and transportable). The second reason why a newly listed future contract fails is due to the perceptions of the market role players. There need to be determined if there is a need for such a future contract or whether current marketing channels or mechanisms are sufficient to mitigate price risk.

After the delegation of the Meat Board in 1997 the market was exposed to price risk (NAMC, 2001:26-46). Price risk increased as the market players were no longer insured of a minimum price for beef. Role players had to find alternative marketing challenges to ensure sustainability against adverse price movements. The need for hedging against adverse price movements raised and the JSE (then SAFEX) launched the first beef carcass contract in 1995 (JSE, 2016: 2-5). The problem is that, if the reasons for low volumes or user resistance cannot be determined, the success of the contract is doubtful. This may indicate that the beef market and its role players have not changed dramatically over the last decade and that current price mitigation strategies are still sufficient.

The following issues therefore emerge:

- Is there sufficient price risk in the beef industry?
- Due to the nature of the product and its market - is the future contract viable?
- Are the current contract specifications and settlement method acceptable to the market?
- What is the view of the role players of the industry regarding the beef carcass contract and the reasons for using it or not?
- What is the opinion on the newly proposed changes to the contract?

This study investigates and analyse the beef market of South Africa by considering the supply and demand thereof. The effect that the market forces, especially the recent drought conditions, have on the beef price and the price volatility in the market are also investigated. After deregulation the beef market should operate in a free market. Risk mitigation strategies are considered with focus on the beef carcass contract as hedging strategy as well as the possibility of inadequate price risk and the intrinsic commodity properties as reason for low trading activity by using statistical analysis on price, supply and demand. The perceptions that role players have on the beef market are established by interviewing them using semi-structured interviews.

The conclusions will help understand the beef market of South Africa and whether the market requires a beef carcass future contract to hedge against price risk as well as determining if the commodity properties and contract specifications (cash settlement method) ensure viability of the contract. Recommendations will be made from these conclusions on how to improve liquidity if the contract is found to be viable.

1.2 Problem statement

This study aims to understand and analyse the beef market of South Africa by examining the market forces of the South African beef industry to better understand the price risk mitigation strategies and marketing channels as used by role players in the industry with focus on the re-enlisted beef carcass contract as a hedging mechanism.

The study will consider supply and demand as well as price volatility. It will investigate the risk mitigation mechanisms, especially the re-enlisted beef carcass futures contracts on JSE and its proposed changes as indicated on 19 July 2017. This will be done by determining the viability of the future contract based on the beef market conditions and the need to hedge against price risk for the industry role players. Their perceptions of the market and a beef carcass future contract will be considered as well.

1.3 Objectives of the study

The objectives of this study aim to understand the beef market conditions and the reason(s) for the low liquidity of the contract. The objectives relate to market forces and price risk as well as the nature of the commodity (objectives 1-4) and the intended users' view and perception of the market (objective 5).

1.3.1 Primary objective

The primary objectives of this study are to analyse the beef market of South Africa and investigate the reasons for low trading volume of the re-enlisted beef carcass future contract on the JSE.

1.3.2 Secondary objectives

- i. **To investigate beef and establish that it is a homogenous commodity that can be classified into a standardised quantity and quality according to standards.** This will ensure that all market participants know what is being traded (regarding quantity and quality) on the derivative market due to the standardisation of the product by using the beef classification system.
- ii. **Determine if the mechanism of cash settlement of the beef contract is viable and that it overcomes the commodities' storage and transportation limitations.** Beef carcasses can be stored and/or transported for a short time span before it is spoiled. This was one of the main reasons for the contract fail when it was first introduced in 1995. Cash settlement contracts are now used as the underlying cash market is working successfully. If one understands the limitations of beef to be marketed in certain channels, insight can be obtained on why certain marketing channels are preferred.
- iii. **Evaluate if the market is determined by supply and demand factors and that prices can move freely on a well-functioning cash market.** Determining if the market is operating under "free" conditions. The commodity must function in a free market to ensure the success of a future contract. The market powers must be balanced with no presence of monopolies manipulating the price.

- iv. **The volatility in the beef price needs to be determined to see if price risk is present.** The beef price must be subject to fluctuations in the short run that will give rise to inherent price risk. If there is no risk, there will be no need for mitigation strategies in the market. This will lead to the future contract not having sufficient liquidity.
- v. **Establish the view and opinions of the beef industry role players on the beef market and their perceptions on the beef market re-enlisted beef carcass contracts.** The value chain role players' view of the market will provide insight to this study's problem statement. They are the intended users of the beef carcass contract and their perceptions will provide an indication of the viability of the contract.

1.4 Research hypothesis

The hypothesis of the study is that the re-enlisted beef carcass contract is failing due to the fact that there is no need for the contract in the market as there is not sufficient risk and that beef as a commodity cannot be traded on a derivative exchange.

1.5 Empirical study and research design

This is an empirical study as its intention is to gain understanding on the South African beef market by observing the data in the beef market relating to supply and demand and ultimately prices. This is to observe the price risk in the market. The study also observed the perceptions of the role players in the market via semi-structured interviews and their conduct on mitigating risk, determining if the beef carcass contract is a viable price risk mitigation strategy.

1.6 Research methodology

The methodology of this study will be explained in this section to indicate the methods to be used to answer the research objectives. In this section the research design, data collection strategy, demarcation of a field study, research ethics as well as the measurement and data analysis plan are provided. The results will be indicated in Chapter 3 and the conclusion and recommendations in the last chapter.

1.6.1 Research design

Review of similar studies done by Hayward (2015: 29-31) indicated that an in-depth industry case study of the value chain combined with a comparative study should be conducted. The design was first prescribed by Bryman and Bell (2007) and will be most suitable for this study. The reason for this is that this study only focuses on the beef industry and value chain and not on the complete meat market of South Africa. The case study design is used to ascertain if there is truly a need for a derivative future beef carcass contract on the JSE CDM. To determine this, the study design aims to comprehend market forces and volatilities in prices impacted by supply and demand. The case study will use quantitative components using secondary data collection strategies and models to answer objectives 1 to 4.

To obtain the perspectives of the different stakeholders, semi-structured interviews will be used. This is similar to the study done by Hayward (2015:41-42) and aims to answer objective 5 of this study. Qualitative data from the beef industry stakeholders will be collected by means of semi-structured telephonic interviews. The data collected is primary data on the marketing and price risk management of beef carcasses. The interviews will be non-leading and will be conducted with each respondent via telephone. Interviews will focus on abattoirs and feedlots and will be conducted to determine their view, perception, concerns and opportunities in the beef market as well as the use of a future beef contract and how to improve the contract volumes traded.

1.6.2 Data collection strategy

The study will collect data on beef price and market forces from the Red Meat Abattoir Association (RMAA) and the Department of Agriculture, Forestry and Fisheries (DAFF). The RMAA provides data on price and volumes on a bi-weekly basis. This price data is provided by contributing abattoirs indicated in Figure 3. This data best reflects the market forces and prices as it is collected in a standardised way and reflects the price movements of the entire national beef market. Data up to October 2016 will be used to include the price spike experienced due to the droughts of 2014 to 2016.

The prices and volumes obtained are used to answer objectives 1 to 4. Beef as a commodity is analysed and it is considered if it is homogenous (objective 1). The price volatility in the market (objective 2) is determined and whether there is a free functioning cash market determined by supply and demand (objective 4). A literature review was conducted to obtain secondary data for determining if a cash-settled method is acceptable and functioning. This is to understand the storage and transportation nature of the commodity (objective 3).

To determine the perceptions of the market players, telephone interviews will be conducted with prominent role players in the market. This is in line with the study done by Strydom (2010). The perception for the need and new proposed change of a derivative contract will also be determined here (objective 5). The stakeholders mainly include feedlots and abattoirs. The semi-structured telephonic interviews are cheaper and quicker and will eliminate the interviewer's bias and influence. The role players also have time constraints and telephonic interviews will be more convenient as indicated by Bryman and Bell (2007). A semi-open questionnaire will be used to guide the interviews as indicated in Table 1.

In summary, objective 1 to 4 will be determined by doing statistical analyses. These analyses will be on the price and volume data obtained from the RMAA and DAFF

including secondary data from the literature review. Objective 5, the role player's perception will be determined by conducting telephonic interviews.

1.6.3 Research ethics

ABSA Group Ltd. will be used as a link to role players in the market to conduct the telephonic interviews. Confidentiality and predilection of data non-disclosure concerns will be considered in interviews and data obtained. The conclusions and recommendations of this study will remain the opinion of the researcher and no contributors of the study will be held responsible for disagreements.

In the next section - 1.7 to 1.11 - the research method (methodology) to obtain the answers to the five objectives is provided. The five objectives differ in the appropriate research approaches to obtain answers. Each section will provide some background to the objective and then the research method used.

1.7 Standardisation of the commodity

In South Africa beef carcass is classified according to two characteristics, namely age and fat percentage on the carcass. From this there are three types of age grades and six fat grades; each grade having its own price. One of the underlying prerequisites for a successful derivative contract is that the commodity needs to be homogenous and standardised. The contract is currently settled on the A2/3 beef carcass grade. For the beef carcass contract to be successful it needs to be ascertained if this grade is an acceptable reference point for all the grades. It needs to be determined if the A2 beef grading is an acceptable indicator of the relationship of the prices between all the grades. Therefor the A2 price movement, up or down, is a good indicator of the movement in the other beef grade prices. This will allow the study to understand the transparency in the beef market and the availability of price forming information to role players. If prices are highly correlated one can conclude that price across the beef grades responds to new information.

To determine if the A2 is a reliable reference grade the correlation between itself and the other grades needs to be determined. This correlation will be on the RMAA time series data on prices over the period from January 1999 to October 2016. These are the average prices obtained from the 28 price contributing abattoirs and other stakeholders from across the country. Dietrich (1991:331) defined correlation as the statistical relationship involving the dependency between two random variables. The study done by Hayward (2015: 34-36) indicates that the most common test to determine the dependence between two variables is the correlation coefficient or Pearson's correlation coefficient. This will therefore indicate if the A2 beef grade can be used as the reference grade as it investigates the predictive relationship between the grades.

The results will indicate if there is a relationship (correlation) between the prices of the different grades and then, more importantly, indicate the strength of the relationship. If there is high correlation it can be concluded that the A2 beef grade can be used as the reference class and that there is transparency in the market. However, if there is a low correlation, it indicates that the commodity cannot be standardised and the beef is not homogenous. When the price risk mitigation strategies are considered, this will mean that the underlying prerequisite is not present in the derivative contract.

1.7.1 Research method to determine price correlation

The two main correlation tests to be used according to the literature is either the Pearson correlation or the Spearman's rho correlation coefficient. The distribution of the data will determine which test is most appropriate. Therefore the first test to be done is the Kolmogorov-Smirnov normality test. If the data is not normally distributed, the normal correlation test cannot be conducted and the Spearman's rho correlation coefficient (ρ) needs to be conducted. This is to indicate the relationship between the variables (prices of the different beef grades). Spearman's rho correlation coefficient is a nonparametric version of the Pearson correlation and has an important assumption that the variables have a monotonic relationship, meaning that the variables contently increase either positively (in the same direction) or negativity (in different directions). Therefore the

Spearman's rho correlation coefficient is less restrictive than the Pearson correlation that assumes a liner relationship.

As mentioned, the first step to determine if beef carcass can be standardised as a commodity is to perform the Kolmogorov-Smirnov normality test. This will determine if the data is normally distributed and well modelled to the bell-shaped curve. It will also be testing if the random variable underlying the data set can be normally distributed. The test works by comparing the empirical cumulative distribution function to an anticipated distribution for the sample data (Hayward, 2015:34-36), determining if the data is normal. If there is a large difference, the null hypothesis of the population being normal will be rejected. Therefore if the Kolmogorov-Smirnov normality test has a p-value less than 1 it can be concluded that the price variables are not normally distributed.

If this is the case then the Spearman's rho correlation coefficient (ρ) needs to be performed to determine the relationship between the variables. The Spearman's rho correlation coefficient is indicated in equation 1 below.

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

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.

Foster and Grassberger (2011:1-2) indicated the relationship of the variables based on the Spearman's rho correlation coefficient. If the relationships between the variables are positive, Y will increase (decrease) when X increases (decreases). The relationship will be negative if Y increases when X decreases and vice versa. If the Spearman's rho correlation coefficient is zero it indicates that there is no relationship between the variables. The coefficient becomes larger in magnitude when the variables (X and Y) merge towards perfect monotone functions of each other. If the Spearman's rho correlation coefficient is 1, it means that the variables have a perfectly monotonic relationship.

The null hypothesis of the test is that there is no relationship or correlation existing between the variables. If the p-value is low the null hypothesis can be rejected, indicating that there is a correlation. The correlation coefficient is positive and high if all the p-values are less than 1.0 (using a confidence level of 10 %). If this is the case for the data it means that there is a correlation between the prices of the different grades and the A2 grade can be used as reference price. It also indicates that the commodity can be standardised and fulfilling the requirement for a derivative commodity future contract.

1.8 Beef commodity analysis

From the failure of the initial beef carcass contract it is clear that this commodity cannot be physically settled due to its nature. These issues refer to the characteristics of beef, including perishability of beef and the difficulty to transport it as it needs to be kept cold. Understanding the characteristics of beef will provide the study insight on the current and preferred mitigation strategies in the beef market to determine if role players are forced to use certain marketing strategies due to the nature of the product.

1.8.1 Commodity analysis method

A literature review will be done to determine if the new proposed cash-settled method overcome the inherent characteristic of the beef commodity. The interviews will also test if the cash-settled method is appropriate and preferred by stakeholders. The interviews will also aim to determine the relationship between the commodity characteristics and preferred marketing channel.

1.9 Market and price analysis

The cash beef market must be free, indicating that prices should be allowed to move freely and determined by supply and demand. Future contracts will be traded and have significant liquidity if there is a need for them. This need refers to hedging against

adverse price movements in the cash market. This is also an underlying prerequisite for future derivative contracts. This means that there must be a free market between buyers and sellers to allow for price fluctuations. Rothbard (1989) indicated that in a free market the price of the commodity is determined by the push and pull of supply and demand and that prices therefore are determined freely by these forces.

To determine if the beef cash market is operating in a free market, the relationship that supply and demand has on the price needs to be investigated. For the beef carcass it will be the slaughter volume per week (demand) and the average price for that week. If there is a correlation, it indicates that there is in fact a relationship and market forces are determining prices indicating a free market. However, this only indicates a relationship; the strength of the correlation will also need to be considered in determining if there is a significant price movement in the beef cash market. For this the price data provided by the RMAA will be used, considering the A2 beef grade quoted in R/kg.

1.9.1 Price analysis approach

To determine the correlation between the volume and price a statistical analysis will be done on the price and slaughter data obtained from the RMAA. A normality test will first have to be done on the variables to determine if they are normally distributed. In the province section the Kolmogorov-Smirnov (KS) test was explained and is the best test to use (Hayward, 2015:36-37) with a significant level of 0.1 for this study.

If the variables are not normally distributed, the Spearman's rho correlation coefficient or Pearson's correlation coefficient needs to be used. The Spearman's rho correlation coefficient seems to be a better fit for the data as explained in a previous section. The p-values will be compared at a significant level of 10 %. If the p-values are less than 0.1 (p-value<0.1) it indicates that there is a relationship between the variables that cannot be due to chance. This indicates that volume has a relationship (positive or negative) with price and that prices are moving freely in the cash market. This leads to the conclusion that the beef market is operating in a free environment.

1.10 The price volatility

Efficient price risk mitigation mechanisms and strategies allow role players to hedge against adverse price movements in the market. A lowering or increase in price has a direct impact on the profitability of both abattoirs and feedlots. Therefore it is one of the most, if not the most, important needs that a mitigation mechanism as a future contract fulfils. It is a means to lock in future prices to ensure long term profitability and sustainability. However, this means that there firstly need to be meaningful price movements in the market and that there currently is no better mechanism in the market to mitigate price risk.

In this section the volatility in the beef prices is determined to establish if there is truly a price risk mitigation need that arises from significant adverse price movements. These changes are unpredictable and are referred to as price volatility. The price volatility will be measured using the conditional standard deviation. Therefore the error term acquired from the prediction of prices are thus linked to the price volatility (Jooste *et al.*, 2006; Jordaan *et al.*, 2007). Two conditions for the occurrence of price volatility according to Strydom *et al.* (2010) indicated the existence thereof. There need to be discrete spikes and the secular increase in such spikes. If there is significant price volatility in the beef market, the future contract will enable the stakeholders to hedge against adverse price movements. If the study finds that volatility is significant the other reason(s) for poor liquidity need to be considered.

1.10.1 Research design to determine price volatility

Following the similar study done by Hayward (2015: 37-38) the method to determine the volatility in the beef prices is done by examining the standard deviation over a period of time. Below is a figure to indicate the methodology to compute conditional volatility described by Moledina *et al.* (2003).

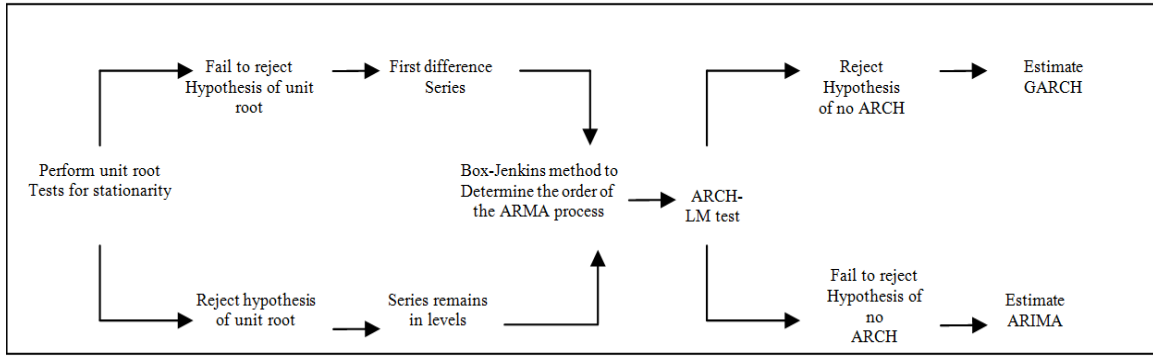


Figure 1: Methodology to compute conditional volatility

Source: Moledina *et al.* (2003)

The methodology above indicates that the first step is to do a unit root test to test for stationary. This means that its statistical properties are constant over time, indicating that it does not matter when the series are observed. The second step is to use the Box-Jenkins method to determine the order of the ARIMA (autoregressive integrated moving average) process. This test must be done on data that has been made stationary by means of differencing. From the literature review it is expected that the error term will have a distinctive size and variance. Therefore an ARCH model will be used to illustrate and model observed time series (Engle, 1982:987–1007). The ARCH-LM test will be conducted to determine the presence of the Auto Regressive Conditional Heteroscedasticity (ARCH) effect. If the ARCH effect is detected, then the GARCH approached must be used. The ARCH models assume that the variance in the current error term to be a function of the actual size of the previous time periods' error term.

Time series data may include factors that may obscure the stationary of the data. These include seasonal trends of demand in the beef market and inflation that needs to be removed to only leave the stochastic component. Thereafter the unit root test can be used to test for the stationary of the time series (Moledina *et al.*, 2003). First the effect of inflation was illuminated by deflating the nominal prices with the consumer price index (CPI) as presented in a seminar by Richardson *et al.* (2004). Seasonality can be removed by the use of a dummy variable. From the literature it was identified that the beef market

does follow seasonal trends based on consumer demands (increase around holiday times) and producer supply following grazing conditions and other production factors. To account for these seasonal trends, dummy variables on the 12 months will be used. Eleven seasonal dummy variables will be used to not fall in the dummy variable trap. Therefore the seasonality will be removed once the real process are regressed using the dummy variables. The residuals from the regression can then be used to eliminate the seasonal effect on the prices. After this is done the data is ready to be used further.

Augmented Dickey Fuller (ADF) will be used to determine how many times the series need to be differentiated to make it stationary. The order of integration is indicated by the number of times the time series need to be differentiated. This is also the value of d in the ARIMA (p,d,q) process. The value of p and q is determined by the Box-Jenkins methodology (Jordaan *et al.*, 2007). In the Box-Jenkins approached it is assumed that the residuals are homoscedastic. This implies that the error is a measure of volatility and denotes that volatility remains the same over time. Therefore in the ARIMA (d) is 0.

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

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

To determine the value of p and q the largest value of either AIC or SBC needs to be considered. An ARIMA (p,d,q) p indicates the number of times the intercept has to be lagged, d is the number of times the series need to be differentiated to obtain a stationary series and q is the time that the error term is going to be lagged. According to Jooste *et al.* (2006) and Jordaan *et al.* (2007) the largest AIC or SBC value serves only as a guideline as the components of the GARCH model needs to be significant.

The GARCH approach should be used if it is found that the series vary over time. If the ARCH-LM test is conducted and the null hypothesis of no ARCH effect is rejected, it indicates that it's a time varying series. The Box-Jenkins approach assumes that the residuals are homoscedastic. This assumption has means that volatility in the series remains steady over time since the error term of equation 1 is used as a measure of volatility. The ARCH effect needs to be tested in the conditional variance of equation 3 and 4 below (Jooste *et al.*, 2006; Jordaan *et al.*, 2007).

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

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

Where u_t^2 is the squared residual in period t , and $\rho_o, \rho_1, \rho_2, \rho_q$ are the parameters to be estimated.

The null hypothesis of no ARCH effect when ARCH equations are fitted will be tested using the Lagrange Multiplier (LM) and F-tests. If the null hypothesis is rejected it can be said that the volatility varies over time (Muthusamy *et al.*, 2008). For this study a 5 % level of significance will be used and then a 10 % level of significance indicating the p-values should be lower than 0.05 or 0.10.

When the hypothesis of no ARCH effect is rejected the GARCH approach is applied. 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 .

When using the GARCH approach the conditional standard deviation is the measurement of volatility. This is given by the square root of each of the fitted values of σ_t^2 provided in equation 4. The conditional standard deviation variance varies over time. Therefore it is impossible to provide a conditional volatility as a single value over a period and it is better to present it graphically.

If it is found that the data is not modelled on the GARCH approach the Logarithmic Total Return (LTR) approach needs to be done. The model works well with financial data and process as described by Ellis *et al.* (2002) entitled “The distribution of the residuals of financial risk models.” The formula below is used to calculate the Logarithmic Total Return (LTR):

$$r_t = \ln\left(\frac{P_t}{P_{t-1}}\right) = \ln(1 + R_t) = \ln P_t - \ln P_{t-1}, \quad (6)$$

As there are no autocorrelation or heteroscedasticity in the log returns, one can use the standard deviation of log returns. The first step will be to test for autocorrelation using the Durbin-Watson test. The next step is to test for ARCH disturbances based on OLS residuals to determine if there is any heteroscedasticity present. If there is no autocorrelation or heteroscedasticity present, the standard deviation can be determined.

1.11. Perceptions of feedlots and abattoirs

The proposed change to the beef carcass contract indicates that, after a year of relisting the contract, the JSE determined that the uptake is still unsatisfactory. They aim to rectify this by changing the settlement price of the contract from the abattoir selling price (to retailers) to the purchasing price (from the feedlot). The JSE hopes that more role players will therefore use the price hedging contract and that it will become more liquid.

In the industry overview the value change of beef was indicated as well as all the role players in the industry. The new proposed settlement price changes aims to target the transaction between feedlots selling to abattoirs, therefore indicating that there will be an

underlying need for the two role players to use a future derivative contract hedge against price risk. This implies that the future contract is the best way to handle adverse price movements and that no better suited method exists in the market.

The best way to determine if there is a need for the current contract by the role players is to have a discussion with the key players in the market. If the view of the feedlots and abattoirs is that the new proposed change will overcome the current problems with the future contract and satisfy a need for derivative contract, the expectation will be that they will use the contract and that it will be liquid.

According to Kvale and Brinkman (2008:23-33) the best way to determine this is by using qualitative research methodology-structured interviews. This is also the method used by Hayward (2015:41-42) in a similar study done on a possible potato derivative contract. From the literature the indication is that there are five types of interviews that can be conducted in this type of study. These include focus groups, structured interviews, semi-structured interviews, unstructured interviews and informal interviews. All differ in the freedom allowed to the respondent to express himself as well as the interviewer leading the discussion of the interview to obtain a specific objective. Barnard (1988:212) indicates that a semi-structured interview allows the respondents to express their own views and opinions. This type of interview also allows the researcher to deviate from the questions if needed, but still conduct the interview in a formal manner to obtain the objectives. Semi-structured interviews will therefore be used for this study.

1.11.1 Interview design

The role players in the market whom the semi-structured interview will be conducted with are the 13 major feedlots in South Africa and the 28 price contributing abattoirs. These interviews will be conducted over the telephone to save on traveling cost and time. The semi-structured interview is described by Flick (1998:156-160) as where a guide is used with open-ended questions to allow the respondent more flexibility in his answer. This way the respondent will not be restricted as in the case with scales and close-ended questions. The semi-structured interview will have a fixed set of questions to obtain a

specific objective and the degree of flexibility differs with the complexity of the issue. The participants are encouraged to expand on answers given until the researcher fully comprehends their view on the matter.

The questions below are in line with the study done by Hayward (2015:42). These questions will lead the interviewer and aim to test objective 5 of the study. After the interview it must be clear how the current role player mitigates price risk, if there is any and what his view is of the newly proposed changes to the beef carcass contract.

Table 1: Role player's questionnaire

Question	
1.	How do you buy or sell your beef? Marketing channels (cash sales, forward contracts, etc.)
2.	How often do you obtain a price that does not result in positive returns and how do you mitigate your exposure to price risk?
3.	Do you make use of a future contracts to mitigate risk and why/why not?
4.	What is your opinion regarding the cash settling method and the price determination of the beef carcass contract?
5.	What is your overall opinion of reintroducing the beef carcass contract onto SAFEX and the proposed changes on the settlement price?
6.	What is your opinion on the current grading standards and system of beef?

1.12 Research methods decisions

The main objectives of this study were identified in this chapter of the study. After reviewing other similar studies, appropriate models and methods were identified to answer these objectives. In this chapter the reasons and research design to be used for each objective were provided in each case.

A correlation test will be used to determine if the beef specification contract grade can be used as the standardised grade and if beef is a homogenous commodity. The correlation test was also used to determine if the beef market was operating under free market conditions. From the literature the normality test was first done, followed by the Spearman's rho correlation coefficient.

A literature review was used to determine if the newly cash-settled method overcomes the inherent characteristics of beef, namely that it cannot be easily stored and transported. Price volatility was determined by looking at the standard deviation of the log returns. To answer the last objective, determining the view and opinion of the proposed change in the beef carcass settlement price, semi-structured interviews will be conducted. The results of the above will enable the researcher to make a conclusion and recommendations on the beef market and price risk mitigation strategies.

1.13 Unit of analysis

The entity being studied is the South African beef market and its role players.

1.14 Limitations of the study

A limitation of this study is the size of the sample that is being interviewed and that the interviews need to be done over the telephone. Time and money are a constraint in any study and therefore only the major feedlots in South Africa can be interviewed. This leads to limited understanding of the commercial producers that have a greater need for this contract. This limitation relates to objective 5 of this study.

1.15 Benefits of this study

This study will firstly help to understand the South African beef market and its price risk mitigation strategies and whether there is a need for a beef commodity derivative contract

in South Africa. The study does this by looking at the commodity nature and the market risk. It is clear from the JSE that the contract is not trading as anticipated and the price settlement will be changed from “selling” price to “purchase” price.

Price risk in the beef market is real and always present. Adverse price movements can wipe out profits and directly impact on the livelihoods of the market players. It is therefore unmistakably apparent that there is a need for a hedging mechanism in the market. The derivative future contract is such a mechanism. However, it seems that in the market it is not widely used. This despite the successful trading of other grain derivative future contracts and the success of beef contracts in other countries as the USA and Australia.

This study will contribute to the South African beef market by investigating and understanding the market forces and the price risk mitigation strategies of role players and why they are not using the beef future contract as a hedging mechanism. It therefore leads to recommendations for the JSE to improve the contract and ensure liquidity and viability of the contract.

1.16 Layout of the study

The study will be conducted in the layout as prescribed by the North-West University. This chapter indicates the problem statement and describes the methodology used to ascertain the objectives of this study, describing the interview process as well as the statistical analysis done on price, supply and demand. In Chapter 2 the beef industry and market forces will be described to lay the foundation of understanding and gaining insight to answer the objectives. The industry and literature review on previous studies conducted, focusing on methodologies, is provided here. The results of the study are presented in Chapter 3 and will indicate the results of this study. The conclusion, limitations and recommendations of the study are indicated in Chapter 4.

Chapter 2: The beef market in South Africa

2.1 Introduction

In this chapter the formulation of understanding is set out to help investigate the research problem. The literature review will also help to determine what literature already is available to obtain objectives of this study. To solve any problem a good literature review will lay the basis (Leedy, 1993:18). This chapter will analyse the literature and the beef market. The beef market in South Africa has not received as much research as other commodities and means that there are limited resources available.

2.2 The South African beef industry

In this section an overview of the South African beef industry is provided. The purpose of this is to enable the reader to understand the scope of the study and the problem statement. The section will begin by indicating the value chain of the South African beef industry. This will also specify which role players will be interviewed and where they fit into the value chain. Next, the beef market will be examined by considering the supply and demand of beef. This will lead to price trend analysis of the different beef classification grades. The section will end by considering the proposed changes that is considered for the beef carcass contract relating to objective five of the study.

2.3 Beef supply chain

In 2011 a study was done by Labuschagne *et al.* (2011:71-88) entitled “*A consumer-orientated study of the South African beef value chain.*” The study provided the best description of the South African beef value chain as shown in the figure below. In the beef value chain it is seen that there are many different role players and governing bodies. These bodies insure that every role player in the supply chain is represented. Many have argued that the beef industry value chain is too diluted in governing and decision-making bodies. If one compare this to the grain supply chain and Grain SA it is clear that unified decisions may be difficult as each body looks after its own interest.

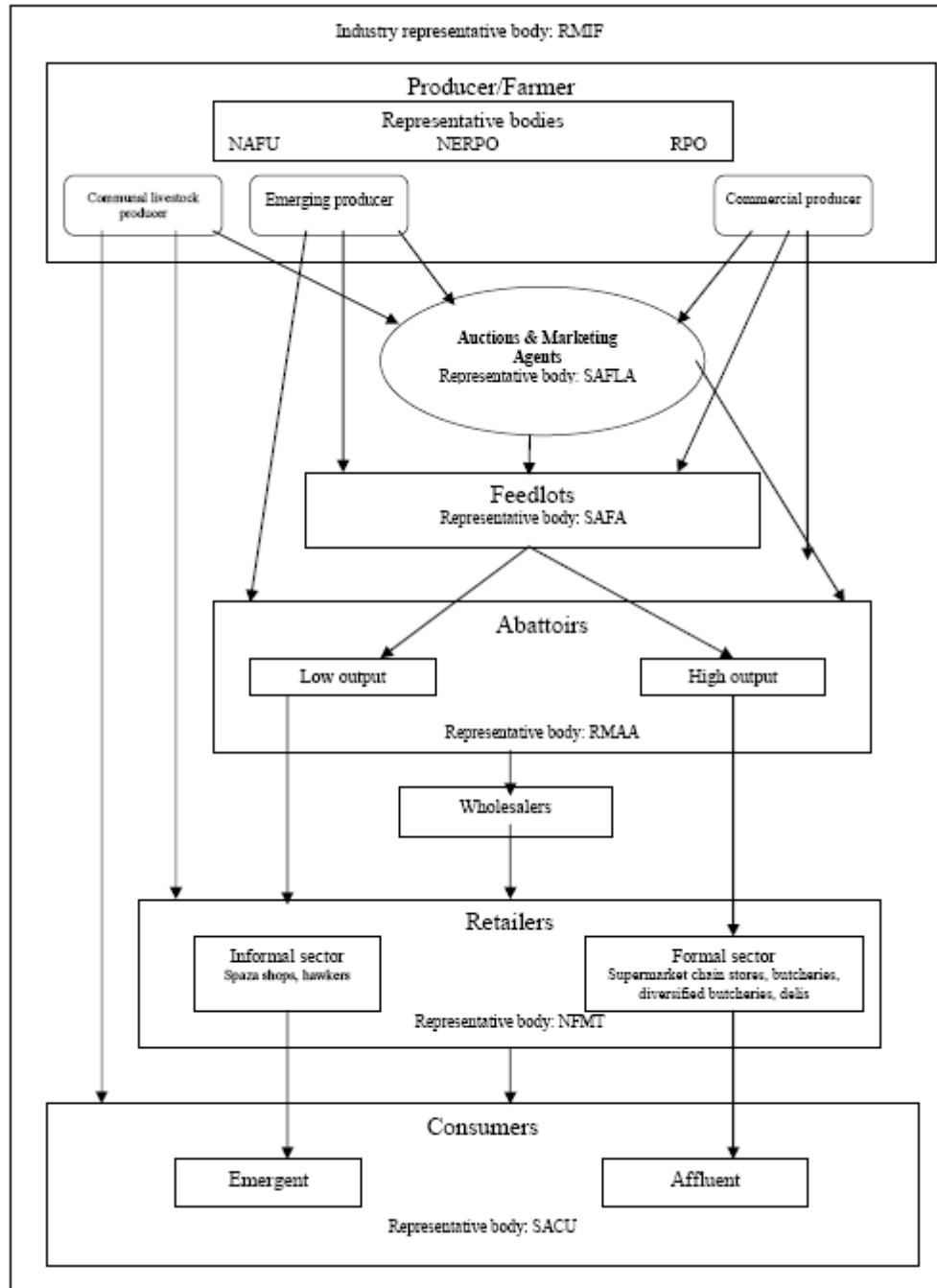


Figure 2: The South African Beef Net Chain

Source: Labuschagne *et al.* (2011:7)

From the figure above this study will focus on the price hedging strategies between the abattoirs and retailers/wholesalers and then also interviewing the feedlots on the proposed changes. This is to test these role players' perceptions of the current future contract and

around the proposed changes in the settlement price of the contract. This is also done to gain understanding on the current price risk mitigation strategies.

The major feedlots in South Africa are represented in the table below. The South African Feedlot Association (SAFA) is the governing body. From the table below it can be seen that 75 % of the feeding capacity in South Africa is owned by 13 feedlots. This means that the industry is relatively concentrated. Karan Beef and Sparta Beef are the biggest feedlots in South Africa (ABSA, 2017). The total feedlot standing capacity in South Africa is around 504,000 heads of cattle spread all over the country. For this study these 13 feedlots will be used as the respondents for the interview to obtain objective 5 of this study.

Table 2: Feedlot distribution >10,000 head capacity

Feedlot Name	Area	Capacity	% of total
KARAN BEEF	Heidelberg	100,000	20 %
SPARTA BEEF	Marquard	60,000	12 %
BULLBRAND FOODS	Krugersdorp	40,000	8 %
EAC GROUP	Sasolburg	35,000	7 %
SIS FARMING	Bethal	35,000	7 %
RANCH ESTATES	Delmas	30,000	6 %
BEEFMASTER	Christiana	25,000	5 %
BEEFCOR	Bronkhorstspuit	25,000	5 %
CHALMAR BEEF	Pretoria	25,000	5 %
KANHYM ESTATES LTD.	Middelburg	15,000	3 %
VLEISSENTRAAL BEHEREND	Pietersburg	15,000	3 %
MANJOH RANCH	Nigel	15,000	3 %
KOODOOLAKE	Stella	10,000	2 %
Other		74,000	15 %
Total		504,000	

Source: ABSA, 2017

In Figure 3 below the number of abattoirs and distribution thereof in South Africa are shown (Spies, 2011). As expected their distribution and size coincide with the market demand for beef. Compared to the distribution of the major feedlots it is clear that the location is based on demand and not supply of cattle. This may be due to the limitation of storing beef in a cold chain.

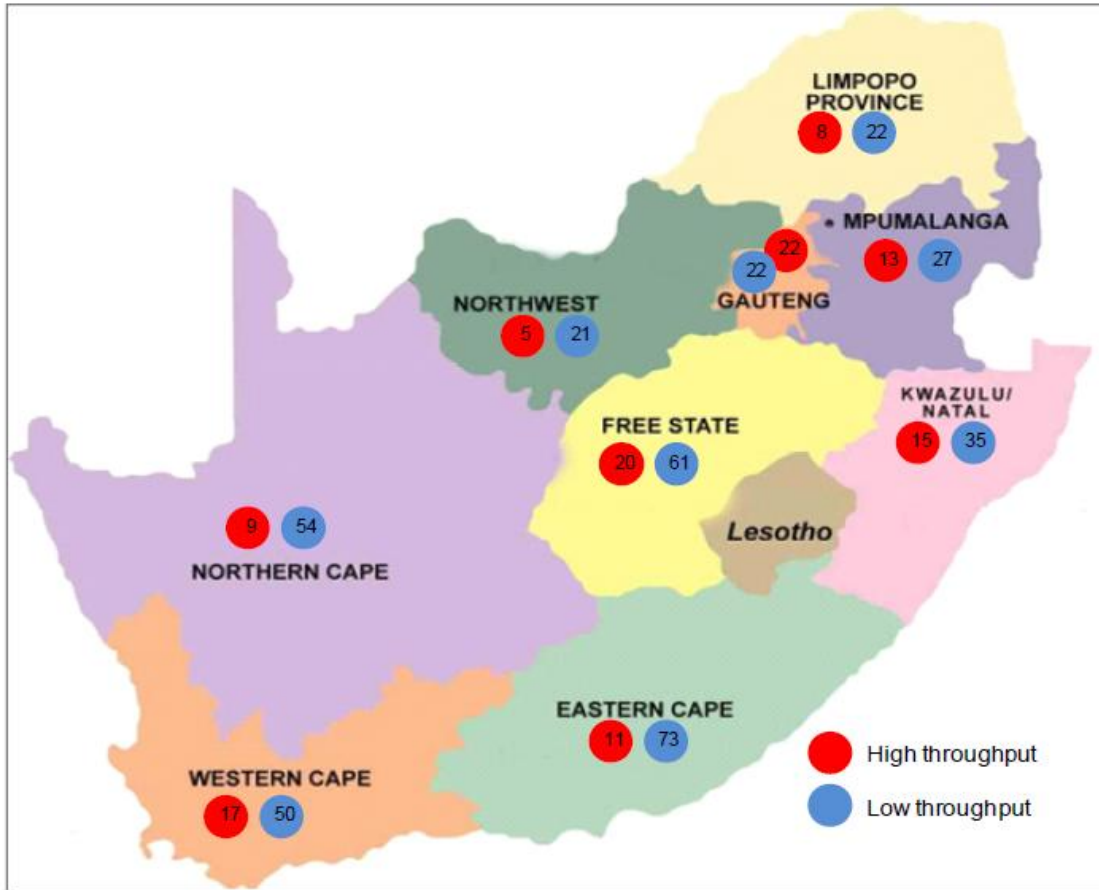


Figure 3: Abattoir distribution per province and classification

Source: Spies, 2011:85

For this study the list of abattoirs to be contacted for an interview is indicated in the table below (JSE, 2016:15). These abattoirs are also used by the JSE as price reference contributors to determine the bi-weekly settlement price for the future contract. It is for

this reason only that these abattoirs will be interviewed. The list below shows a good geographical representation of the market.

Table 3: Abattoirs for JSE price information contributors

ABATTOIR	TOWN	ABATTOIR	TOWN
Ambleside	<i>Winterton</i>	Morgan	<i>Springs</i>
Beefmaster	<i>Kimberley</i>	Ramburg	<i>Nelspruit</i>
Boshof Abattoir	Boshof	Roelcor	<i>George</i>
Cavalier	<i>Cullinan</i>	Roelcor	<i>Malmesbury</i>
Country Meat	<i>Kroonstad</i>	Rooidag Sekundi	<i>Springbok</i>
Driefontein	<i>Bethulie</i>	Saamstaan	<i>Swartruggens</i>
East London	<i>Cambridge</i>	Sparta Foods	<i>Welkom</i>
GWK Vleis	<i>Groblershoop</i>	Thabazimbi	<i>Thabazimbi</i>
Heuvelkor	<i>Bloemfontein</i>	Tomis	<i>Wellington</i>
Huntersvlei	<i>Viljoenskroon</i>	Vencor	<i>Polokwane</i>
Koelkor	<i>Humansdorp</i>	Vereeniging	<i>Vereeniging</i>
Koepel	<i>Vredefort</i>	Vryburg	<i>Vryburg</i>
Lentaba	<i>Walmer</i>	Vryheid	<i>Vryheid</i>
Meat to Market	<i>Jan Kempdorp</i>	Williston	<i>Williston</i>

Source: JSE, 2016:15

2. 4 Market analysis

In the next section of this chapter a market analysis will be provided, starting with the supply of beef by considering the national herd numbers.

2.3.1 Supply of beef

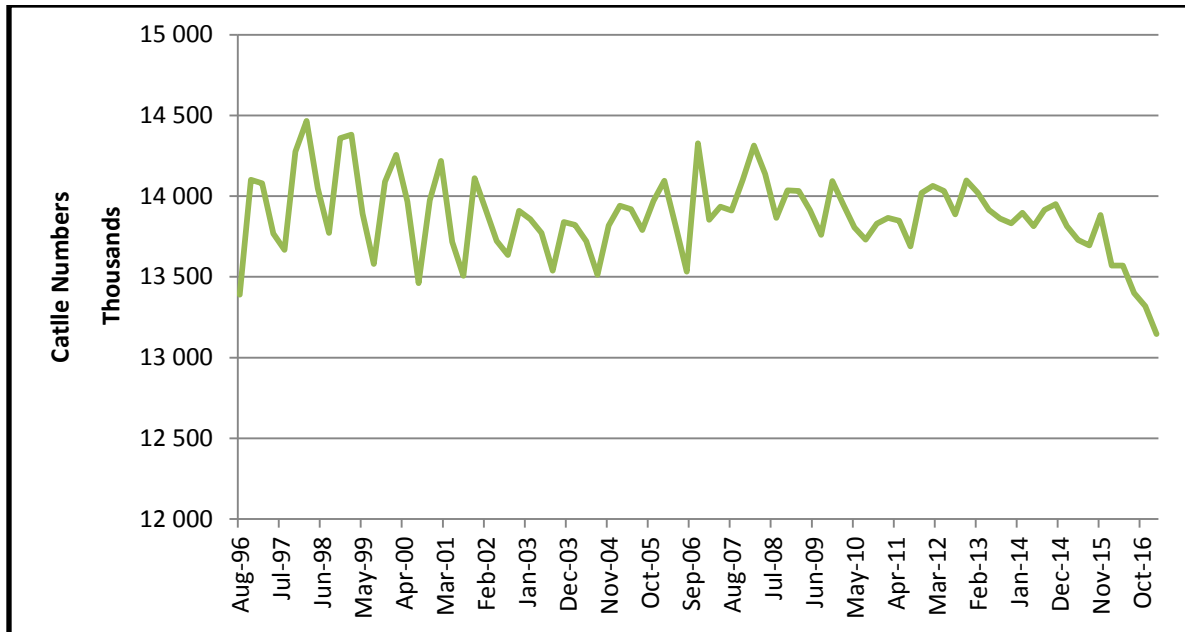


Figure 4: South African cattle numbers

Source: South Africa, 2017

Figure 4 illustrates the national herd numbers in South Africa as reported yearly by the Department of Agriculture, Forestry and Fisheries (DAFF). The national herd includes breeding cows and heifers and the numbers average between 13,500 and 14,500 from 1996 up until 2015 (South Africa, 2017). The impact of the severe drought experienced from 2014 can clearly be seen in the rapid decline of the national herd size. From 2015 the numbers have decreased to around 13,100 as producers had to cull breeding cows to save grazing. This is a 9.6 % decrease in the national herd that is substantial. As with most agricultural commodities this meant a delay in the decline of weaners and cattle to

the market. Lower supply and steady demand of beef will lead to an increase in prices, giving support for a sound heading strategy to ensure profitability.

In Figure 5 below the distribution of cattle per province is shown, with Eastern Cape (25 %), KwaZulu-Natal (19 %) and Free State (17 %) being the top three producing provinces (South Africa, 2017). The drought of the last couple of years hit the North-West and the Free State the hardest, impacting around 29 % of the market supply. Producers are currently rebuilding their herds and it is expected that weaner supply will increase from 2018 onwards.

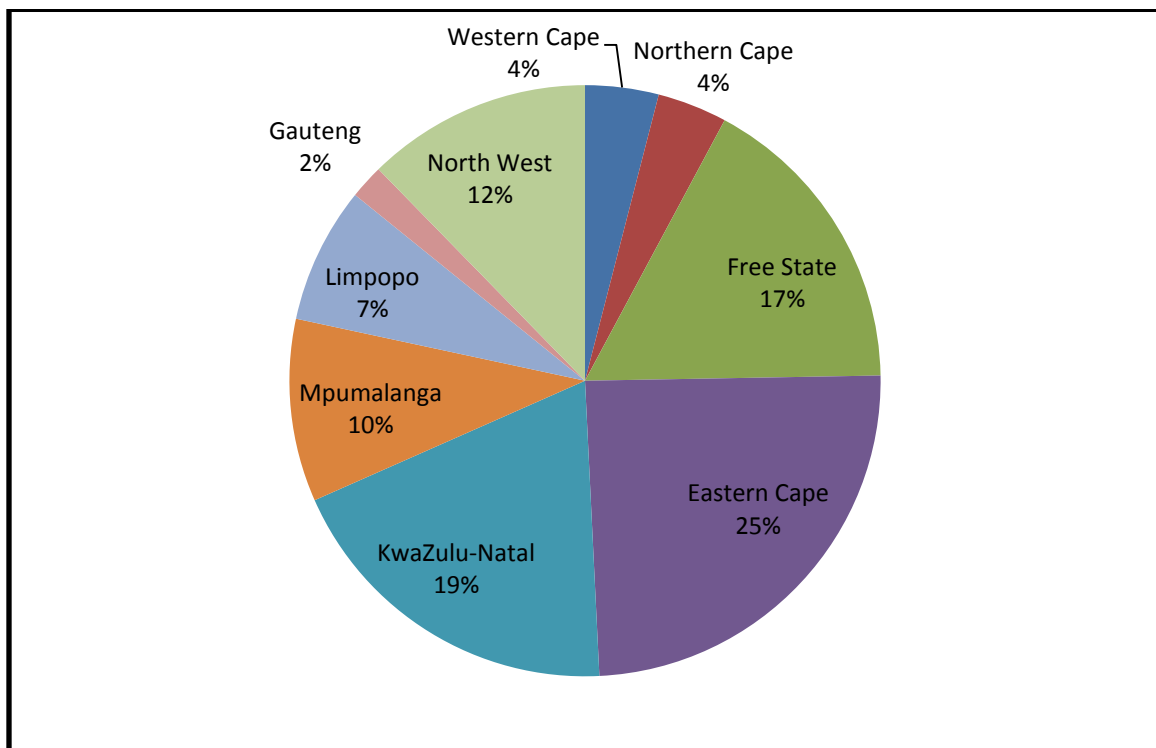


Figure 5: Cattle numbers per province in Feb 2017

Source: South Africa, 2017

The demand for beef is indicated in Figure 6 below and is obtained from the Bureau for Food and Agricultural Policies (BFAP) baseline of 2017.

2.3.2 Domestic demand for beef

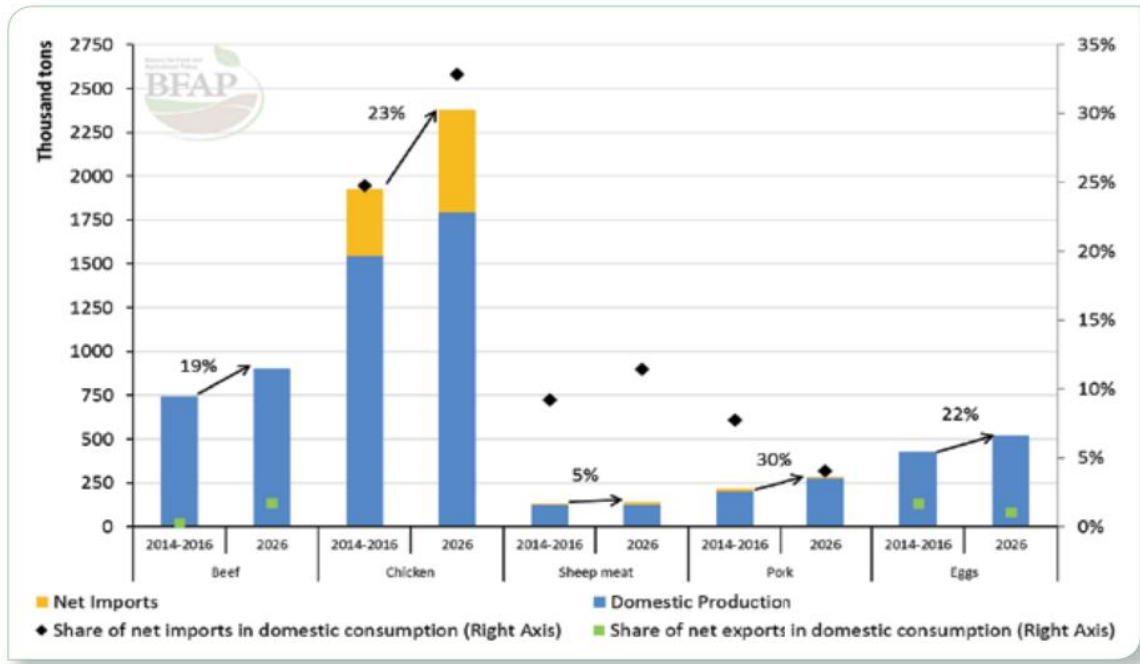


Figure 6: SA beef production, consumption and price

Source: BFAP, 2017:70

From Figure 6 we see that the average demand for beef between 2014 and 2016 was around 750,000 tonnes per year. BFAP uses multiple linear regressions to estimate future demand and forecasts a 19 % increase in the demand for beef by 2026. Being one of the more expensive sources of protein and meat it can be seen that consumers are predicted to move towards cheaper sources such as pork and chicken (BFAP, 2017:70-73).

In Figure 7 below it is shown that the beef market follows a clear trend demand for beef in South Africa. The demand, which is indicated in the number of slaughtering a week, increases around the holidays (March/April and December) as consumers BBQ more (BFAP, 2017:70-73).



Figure 7: Slaughtering numbers per month

Source: BFAP (2017:71)

It should be noted that the beef market supply is relative inelastic and slow to react, as producers cannot rapidly increase or decrease supply. This is due to the nature of the product; a cow will only be able to calve from two years old, meaning that producers will have to plan two years in advance to increase supply. Additional grazing might have to be purchased in order to do so. Feedlots also have to feed cattle for 120 to 150 days and gain most profit in the latter part of the feeding plan. This means that they have to sell at optimum weight, leading to a slow response to demand.

This means that supply is steady, but demand fluctuates. The beef market is sensitive to substitute products and holiday demand spikes. It is therefore expected that the price of

beef is dependent on demand (indicated by weekly slaughtering). The relationship is expected to be positive, as an increase in demand with supply at the same levels will lead to an increase in price.

Figure 8 below indicates the total number of slaughtering per year and the national herd size from 2007 (South Africa, 2017).

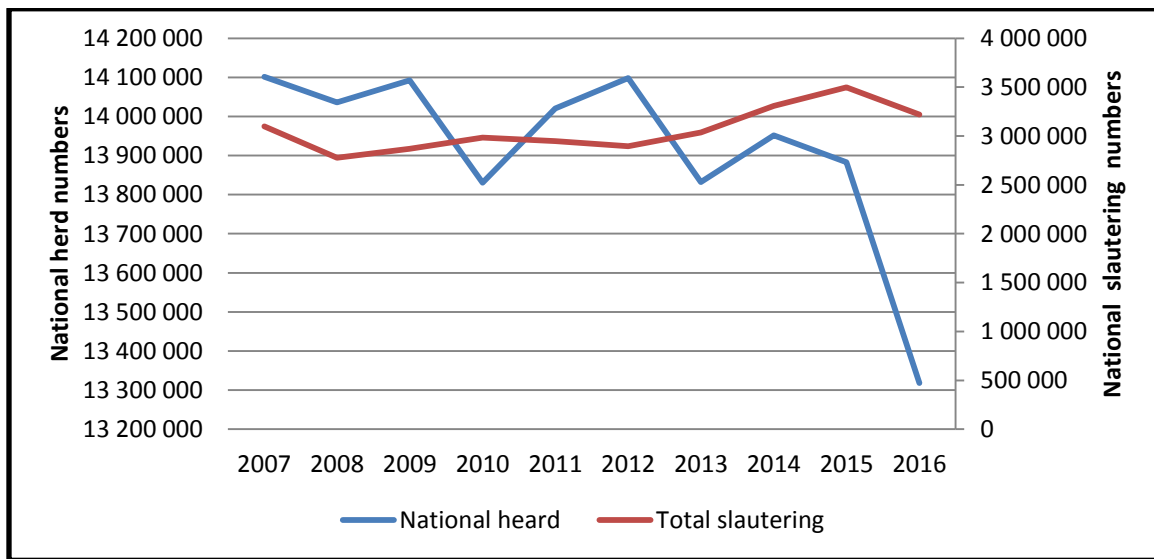


Figure 8: South African cattle slaughtering numbers per year.

Source: South Africa, 2017

The rapid decline in the national herd is clearly illustrated in the figure and indicates a 9.6 % decrease from 2015. The figure also indicates that the total number of slaughtering per year remained steady around 3,200,000 cattle (South Africa, 2017). It therefore indicates a shortage in supply and as expected, an increase in prices. Imports therefore have to increase and consumers are moving to cheaper substitutes such as pork and chicken (BFAP, 2017:70-73).

Figure 9 indicates the effect that supply and demand has on prices provided by BFAP (2017:70-73). This figure clearly indicates the effect market forces have on the beef price in a well-functioning cash market. Prices increased when supply dropped and demand increased.

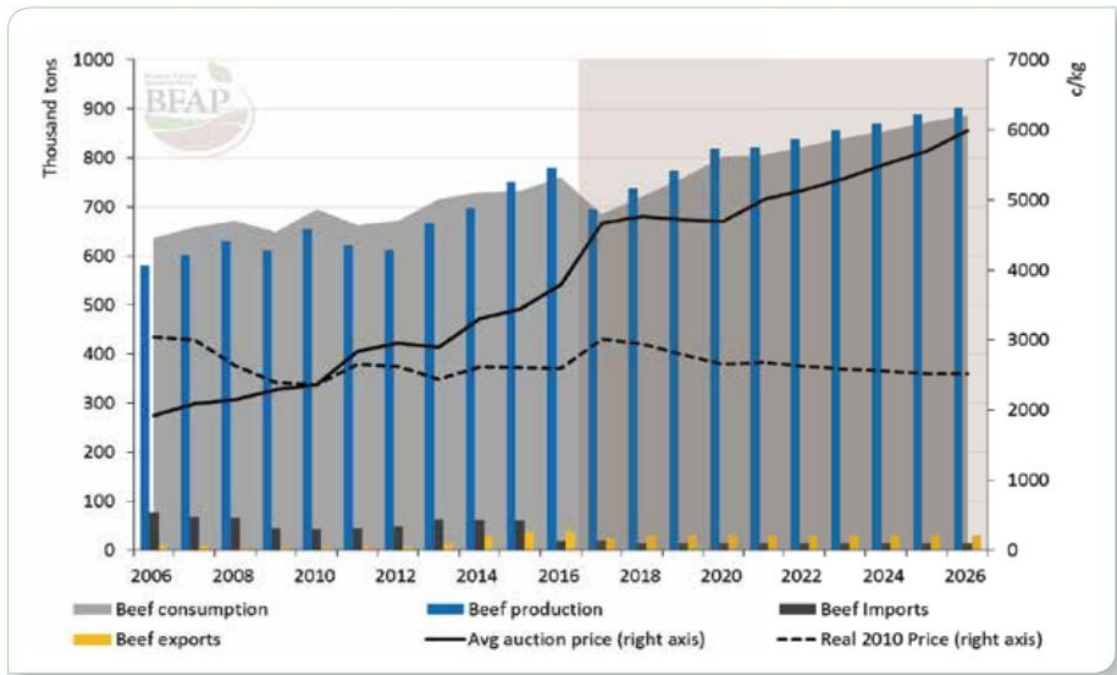


Figure 9: South African meat consumption and prices

Source: BFAP, 2017:71

2.5 Beef prices

The beef price for the different classification grades are shown below.

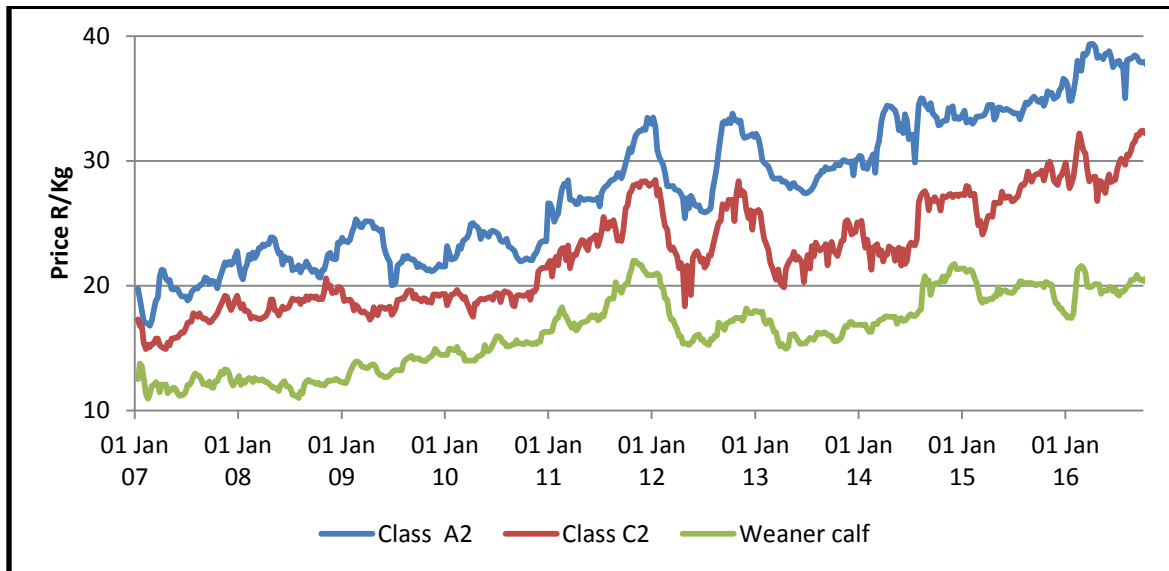


Figure 10: Nominal beef prices

Source: ABSA, 2017

In Figure 10 the beef prices for the different classification grades are indicated and a strong positive relationship is observed as they move parallel to each other, signifying that they increase and decrease in the same direction. Again, this provides insight into objective 1 of the study that the A2 grade can be used as a reference point and that beef is a homogenous product.

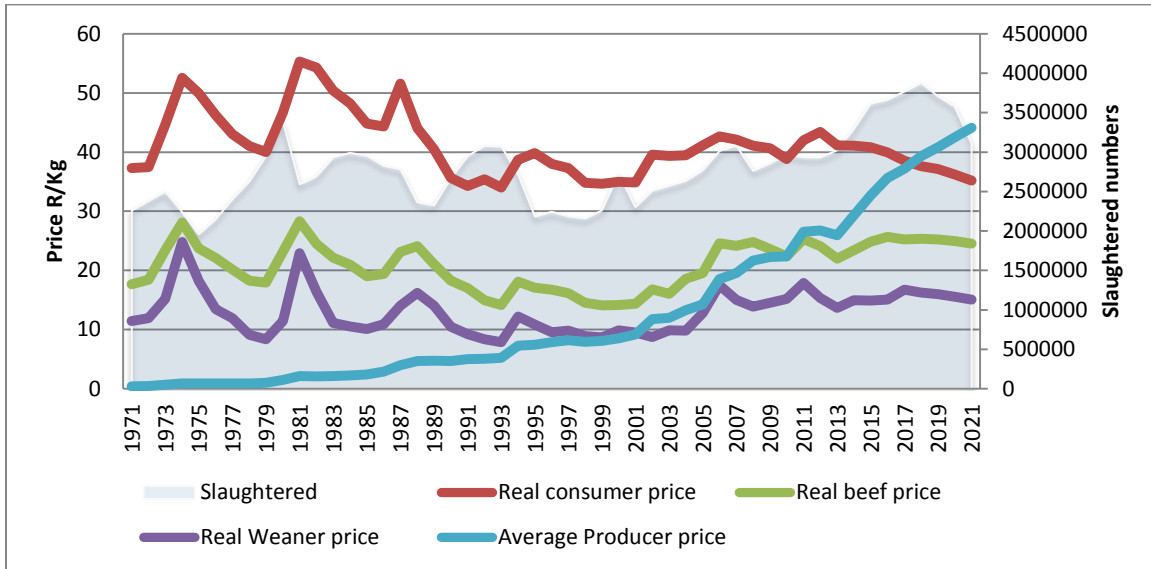


Figure 11: South African real beef price trends

Source: ABSA, 2017

The real beef price in South Africa is given in Figure 11 above (ABSA, 2017). The rapid increase in the average producer price since 2013 is clearly demonstrated. This is, as expected with drought, having an impact on the supply of cattle. However, the forecast to 2021 is that the price of beef should decrease as supply recovers. The average beef price (A2) is around R42/kg.

2. 6 Export market

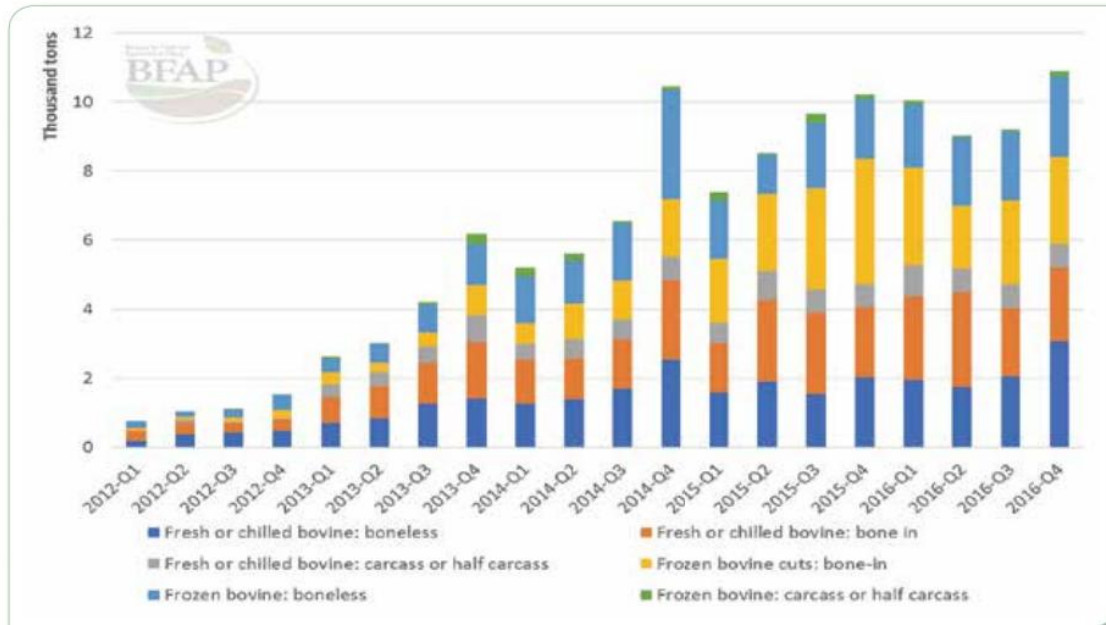


Figure 12: Beef export cuts

Source: Macaskill, 2017:73

In the beef market export depends on the exchange rate and the type of cut (BFAP, 2017:70-73). In Figure 12: Beef export cuts we see a rapid increase in exports from 2014, mainly due to the devaluation of the Rand/ US Dollar exchange rate. The mixture is well balanced between fresh and frozen cuts, with most exports going to the Asian market as the US and European markets are unreachable, due to South Africa's lack of a traceability system and foot-and-mouth disease status.

This chapter provided an overview of the South African beef market. This was done by keeping the objectives of this study in mind; some insight into these objectives was already gained from the figures. The last part of this chapter will focus on objective 5, namely to establish the view and opinion of the value chain role players on the proposed

changes on the beef carcass contract settlement price. The newly proposed changes to the contract and the reasons thereof given by the JSE will be provided.

2.7 Proposed changes to the beef carcass contract

On 19 July 2017 the JSE issued a notice (328/2017) with the subject: Changes to the settlement process of the beef carcass contract (JSE, 2017b:2-3). In this notice they announced that they are investigating and is proposing to change the settlement price of the beef carcass future contract. Currently the settlement for the contract is cash settled (to overcome the storage and transportation nature of the commodity) on the “selling prices” between abattoirs to settle the beef carcass contract at expiration. This referred to the price/transaction between the abattoirs and the retailer, including the fifth quarter.

However, from the low trading volumes on the JSE it is clear that the uptake of the contract is much lower than anticipated. After investigation the JSE provided in market noticed 328/2017 the following as possible reasons why abattoirs and retailers are not using the contract as a price hedging strategy:

1. Meat processors and retailers do not purchase whole carcasses and prefer to buy quarters on demand. This is a problem as the contract commodity is for a whole carcass.
2. Abattoirs are marketing the quarters of the carcass to retailers, using software to optimise their profitability.
3. The processors and retailers have no incentive to use a price hedging mechanism as a future contract as they pass-on price fluctuations to the consumer.

Therefore, after considering the reasons listed above the JSE is proposing to settle the beef carcass contract using “purchasing prices” instead of “selling prices”. They are moving away from retailers/wholesalers and focus on feedlots as they are buying and selling whole beef carcasses.

It is in the light of this recent change that feedlots and abattoirs will be interviewed to gain perspective if they will be more inclined to use the beef carcass contract as a hedging strategy.

2.11 Marketing conduct

2.11.1 Pricing

It is clear from the nature of the agricultural commodity that there always is the presence of price risk. Cutt and Geyser (2007:291-300) indicated that large price fluctuations globally and domestically are due to the short-term inelasticity of supply and demand in agricultural products. It was concluded that an increase in supply of meat is very inelastic. The supply is also dependent on environmental conditions, making price fluctuations difficult to predict.

2.11.2 Marketing of beef

Beef can be marketed in various channels according to the Department of Agriculture, Forestry and Fisheries. These include:

- Marketing agents: These are third parties that facilitate the transactions by bringing buyers and sellers together for price discovery, mainly by means of an auction.
- Feedlots: Producers can sell directly to feedlots.
- Abattoirs: If the cattle are a desirable weight and grade the producer has the option of selling the cattle directly to the abattoir.
- Butchers: The producer can directly approach the butcher. The butcher will then arrange for the slaughtering of the cattle.
- Private sales between parties.

It is important to note that, no matter the channel, the beef will still have to be slaughtered at an abattoir to be sold to the consumer.

The study also indicated the following factors affecting the preferred marketing channel:

- Availability of the market
- Difference in process between marketing channels
- Distance to the market
- Size of the market

The main focus on marketing beef will be to use a contract (forward or future) or in the cash market. The different contracts are provided below.

2.12 Forward contracts

These contracts are between two parties that are known to each other. The contract is for the physical deliverance of a commodity on a future date. The parties agree upon the price, quantity, grade and location when entering into the contract. These contracts may include a force majeure clause where future contracts do not (JSE, 2010).

The use of forward contracts is growing in the agricultural sector. A study done by Kirtsen and Sartorius (2002:5-7) indicated the reason for this. The benefits of a forward contract include:

- It provides a way to diversify both production and price risk, lowering transaction cost.
- Fewer barriers to entry and new marketing techniques as well as marketing channels.
- Producers can access the knowledge and expertise of their input suppliers.
- Buyers are assured of quality and quantity.

These benefits are mainly present from the fact that these parties are known to each other. This means that they can communicate and collaborate in aligning their production effort to meet the consumer needs. In other commodities like grain the product is very standardised and therefore a derivative contract is sufficient. The nature and variability of

the beef product and the limitation of the classification system may make future contracts more attractive to buyers than future derivative contracts.

2.13 Derivative future contracts

A derivative contract is defined by John C. Hull (2002:152-160) as a contract which value depends on, or derives from, the value of an underlying asset, reference rate or index. These contracts were established from the need to hedge against trading risk in the market. According to Madura (2008:742) the main risk of future contracts is prepayment risk, credit risk, basis risk, liquidity risk and market risk. The main marketing channel available to market players is a future derivative contract on the JSE and a forward contract.

2.13.1 Futures contracts

Contracts on the JSE are derivative in nature: They are contracts between two parties where the price is derived from an underlying asset (beef). The contract expires at a predetermined date in the future. The quantity and quality of the underlying commodity is specified (e.g. 1,000kg of A2/A3 beef). If the contract expires before closure, the short position holder has to make physical delivery. This could also be done at any time during the expiration month. There are two positions for futures contracts, a short and a long position.

- a. Short position: This is the position a seller of the commodity takes. The seller takes this position to hedge against a downturn of prices in the coming marketing season. Depending on the actual price at expiration, the producer offsets losses on the spot market by using profits in the futures market to neutralise one another.
- b. Long position: This is typically the strategy of a buyer. The buyer hedges against a possible price increase in the market.

2.13.2 Producer preference to adopt derivative contracts

Ueckermann *et al.* (2008:231-235) explains the South African grain producer's preference to adopt derivative contracts. They identified some of the factors that influence the producer's preferences and certain conclusions were drawn.

One of the important conclusions they made was that producers will differ in hedging practices, as well as in their reasons to trade on SAFEX. The study by Ueckermann *et al.* (2008:231-235) also concluded that the following factors influenced the producer the most to adopt trading on derivative markets:

- a. The producer's inability to predict daily prices and trends. This is one of the main reasons why many producers do not actively trade on SAFEX. To predict price movements and trends, one needs up to date, accurate information on all the factors that influence supply and demand. Not only is it costly to gather all this information, it is also very time consuming. Expert knowledge to interpret the data is also needed, a skill that producers do not always have.
- b. Regional geographic characteristics, such as climate variables, yield expectations, production patterns and other unobserved characteristics that will influence expected supply of the producer.
- c. Farm size: It was found that producers with large farms have more preference to use derivative markets.

In the case of forward contracts it was found that producers are willing to enter into such agreement if the variable cost was covered (Cobb & Barnett, 1999:9-11).

2.14 Price volatility quantification

From the literature it is clear that there is no one best method to determine the volatility or variability. There are three main models that are used to measure volatility. These are the Black-Scholes-Merton model, coefficient of variation and the unconditional standard

deviation. The Black-Scholes-Merton model is in itself unable to account for periods of change since one of the assumptions are that prices vary in a deterministic way (Jooste *et al.*, 2006; Jordaan *et al.*, 2007). The problem with the coefficient of variation and the unconditional standard deviation is that both assume that the past realisations of price and volatility have no effect on present and future realisations (Jooste *et al.*, 2006; Jordaan *et al.*, 2007).

Following similar studies, the best method to determine variability in agriculture prices is the Autoregressive Conditional Heteroscedasity (ARCH) or Generalised Autoregressive Conditional Heteroscedasity (GARCH) approach, as described by Moledina *et al.* (2003) and Pope and Just (2002:1-7). This model is most suitable as it accounts for both predictable and unpredictable components in the price process.

2.15 Beef contract settlement price determination

From the literature and comments from the JSE it is clear that, due to the nature of cattle and beef, the contract must be cash settled. Therefore, determining the settlement price is described below. Prices of the future contract are determined by bids and offers on the JSE and this section refers to the determination of the settlement price.

The current settlement price of the beef carcass contract is determined based on the Final Settlement Price (FSP). This is calculated on the last day of trading when the contract expires (JSE, 2017b:2-5). The contract will be settled in cash and is equivalent to 1,000kg of A2 or A3; the final settlement value (FSV) therefore is:

$$FSV=1000xNxFSP \quad (1)$$

Where N is the number of contracts held at expiration. Last trading day is the last Wednesday of the expiry month. Final Settlement Price (FSP) is obtained over the preceding two weeks.

$$FSP = \sum_{j=(d-1)}^d \theta_j WSP_j \quad (2)$$

Where, $\theta_j = \frac{\text{Total average mass of } A_2 \text{ and } A_3 \text{ in week } j}{\text{Grand total of } A_2 \text{ and } A_3 \text{ average masses in both weeks}}$

The WSP is simply the weighted average weekly price per kilogram of A2 and A3 class beef per contributing abattoir. This information is supplied by the Red Meat Abattoirs Association.

$$WSP = \beta_{A2} \sum_{i=1}^n \omega_{iA2} P_{iA2} + \beta_{A3} \sum_{i=1}^n \omega_{iA3} P_{iA3} \quad (3)$$

Where the weights:

$$\omega_{iA2} = \frac{\text{Total average mass of } A_2 \text{ class sold by contributor } i}{\text{Sum total of } A_2 \text{ average mass in one week}}$$

$$\omega_{iA3} = \frac{\text{Total average mass of } A_3 \text{ class sold by contributor } i}{\text{Sum total of } A_3 \text{ average mass in one week}}$$

$$\beta_{A2} = \frac{\text{Sum total of } A_2 \text{ average mass in one week}}{\text{Grand total of } A_2 \text{ and } A_3 \text{ average masses in one week}}$$

$$\beta_{A3} = \frac{\text{Sum total of } A_3 \text{ average mass in one week}}{\text{Grand total of } A_2 \text{ and } A_3 \text{ average mass in one week}}$$

And

P_{iA2} and P_{iA3} are A2 and A3 average prices in rand per kilogram for contributor i.

The proposed change to the contract will therefore impact the $PiA2$ and $PiA3$ of the settlement price formula as well as the contributor's. The average prices in rand per kilogram for A2 and A3 will now have to be determined by collecting information on the price that the abattoir is purchasing the carcass from the feedlot and not selling to the retailer. The same formula and contributors will be used at this stage. However, it is unclear what role the Feedlot Association of South Africa will play.

2.16 South African beef grading system

The contract is based on the underlying commodity assumption of 1,000kg of A2/A3 beef. Below is the complete description of the underlying commodity as provided by the JSE (2016):

“Chilled beef carcasses consisting of two sides per carcass, graded as A2/A3 and having conformation of 2, 3, 4 or 5, a damage class of not more than 1 on either the buttock, loin or forequarter, and no measles, in terms of the national beef grading guidelines. Carcasses must comply with minimum dressing standards and must be fit for human consumption. For the purposes of this contract, deboned carcasses shall be considered only in instances where it is possible to work back the original carcass price.”

Therefore an understanding of the South African beef classification system is required in investigating the research problem. The system is referred to as a grading system in the industry, but please note that it is only a classification method and is not mandatory.

Table 4 : Beef classification system

Characteristic	Class	Class description	Comment
Age	A	No permanent incisors	Carcass whose head is not available for determination of age is deemed to be in class C
	AB	At least one but not more than two permanent incisor teeth	
	B	Has at least three but not more than six permanent incisors	
	C	Has more than six permanent incisors	
Conformation	1	Very flat	
	2	Flat	
	3	Medium	
	4	Round	
	5	Very round	
Damage	0	Undamaged	Classification considers damage in relation to locality, extent and depth of damage plus fat to meat to bone ratio
	1	Disturbed to a slight extent	
	2	Moderately disturbed	
	3	Is severely disturbed	
Sex			The carcass of a ram or a bull as well as of a *hamel, a *kapater or an ox showing signs of late castration of the A-, AB-, B- or C-age classes, are identified

Source: Soji & Muchenje (2017:269)

In addition to the above mentioned characteristics fat conformation also needs to be taken into consideration, as indicated by Soji and Muchenje (2017:270).

Table 5: Grading based on fat conformation

Characteristic	Fatness class	Beef	
		Carcass description	Comment
No fat	0	Nil	SF < 1
Very lean	1	SF < 1	1 ≤ SF ≤ 3.6
Lean	2	1 < SF ≤ 3	3.6 < SF ≤ 5.6
Medium	3	3 < SF ≤ 5	5.6 < SF ≤ 7.6
Fat	4	5 < SF ≤ 7	7.6 < SF ≤ 9.6
Slightly over fat	5	7 < SF ≤ 10	9.6 < SF ≤ 11.7
Excessively overfat	6	10 < SF	11.7 < SF

SF: subcutaneous fat thickness (mm).

Source: Soji & Muchenje (2017:270)

From Table 4 and Table 5 above the contract is therefore only relevant to weaners with subcutaneous fat thickness not more than 3 mm. The classification system of beef has come under question in recent times with the industry criticising the system for discriminating against non-feedlot bound calves.

Grass-fed or beef from the veld (as in the case of informal farmers) is for example not included in the grading of the carcass. These carcasses have a distinct yellow fat. An article in the *Landbou Weekblad*, published on 13 October 2017 ("*Graderingstelsel sal rooivleisbedryf help*") (Van Rooyen, 2017:59-60) explains how SA can benefit from the new Australian classification system. This system takes the preference of the consumer in consideration and the fact that they are willing to pay a premium for grass-fed beef. Currently our system does not allow for this.

2.15 Empirical study

Similar studies were done by Hayward (2015:30) entitled "*The viability of re-enlisting potato commodity derivatives on the Johannesburg Stock Exchange.*" The study differs in the fact that the potato contract was not already on the JSE. However the objectives and methodology are relevant to this study. Using descriptive statistics and interviews the study concluded that, although there is sufficient risk in the market and the potato commodity will be able to be traded on a derivative market, there are not enough participants in the market to ensure liquidity.

Relevant to this study is the investigation done by Hung *et al.* (2011:452-458) to look at the success of a contract by considering its trading volume. They used regression on panel data between the contract success and other variables including cash market volatility, first mover effect, market competition, contract size and size of the exchange. The study found that the size of the contract and the structure of the exchange influenced the trading success of the contract.

In another study done by Pinduck (2001:1-29) it was investigated how the equilibrium of supply and demand in the cash market and storage determined the prices in spot and

future markets as well as influencing inventories. The study found that these fundamentals determined price to a large extent and not the behaviour of speculators. A fundamentals model was created with the speculative behaviours as an error term. This model explains a large portion of price movements and how commodity markets respond to changes in demand and supply.

2.16 Summary

The chapter started with an overview of the beef industry followed by a theoretical and literature review. This is to help answer the problem statement in analysing the South African beef market. The beef industry has many role players and is represented by various governing bodies making alignment and decisions difficult.

The worst drought in 100 years was experienced from 2014 to 2016. The national herd has declined with producers culling breeding cattle as there is no more grazing available. This meant that feedlots are under pressure to obtain weaner calves. The producers are currently rebuilding their herds meaning prices of breeding cattle and weaners increased dramatically in the last part of 2016. Demand is remaining steady but is expected to decrease as consumers move to cheaper substitute products. Exports are on the increase as the weakening rand means higher prices can be obtained for deboned cuts.

After investigating the market, some insights into the study's objectives were gained. Figure 9: Nominal beef prices indicated that the price for the different beef grades seems to have a positive relationship. This means that for objective 1 the A2 beef grade should be an acceptable reference point and beef is a homogenous product. Figure 10: South African real beef price trends provided some answers for objective 3 and 4 that there is volatility in the market and that there is a well-functioning free cash market.

The chapter looked at the proposed change and reasons for it to the beef carcass contract. These changes in settlement price from the "selling price" to the "purchase price" mean shifting the focus to feedlots and abattoirs. The chapter also provided an understanding of

the beef classification system in South Africa as well as the price determination process of the beef future contract. Lastly the chapter looked at previous studies to determine that research design would work best to obtain the study's objectives.

In the next chapter the results are discussed of the five objectives as provided in chapter 1. This is to understand the beef market better and to be able to draw conclusions in Chapter 4. The chapter will provide understanding on beef as a commodity, market forces, its impact on price and a summary of the interviews conducted. These interviews provide insight on the perceptions of the beef market and the beef carcass contract.

Chapter 3: Imperial investigation in the South African beef market

3.1 Introduction

Agricultural commodities have inherited risk in supply as they are biological products that depend on climate. The cattle industry supply of weaners directly depends on the grazing available in South Africa. In Chapter 2 the effect of a severe drought was shown in Figure 4: South African cattle numbers. The study indicated that cattle are produced all over South Africa with feedlots located in areas where weaners are available throughout the year. Abattoirs are located around the consumer and differ greatly in slaughtering capacity. The value chain of the South African beef market is shown in Figure 2. From this it is clear that the beef market has a long way to go as there are too many decision-making bodies representing their own interest.

The literature review and Figure 11: South African real beef price trends clearly indicated that in the beef market the supply of weaners is inelastic and prices are determined by demand rather than supply. This was even clearer in the seasonal trends of demand and its effect on price volatility. Figure 8: South African cattle slaughtering numbers per year. clearly indicates that around the holidays the demand for beef increases and therefore the price as well. The drought of 2014 to 2016 led to a dramatical increase in price as producers aimed to rebuild their herds. Price risk is present in the market and all role players are exposed to it. To mitigate this risk, role players use various mechanisms and marketing channels, one being contracts. Forward contracts are between two parties that are known to each other and seem to be preferred over future contracts.

The study aimed to determine the reason role players do not use the beef carcass contract to hedge against price risk. In July 2017 the JSE sent out a notice indicating that they admit trading volumes well below expected and provided reasons for this. They indicated

that they are aiming to change the settlement price of the contract from the “selling” price (between abattoirs and retailers) to the “purchase” price (between feedlots and abattoirs).

The objectives of this study therefore investigated the inherent commodity characteristics of beef, the price risk and mitigation in the beef market. It also investigated the perception of role players regarding the market and the beef carcass contract as a mitigation mechanism. First the homogenous nature of beef is discussed and whether the A2 is an appropriate reference price of the commodities when determining the correlation between the A2 and other grades. Secondly, it was investigated if the cash settlement price is overcoming the storage and transportation limitations by considering literature and the interviews conducted. The study then investigated if prices are determined by supply and demand, using the correlation between prices and slaughtering numbers (demand) again. This is to establish whether beef is in a free market. The fourth objective was to determine if there is price risk in the market by determining the volatility in prices using the standard deviation. Lastly interviews were conducted with feedlots and abattoirs to get their opinion on the above-mentioned objectives And more importantly, to gain understanding from the feedlots whether they will be using the beef carcass contract in the future.

3.2 Standardisation of the beef carcass

In this section the results are shown on whether the beef carcass can be standardised into a homogenous commodity, by determining the correlation between the prices of the A2 (the contract specification grade) and AB2, B2, C2 beef classification grades. First the Kolmogorov-Smirnov test for normality was done on the data and it was determined that all the prices were not normally distributed, since the p-values were less than 0.1. The Spearman’s rho correlation was therefore performed on the price data and the results are indicated in the table below.

Table 6: Correlations between beef price grades

Correlations						
			Class A2	Class AB2	Class B2	Class C2
Spearman's rho	Class A2	Correlation Coefficient	1.000	.996**	.995**	.994**
		Sig. (2-tailed)		0.000	0.000	0.000
		N	931	931	931	931
	Class AB2	Correlation Coefficient	.996**	1.000	.997**	.992**
		Sig. (2-tailed)	0.000		0.000	0.000
		N	931	931	931	931
	Class B2	Correlation Coefficient	.995**	.997**	1.000	.995**
		Sig. (2-tailed)	0.000	0.000		0.000
		N	931	931	931	931
	Class C2	Correlation Coefficient	.994**	.992**	.995**	1.000
		Sig. (2-tailed)	0.000	0.000	0.000	
		N	931	931	931	931
**. Correlation is significant at the 0.01 level (2-tailed).						

The table above indicates that all the classes' p-values were less than 0, implying that all classes' correlation coefficients were positive and high. This indicates that the A2 price of beef is highly and positively related to the other grades AB2, B2 and C2. Positive relationships indicate that the prices of the different beef grades move in the same direction. If the prices of A2 beef should increase, it is expected that all the other beef grade prices should also increase and vice versa.

From the table above the correlation coefficient is shown between A2 beef prices and the other grades. A correlation coefficient of 1 indicates perfect correlation where 0 means that there is no correlation. The results are that the prices for A2 beef and AB2 beef are highly positively related with a coefficient of 0.996. As for the B2 beef prices the correlation coefficient was 0.995 and for C2 grades prices, 0.994. In both cases a highly positive relationship is observed. From these results we can conclude that the A2 beef classification grade can be used as the base price to derive the other prices from; therefore indicating that the beef commodity and its classification grades can be standardised.

In the literature review the study indicated the classification system on beef in South Africa. The classification characteristics are understood and accepted by everyone in the

value chain. These characteristics mainly refer to age and fat conformation of the animal. This clear understanding of the classification is another indication that beef as a commodity can be homogenous. However, from the interviews done some of the respondents indicated that the classification system needs to be expanded to include other characteristics as grass or grain-fed cattle. These characteristics indicate the preference of the consumer.

In conclusion, due to the highly positive correlation between the different beef grade prices and the tested and accepted classification system, the results indicate that the commodity is homogenous and that there is transparency in the market on formulating different grade prices.

3.3 Cash settlement of beef carcass contract

The JSE indicated that the contract will have to be cash settled due to the transportation and storage limitations of beef. Beef is a highly perishable commodity and once slaughtered needs to be kept cool throughout the value chain. It is for this reason the cash-settlement method is used for this contract. This method is shown in the literature to be an acceptable way to overcome commodities that does not have the prerequisite characteristics of transportation and storage. Other exchanges in America and Australia are successfully settling derivative contracts in this manner. Therefore the literature indicates that the beef carcass contract can be settled in this way. However, the price determination of the settlement price came into question during the interviews.

The price determination method of the settlement price is indicated in Chapter 2 of this study. It uses a weighted average of prices of representative abattoirs all over South Africa. The abattoirs provide the JSE with two weeks of price data and a weighted average is determined for the final settlement price. The difference between the price obtained and the final settlement price is then paid by, or paid to the JSE. All respondents agree with the method to determine the final settlement price; many expressed concern on the price provided by the abattoirs.

There was one response of someone who was involved in the initial launch and unlisting of the beef carcass contract on the JSE. It was indicated that one of the reasons the initial beef contract failed was due to suspected price data manipulations by the price contributors (the feedlots). This time more price contributors are used to determine the price. However, this is no guarantee that manipulation of data is not possible. The same respondent indicated that in his opinion our cattle are not as standardised as other countries like America where the contract is trading well. The new proposed change on the settlement price hopes to get feedlots and producers to use the contract as a price hedging mechanism.

However, for this section it is concluded that from the literature and interviews that a cash settlement derivative contract is adequate to overcome the inherent commodity characteristics concerns. It is also concluded that the cash settlement method can work well. The interviews also indicated that, due to these commodity characteristics forward contracts are also preferred if no volume and price are agreed upon.

3.4 Price movement in the cash market

The price movements in the beef market are investigated to determine if the beef market is operating in a free market. This is also one of the requirements of an underlining commodity of a derivative contract. This means that the supply and demand should be able to move freely and that they alone determine the equilibrium price of the commodity. To determine whether our beef reference price (A2) is determined by supply and demand the correlation coefficient was calculated from the literature and Figure 11: South African real beef price trends. The weekly slaughtering numbers will be used as demand for beef. Supply is considered to be inelastic and therefore will not be correlated to price. If it is found that there is a strong correlation between slaughtering numbers (demand) and the price of A2 beef, one can conclude that the demand has an influence on prices and therefore beef is in a free market. A positive relationship is expected as an increase in demand with a steady supply will lead to an increase in prices and vice versa.

Again the Kolmogorov-Smirnov test for normality was done on the data and it was determined that the data was not normally distributed, since the p-values were less than 0.1. The Spearman's rho correlation was therefore performed on the price and slaughtering numbers and the results are indicated in the table below.

Table 7: Correlation between price and demand

Correlations				
			Class A2	Slaughtering numbers (Demand)
Spearman's rho	Class A2	Correlation Coefficient	1.000	.952**
		Sig. (2-tailed)		0.000
		N	783	783
	Slaughtering numbers (Demand)	Correlation Coefficient	.952**	1.000
		Sig. (2-tailed)	0.000	
		N	783	783
**. Correlation is significant at the 0.01 level (2-tailed).				

The results indicated that there is strong positive relationship between the A2 beef price and the weekly slaughtering numbers (demand). The correlation coefficient is 0.952, with 1 indicating a perfect relationship. This is as expected and indicates that demand has a strong effect on prices. The positive relationship is also expected as previously indicated.

Therefore it can be concluded that beef is operating under free market conditions meaning that the underlining commodity is fulfilling the requirement.

3.5 Price volatility

In this section it was determined if there is sufficient volatility in the prices of beef over time. This will indicate if there is price risk in the market and the degree thereof. If there is no price risk in the market, then role players will have no need to use a price risk mitigation mechanism as a derivative contract. If the results show that there is sufficient price risk present in the market, the conclusion must be made that role players in the value chain used other risk mitigation mechanisms. First the volatility will be determined

and described by calculating the variance in the A2 beef price over time. Interviews will then be conducted to determine what other risk mitigation mechanisms are used in the market.

From the methodology the Logarithmic Total Return (LTR) approach needs to be done. The first step will be to test for autocorrelation using the Durbin-Watson test. The next step is to test for ARCH Disturbances Based on OLS residuals to determine if there is any heteroscedasticity present. If there is no autocorrelation or heteroscedasticity present the standard deviation can be determined and used as an indication of variance.

The Durbin-Watson test was performed on the data and the results are indicated in the table below.

Order	DW	Pr < DW	Pr > DW
1	1.8905	0.0684	0.9316
2	1.8797	0.0556	0.9444
3	1.8916	0.0812	0.9188
4	1.8974	0.0999	0.9001
5	1.9431	0.2617	0.7383
6	1.9889	0.5021	0.4979 No autocorrelation

Table 8: Durbin-Watson statistics on beef prices

From the table above the results indicate that an autocorrelation is present in the price data. Pr<DW is the p-value for testing positive autocorrelation, and Pr>DW is the p-value for testing negative autocorrelation.

The next step is to determine ARCH disturbances based on OLS residuals to test for heteroscedasticity. The results of the test are indicated in the table below.

Order	Q	Pr > Q	LM	Pr > LM
1	0.5439	0.4608	0.4046	0.5247
2	1.5723	0.4556	1.7752	0.4116
3	1.6059	0.6581	1.8687	0.6001
4	7.7985	0.0992	7.7579	0.1009
5	8.7631	0.1189	8.4571	0.1328
6	10.8323	0.0937	10.3518	0.1106
7	12.3153	0.0907	11.6185	0.1138
8	12.9057	0.1151	11.8467	0.1582
9	12.9804	0.1635	11.9728	0.2148
10	13.0522	0.2208	12.0145	0.2841
11	13.0793	0.2882	12.2433	0.3456
12	18.0467	0.1143	15.6353	0.2085 No heteroscedasticity

Table 9 : ARCH disturbances based on OLS residuals

The results indicate that there is no heteroscedasticity present in the data. From this the standard deviation in the log can be calculated as there is no autocorrelation or heteroscedasticity.

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
ClassA2	Class A2	931	19.8219558	8.3908697	6.7790000	37.5023000
Ret		699	0.3614203	1.0574735	-5.0323297	3.2399185

Table 10: Standard deviation in beef prices

The standard deviation of log returns is 1.057 and for the A2 beef price 8.39 indicating that there is volatility in the prices. Therefore the presence of price risk can be assumed.

Thus it can be concluded that price risk is present and role players need to mitigate against it. However it seems that the beef carcass contract is not the preferred price hedging mechanism. The interviews in the next section will therefore help to understand what other mitigating mechanisms the market is using.

3.6. Perceptions of feedlots and abattoirs

In this section results of interviews that were conducted via telephone with the respondents indicated in Chapter 2 are provided. These are the role players in the value chain that are intended to use the beef future contract to mitigate price risk. The focus was on the abattoirs and feedlots. The feedlots were only interviewed to test their opinion on the proposed changes on the settlement price. This change will enable them to use the beef future contract when selling to the abattoirs. The JSE has released a notice on 19 July 2017 providing reasons why the current contract is not used by retailers and wholesalers. Therefore the interviews were not conducted on these role players.

The aim of the interviews was to determine what marketing strategies are used by abattoirs and why they may not be using the beef future contract as a risk mitigation tool, as well as what the opinion of the feedlots is to establish if they are going to trade the contract. The results of the abattoirs are provided in the next section, first considering forward contracts (not to be confused with future contracts).

The abattoir respondents indicated that they do not make use of forward contracts to market their beef as the setting of price and volume needed on a future date is difficult to establish and only one party benefits from it. In most cases only supplier agreements were used to set an understanding between parties. The main marketing channel was direct relationship between the abattoirs and the retailers/wholesalers and butcheries.

Where agreements were in place it was mostly for retailers to ensure quality issues as trimmings, size and deboning. The direct relationships meant that prices and volumes were determined daily via telephone. The abattoirs indicated that the competition for clients (retailers etc.) is very strong.

It was determined that everyone experience price risk in the market. However, the risk is very seasonal, following the trend of demand. The main mitigation of price risk seems to be market experience and intelligence. The respondents indicated that, to ensure a profit, they focus on buying and selling at market-related prices. Therefore sourcing price information and supply and demand trends are critical to limit losses. Since transactions happen on a weekly basis the respondents indicated that decisions on whether or not the price offered will deliver a positive return can be made quickly and accurately, if one has all relevant information and experience. One respondent indicated that by deboning the beef they move into another market that usually offers better returns, but they are currently limited by their capacity. Another respondent indicated that they make use of horizontal integration in the value chain to mitigate risk as well as diversification into other meats.

None of the respondents indicated that they make use of the current beef carcass future contract on the JSE. It was clear from the interviews that they did not have a clear understanding of the use of SAFEX as a hedging mechanism. This indicates that training and awareness may be needed by the abattoirs. However, the feedlot owners are fully aware of the use of SAFEX as they hedge their grain on the future exchange, making the change on the settlements price a promising one for the JSE. Another respondent indicated that they were concerned about possible manipulations by speculators on SAFEX. This seems to always be a concern to producers in South Africa.

The classification system was also investigated to determine why respondents may not use the future contract. Around half of the respondents indicated that the current classification system needs to be re-evaluated. Respondents said that most retailers don't discriminate between A2 and AB2/3 carcass. This is a concern for the viability of the

future contract that only accounts for A2/3 beef. One respondent elaborated on this, indicating that some beef breeds mature faster than others and the 2-tooth system of identifying age may not be sufficient. The respondent also indicated that they get penalised for a heavier carcass, therefore it is clear that the beef classification system and the JSE beef contract specifications may need to be investigated.

In conclusion, the interviews confirmed the JSE notice for a need to change the settlement price to move the focus from retailers to feedlots. Abattoirs make no use of the future contract as they use direct marketing as their sales line. They also do not make use of forward or future contracts. It was clear that they had limited understanding of SAFEX and the use of it as a price risk mitigation mechanism relying on market intelligence and experience to mitigate risk. Thus the feedlots were interviewed in the next section.

The feedlots showed a much better understanding of the use of SAFEX and many of them are currently hedging their maize on the exchange. From this respondents indicated that they are interested in the new changes and will be considering hedging their carcasses on the exchange. One respondent indicated that the main users of the contract are not the big feedlots as they mitigate risk internally, but rather the commercial producers of beef. The JSE needs to ensure that these commercial producers understand the use of a future contract. The respondent also raised concerns around the margin call of the contract being too high and this may discourage trading.

Another respondent indicated his concern on the price contributors, providing prices to the JSE that is not a true reflection of the market prices. However, in this case it is not a data manipulation issue but rather the difference of the abattoirs slaughtering preferences and price. This difference lays in two issues namely trimmings and hot-cold deductions of the carcass. Trimmings are the amount of fat cut off from the carcass by the abattoir and the hot-cold deductions are the percentage weight loss after cooling. The respondent indicated that he obtains different prices on the same day at similarly located abattoirs due to the difference in their trimmings and the hot-cold deductions. One abattoir will provide a higher price, but trims much more weight off the carcass. It is unclear how this

will then affect the calculations of the final settlement price of the JSE, but it still is a concern. There may therefore be a need to set a standard of trimming and hot-cold deductions and include this in the contract specifications of the future contract.

Overall the respondents are eager for the new change in the settlement price of the beef carcass contract, indicating that the JSE is moving in the right direction to ensure contract liquidity.

Some of the key findings of the interviews are listed below:

Abattoirs in the beef markets

- a. Abattoirs do not use contracts to market their beef and rely on personal relationships with their clients. Where agreements are in place, it is in the form of off-take agreements.
- b. Price risk is mitigated by analysing the market trends of demand and benchmarking prices. Other respondents use integration and diversification to mitigate price risk. The main conclusion is that deals mainly happen on a weekly basis and there is no need for long-term risk mitigation.
- c. Abattoirs are unfamiliar with SAFEX and the use of it.
- d. Some abattoirs sell AB2 as A2 grades and the retailers do not discriminate.

Beef feedlots

- a. Better understanding of SAFEX and indicate that they will be looking at using the future contract once the change is made.
- b. Concerns on the calculation of the final settlement price.
- c. Issues with the abattoirs slaughtering preferences in handling trimmings and hot-cold deductions.

Chapter 4: Conclusion and Recommendations

4.1 Introduction

The South African beef market is still exposed to price risk due to the free market forces of supply and demand. This is clear after the harsh drought conditions experienced by producers the last couple of years. Beef prices spiked in 2016 and many stakeholders struggled to make a profit. It is in conditions such as a drought that the value of a risk mitigation mechanism is valued. Unfortunately the study found that the re-enlisted beef carcass contract is still not being used by its intended role players. The JSE issued a notice that they aim to include feedlot owners by changing the cash settlement price from the “selling” price to the “purchase” price.

In this chapter the conclusions of this study derive from the results that were obtained. First the problem statement of the study is provided. Then the five objectives are listed and the respective answers obtained are provided. The chapter then provides some recommendations and limitations of the study. The chapter ends with a final conclusion derived from the answering of the problem statement.

4.2 Review of the problem statement

This study aimed to understand and analyse the beef market of South Africa by examining the market forces of the South African beef industry. This was to better understand the price risk and price risk mitigation strategies available in the market as used by role players in the industry with focus on the re-enlisted beef carcass contract as a hedging mechanism.

The study considered supply and demand as well as price volatility. It investigated the risk mitigation mechanisms in the market and considered the re-enlisted beef carcass future contracts on JSE and its proposed changes as indicated on 19 July 2017. This was

done to determine the viability of the future contract based on the beef market and the need to hedge against price risk. It also considered the perceptions of the role players about the market and beef carcass future contract.

4.4 Objectives of the study

- i. **The first objective was to determine if beef can be standardised into a homogenous product.** The study determined the correlation between the price of the A2 beef classification and the AB2, B2 and C2. It was determined that there is a strong correlation using the A2 grade to derive the other grades from. It was concluded that beef can be standardised into a homogenous product.
- ii. **The second objective was to determine if the cash settlement method is a suitable method to overcome the inherent transportation and storage issues of beef.** The literature and interviews confirm that this method is well accepted and used on other exchanges. Concerns on data collection for the final settlement price are still an issue that may need additional research. However, in conclusion the cash settlement method is a viable solution for beef.
- iii. **The third objective was to determine if beef was functioning in a free market where supply and demand determine prices.** To establish this, the study used the correlation between the A2 beef price and the weekly slaughtering numbers as demand. Demand was used as it was shown that this is a bigger influencer on price than supply, because of supply being relatively inelastic. The results show that there is a strong positive correlation and that price or the market is influenced by supply and demand.
- iv. **The forth objective was to determine if there is sufficient price risk in the market by looking at the volatility.** The volatility was calculated by looking at

the standard deviation in the log returns of the A2 beef price. The results indicated that there is volatility and therefore price risk in the market.

- v. **The fifth objective was to understand the perceptions of the role players in the beef industry to better understand the beef market.** The study found that there is risk in the market caused by supply and demand. However, role players use other price risk mitigation strategies.

4.5 Limitations of this study

The biggest limitation of this study is that the commercial producer and feedlot owner were not interviewed as part of this study. Only the big feedlots were included in this study and as it was pointed out, they are not the intended users of the contract as they have internal risk mitigation strategies.

4.6 Recommendations

- a. It is recommended that all stakeholders attend a workshop on the beef classification system of South Africa. This is to determine any limitations to ensure that the future contract standards are correct.
- b. The JSE should reconsider its final settlement price calculations as they may unintentionally receive different price data.
- c. The JSE should spend more resources on training producers and abattoirs to use derivative markets to hedge against price risk.

4.7 Final conclusion

The South African beef market is operating under free market conditions with prices being determined by supply and demand. Price risk is evident in the market and adverse price conditions and the need to mitigate risk became very important in the recent drought of 2014 to 2016. However, it seems as if role players do not make use of the beef

carcass future contract as a mitigation mechanism and rely on market intelligence and experience. The industry beef classification system was not sufficient in the opinion of some of the role players' opinion and requires additional development. It seems as if the South African beef industry is hindered by too many decision-making bodies unwilling to pay for additional needed research and lobbying opportunities. These opportunities include access to international markets by ensuring a foot-and-mouth free origin and a traceability system.

Regarding the beef carcass future contract the study considered the beef market and found that beef had all prerequisites for a successful future contract. It was then clear that other reasons may explain the low trading volume of the contract. This study found that the reason for the beef contract not trading is that the wrong role players were targeted. The JSE confirms this with its notice in July 2017. Many feel that the weaner future contract should have been launched first to ensure liquidity. The feedlots indicated that the JSE is moving in the right direction with the proposed change as the primary producer is now targeted. However, it seems that training and awareness of the contract are still the main drivers of success.

A scenario where a weaner future contract will have been used is when the weaner calf price increased from R20.83/kg at the end of November 2016 to R37.72/kg in July 2017. This is an increase of more than 80 % and would have a negative impact on the profitability of a feedlot owner who buys weaners. The feedlot could have locked in the future price, for example R21/kg for delivery in August 2017 when he was worried about a price increase in November 2016. If the price increased he would have been paid the difference in cash (R6.72/kg). In another scenario the weaner producer would have hedged against an expected lower price by shorting the August contract if he suspected that the price could fall to R16/kg; therefor also obtaining the difference in the prices and offsetting against possible losses.

Operating in a free agricultural market means that beef producers will always be exposed to risk. In the last few years a need for price stability and risk mitigation strategies

became very evident. The conclusion is however that the current strategies may not be sufficient to ensure long-term viability in the market if one considers the global market.

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7. Appendix-Statistical Results

Autocorrelation present in log returns

The AUTOREG Procedure

Dependent Variable ret

Autocorrelation present in log return

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	762.238986	DFE	697
MSE	1.09360	Root MSE	1.04575
SBC	2057.31534	AIC	2048.21604
MAE	0.7584083	AICC	2048.23328
MAPE	201.240889	HQC	2051.73368
Total R-Square			0.0234

Durbin-Watson Statistics			
Order	DW	Pr < DW	Pr > DW
1	1.8905	0.0684	0.9316
2	1.8797	0.0556	0.9444
3	1.8916	0.0812	0.9188
4	1.8974	0.0999	0.9001
5	1.9431	0.2617	0.7383
6	1.9889	0.5021	0.4979 No autocorrelation

NOTE: Pr<DW is the p-value for testing positive autocorrelation, and Pr>DW is the p-value for testing negative autocorrelation.

Parameter Estimates					
Variable	DF	Estimate	Standard Error	t Value	Approx Pr > t
Intercept	1	0.6613	0.0833	7.94	<.0001
tyd	1	-0.000616	0.000151	-4.09	<.0001

Heteroscedasticity in log return

The AUTOREG Procedure

Dependent Variable ret

Heteroscedasticity in log return

The AUTOREG Procedure

Ordinary Least Squares Estimates

SSE	871.845247	DFE	699
MSE	1.24728	Root MSE	1.11681
SBC	2138.12795	AIC	2138.12795
MAE	0.77344097	AICC	2138.12795
MAPE	189.367805	HQC	2138.12795
Durbin-Watson	1.6528	Total R-Square	0.0000

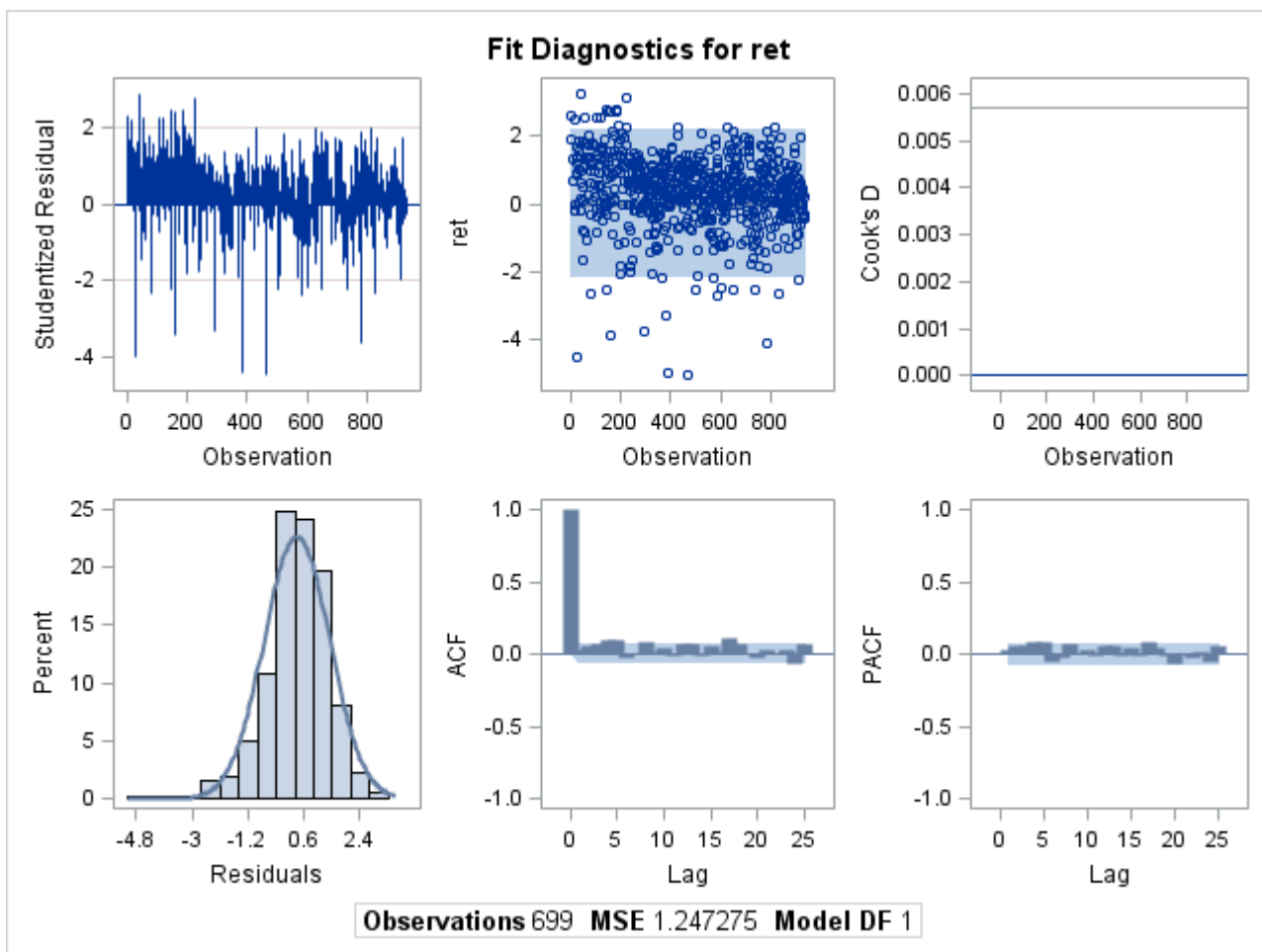
NOTE: No intercept term is used. R-squares are redefined.

Tests for ARCH Disturbances Based on OLS Residuals				
Order	Q	Pr > Q	LM	Pr > LM
1	0.5439	0.4608	0.4046	0.5247
2	1.5723	0.4556	1.7752	0.4116
3	1.6059	0.6581	1.8687	0.6001
4	7.7985	0.0992	7.7579	0.1009
5	8.7631	0.1189	8.4571	0.1328
6	10.8323	0.0937	10.3518	0.1106
7	12.3153	0.0907	11.6185	0.1138
8	12.9057	0.1151	11.8467	0.1582
9	12.9804	0.1635	11.9728	0.2148
10	13.0522	0.2208	12.0145	0.2841
11	13.0793	0.2882	12.2433	0.3456
12	18.0467	0.1143	15.6353	0.2085No heteroscedasticity

NOTE: No parameter estimates exist.

Heteroscedasticity in log return

The AUTOREG Procedure



Standard deviation of log return

The MEANS Procedure

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
ClassA2	Class	931	19.8219558	8.3908697	6.7790000	37.5023000
ret	A2	699	0.3614203	1.0574735	-5.0323297	3.2399185

Descriptives					
			Statistic	Std. Error	
Class A2	Mean		19.821955766401900	0.274999645720191	
	95% Confidence Interval for Mean	Lower Bound	19.282263989577800		
		Upper Bound	20.361647543226000		
	5% Trimmed Mean		19.558725356290500		
	Median		20.701890719952000		
	Variance		70.407		
	Std. Deviation		8.390869656426590		
	Minimum		6.779000000000000		
	Maximum		37.502300000000000		
	Range		30.723300000000000		
	Interquartile Range		13.101000000000000		
	Skewness		0.248	0.080	
Class AB2	Kurtosis		-0.957	0.160	
	Mean		21.006225298049400	0.293491237936749	
	95% Confidence Interval for Mean	Lower Bound	20.430243437165300		
		Upper Bound	21.582207158933500		
	5% Trimmed Mean		20.766211133382000		
	Median		21.070000000000000		
	Variance		80.194		
	Std. Deviation		8.955090528866560		
	Minimum		7.921000000000000		
	Maximum		39.380000000000000		
	Range		31.459000000000000		
	Interquartile Range		15.414869714979400		
	Skewness		0.269	0.080	
Class B2	Kurtosis		-1.147	0.160	
	Mean		19.781221030700700	0.276640440785162	
	95% Confidence Interval for Mean	Lower Bound	19.238309163895300		
		Upper Bound	20.324132897506000		
	5% Trimmed Mean		19.542532676431900		
	Median		20.059275578079100		
	Variance		71.249		
	Std. Deviation		8.440934075553480		
	Minimum		7.451000000000000		
	Maximum		37.500000000000000		
	Range		30.049000000000000		
	Interquartile Range		14.332000000000000		
	Skewness		0.242	0.080	
Class C2	Kurtosis		-1.128	0.160	
	Mean		18.480332953438100	0.247671826235785	
	95% Confidence Interval for Mean	Lower Bound	17.994272516449500		
		Upper Bound	18.966393390426600		
	5% Trimmed Mean		18.304922162132500		
	Median		19.450000000000000		
	Variance		57.109		
	Std. Deviation		7.557035232067680		
	Minimum		7.056000000000000		
	Maximum		33.660000000000000		
	Range		26.604000000000000		
	Interquartile Range		12.983394105490700		
	Skewness		0.161	0.080	
	Kurtosis		-1.170	0.160	

Tests of Normality							
	Kolmogorov-Smirnov ^a			Shapiro-Wilk			
	Statistic	df	Sig.	Statistic	df	Sig.	
Class A2	0.120	931	0.000	0.951	931	0.000	
Class AB2	0.131	931	0.000	0.939	931	0.000	
Class B2	0.129	931	0.000	0.942	931	0.000	
Class C2	0.122	931	0.000	0.943	931	0.000	
a. Lilliefors Significance Correction							

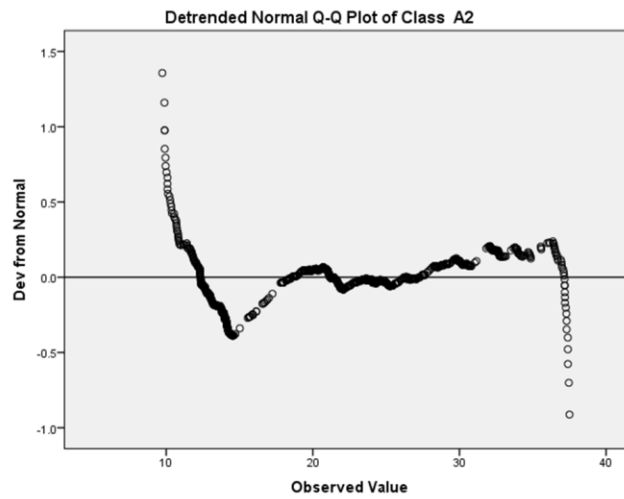
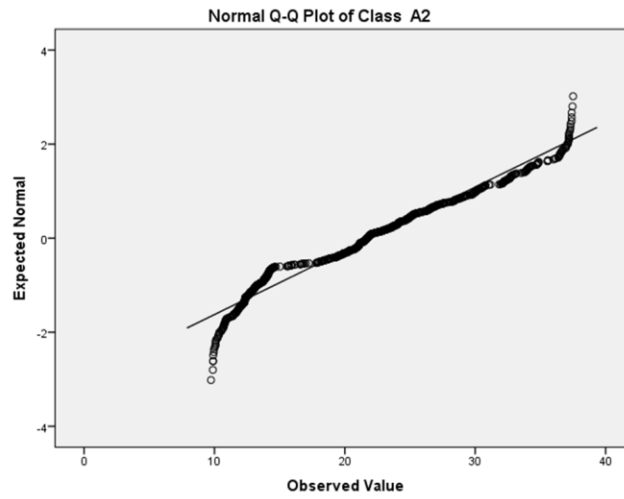
Nonparametric Correlations						
Notes						
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	Active Dataset	DataSet11				
	Filter	<none>				
	Weight	<none>				
	Split File	<none>				
	N of Rows in Working Data File	932				
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.				
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.				
Syntax	NONPAR CORR /VARIABLES=ClassA2 ClassAB2 ClassB2 ClassC2 /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.					
Resources	Processor Time	00:00:00.02				
	Elapsed Time	00:00:00.02				
	Number of Cases Allowed	449389 cases ^a				
a. Based on availability of workspace memory						

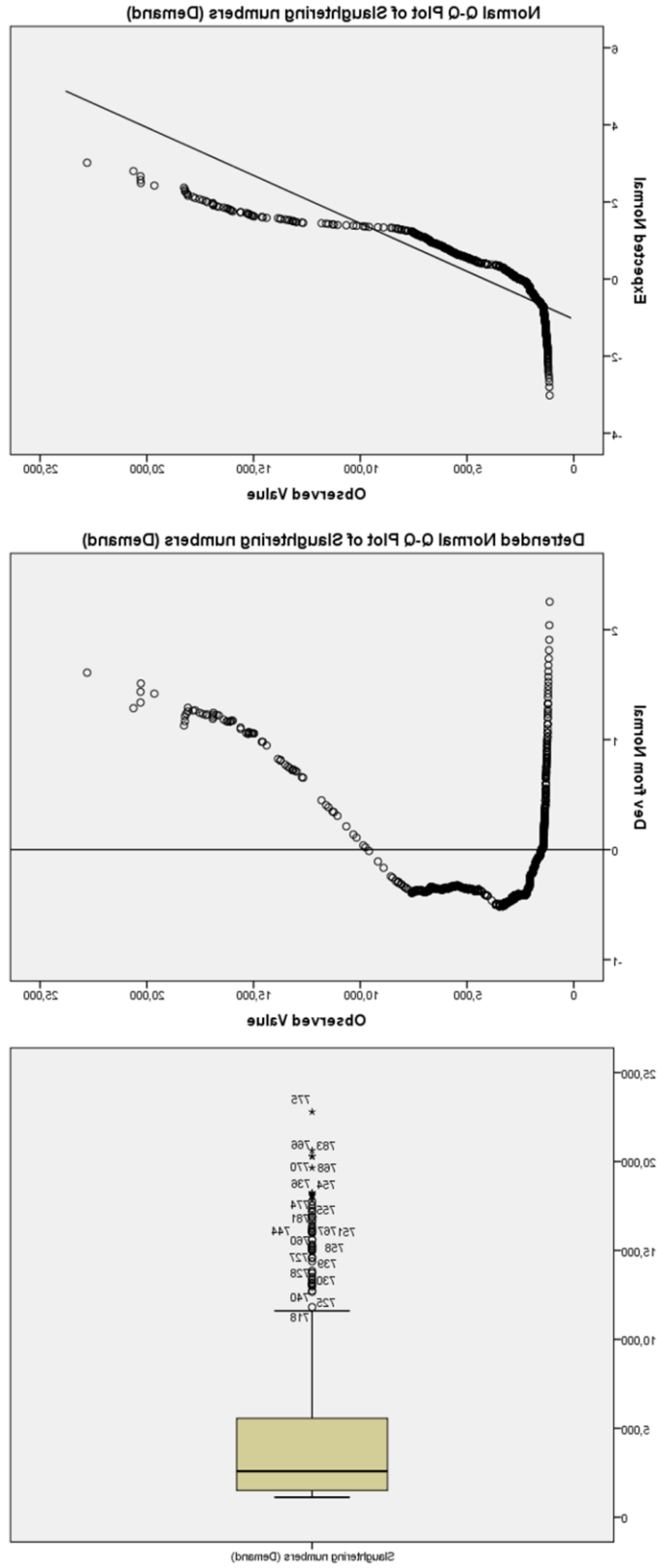
Correlations						
			Class A2	Class AB2	Class B2	Class C2
Spearman's rho	Class A2	Correlation Coefficient	1.000	.996**	.995**	.994**
		Sig. (2-tailed)		0.000	0.000	0.000
		N	931	931	931	931
	Class AB2	Correlation Coefficient	.996**	1.000	.997**	.992**
		Sig. (2-tailed)	0.000		0.000	0.000
		N	931	931	931	931
	Class B2	Correlation Coefficient	.995**	.997**	1.000	.995**
		Sig. (2-tailed)	0.000	0.000		0.000
		N	931	931	931	931
	Class C2	Correlation Coefficient	.994**	.992**	.995**	1.000
		Sig. (2-tailed)	0.000	0.000	0.000	
		N	931	931	931	931

** . Correlation is significant at the 0.01 level (2-tailed).

EXAMINE VARIABLES=ClassA2 SlaughteringnumbersDemand					
/PLOT BOXPLOT NPLOT					
/COMPARE GROUPS					
/STATISTICS DESCRIPTIVES					
/CINTERVAL 95					
/MISSING LISTWISE					
/NOTOTAL.					
Explore					
		Notes			
Output Created		18-SEP-2017 10:39:59			
Comments					
Input	Data	Q:\HHartwigsen_Jurre_Sept17\Price_Volume.sav			
	Active Dataset	DataSet12			
	Filter	<none>			
	Weight	<none>			
	Split File	<none>			
	N of Rows in Working Data File	784			
Missing Value Handling	Definition of Missing	User-defined missing values for dependent variables are treated as missing.			
	Cases Used	Statistics are based on cases with no missing values for any dependent variable or factor used.			
Syntax		EXAMINE VARIABLES=ClassA2 SlaughteringnumbersDemand /PLOT BOXPLOT NPLOT /COMPARE GROUPS /STATISTICS DESCRIPTIVES /CINTERVAL 95 /MISSING LISTWISE /NOTOTAL.			
Resources	Processor Time	00:00:00.80			
	Elapsed Time	00:00:00.73			
Case Processing Summary					
	Cases				
	Valid		Missing		Total
	N	Percent	N	Percent	N Percent
Class A2	783	99.9%	1	0.1%	784 100.0%
Slaughtering numbers (Demand)	783	99.9%	1	0.1%	784 100.0%

Descriptives								
			Statistic		Std. Error			
Class A2	Mean		21.977681972587200		0.263579827761253			
	95% Confidence Interval for Mean	Lower Bound	21.460274190729900					
		Upper Bound	22.495089754444500					
	5% Trimmed Mean		21.789841380801000					
	Median		21.692750000000000					
	Variance		54.398					
	Std. Deviation		7.375526892831220					
	Minimum		9.732000000000000					
	Maximum		37.502300000000000					
	Range		27.770300000000000					
	Interquartile Range		12.606802976770100					
	Skewness		0.237		0.087			
	Kurtosis		-0.827		0.175			
Slaughtering numbers (Demand)	Mean		4195.900349330700000		143.665030192666000			
	95% Confidence Interval for Mean	Lower Bound	3913.885578952360000					
		Upper Bound	4477.915119709040000					
	5% Trimmed Mean		3635.029762347010000					
	Median		2589.000000000000000					
	Variance		16160838.825					
	Std. Deviation		4020.054579841340000					
	Minimum		1126.000000000000000					
	Maximum		22795.000000000000000					
	Range		21669.000000000000000					
	Interquartile Range		4062.000000000000000					
	Skewness		2.114		0.087			
	Kurtosis		4.317		0.175			
Tests of Normality								
	Kolmogorov-Smirnov ^a					Shapiro-Wilk		
	Statistic		df		Sig.	Statistic	df	Sig.
Class A2	0.112		783	0.000		0.961	783	0.000
Slaughtering numbers (Demand)	0.223		783	0.000		0.718	783	0.000
a. Lilliefors Significance Correction								





Nonparametric Correlations				
Notes				
Output Created		18-SEP-2017 10:40:55		
Comments				
Input	Data	Q:\HWartwigsen_Jurre_Sept17\Price_Volume.sav		
	Active Dataset	DataSet12		
	Filter	<none>		
	Weight	<none>		
	Split File	<none>		
	N of Rows in Working Data File	784		
	Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.	
	Cases Used	Statistics for each pair of variables are based on all the cases with valid data for that pair.		
Syntax		NONPAR CORR /VARIABLES=ClassA2 SlaughteringnumbersDemand /PRINT=SPEARMAN TWOTAIL NOSIG /MISSING=PAIRWISE.		
Resources	Processor Time	00:00:00.02		
	Elapsed Time	00:00:00.01		
	Number of Cases Allowed	629145 cases ^a		
a. Based on availability of workspace memory				
Correlations				
			Class A2	Slaughtering numbers (Demand)
Spearman's rho	Class A2	Correlation Coefficient	1.000	.952**
		Sig. (2-tailed)		0.000
		N	783	783
	Slaughtering numbers (Demand)	Correlation Coefficient	.952**	1.000
		Sig. (2-tailed)	0.000	
		N	783	783
**. Correlation is significant at the 0.01 level (2-tailed).				