



Price dynamics of red meat types in South Africa for the period 2013 to 2017

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ARTICLE INFO

Keywords:

Price dynamics
Consumer-orientation
Consumer profile
Abattoir
Producers

ABSTRACT

The agricultural product market is changing from a producer-orientated to a more consumer-orientated market. Consumers rely on the classification system within the red meat types. Different red meat types and carcass classifications influence the prices of red meat. This study was conducted to determine the price dynamics of different red meat carcasses and carcass classes. It was theorised that the different red meat classification classes and number of carcasses sold influence the price and demand of red meats. It was also theorised that specific meat classes have a greater influence on meat prices and demand than others. The results of this study support the hypothesis that red meat carcass type and specific meat classes within carcass type influence red meat carcass prices. There is a differentiation among classes in terms of the degree to which class influences price, since classes were identified that had no influence on price dynamics of other meat types.

1. Introduction

The main factors that affect the price of carcasses are the external influences on supply and demand. Supply is a function of production system, efficiency of production, feed costs and external random variables such as disease and weather conditions which in the South African context is mainly periodic and prolonged drought. Demand is by consumers who respond to a complex interaction of factors that include a perception of quality, value for money, perceived healthiness of the product, economic profile and expendable income, and urbanization (Davids, Jooste & Meyer, 2013; Hahn, 2004; McCarthy, de Boer, O'Reilly, Cotter, 2003, 2004; Van Zyl, Vermeulen & Kirsten, 2013; Zotte, 2002). Culture and religion are also important determinants in the demand for meat and the carcass class of meat (Ackerman & Tellis, 2001; Van Zyl et al., 2013). According to Stotts (2013) the availability and price of pork and poultry almost certainly influence beef price increases, meaning that the availability and price of one meat product will result in changes in demand of another meat product.

A wide range of institutions are employed to procure carcasses and deboned meat for the fresh meat market and agro-processing. The nature of selling and buying carcasses has changed from an open market, auction-based system referred to by Du Toit (1982) in a study of the price elasticity between red meat sources towards contractual arrangements (Vermeulen, Kirsten & Sartorius, 2008).

Since the rate of increase in price is not proportional to the rate of

increase in money supply (Asfaha and Jooste 2007), understanding the factors that influence agricultural prices is fundamental for planned production, sustained growth, gross domestic product (GDP) of the agricultural sector and the national economy.

In the short-term, livestock and meat prices vary more than the costs of production, processing and marketing. Monthly changes in livestock and meat prices are driven by dynamic adjustments: it takes time for prices to adjust and tend to adjust. These adjustments are more rapid when adjustments are increasing than decreasing (Hahn, 2004; Mckenzie and Holt 2002; Monk, Jordaan, Grové 2010; Ogundeji, Jooste, et al. 2011). Although in the short-term there are dramatic price adjustments, price adjustments tend to be less dramatic in the long-term (Chambers & Just 1981; Monk, Jordaan & Grove, 2010; Ogundeji, Jooste, et al. 2011).

Market research showed that interactions may be expected between the different classes of red meat, which means that if the supply of one carcass class of carcass class increases, it may result in an associated decrease on the demand for another class. These dynamics influence the price elasticity of the carcass class carcasses presented in the market (Du Toit, 1982).

The cited study by Du Toit (1982) was the last complete study of supply and demand in the South African meat industry done 35 years ago when South Africa was functioning under a divisive political system. The study focused mainly on beef, and mutton and lamb meat production, although pigs and poultry were included. Du Toit (1982)

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concluded with an Ordinary Least Squares (OLS) model to calculate demand. Hancock, Nieuwoudt and Lyne (1984) published results of a study that was built on the results of Du Toit (1982), which concluded with a single and simultaneous OLS equation for demand. Loubser (1990) produced an updated version of the ODL, which was followed by the Rotterdam model (Badurally-Adam 1998). Lately, the Almost Ideal Demand System (AIDS) model is used to determine demand of meat (Taljaard, Van Schalkwyk and Alemu 2006). However, none of these formulas described the demand of meat perfectly. There is no correct or final equation for a specific commodity market, so the monitoring of a specific commodity is an on-going process. Without demand, production and marketing are futile exercises (Delpont, Louw et al., 2017). The first study in South Africa regarding the demand in the meat industry was done by Du Toit (1982) which was based on different dynamics compared with the prevailing dynamics.

These studies considered meat supply, demand and price in a context of gross supply. There is no study on the effects of red meat carcass classes on the purchase prices of carcasses and carcass classes. A study was designed to determine the effect of different red meat carcass classes on purchase price of red meat carcasses by abattoirs. The study of Du Toit (1982) focused on external factors, while the present study focuses on the effects of the different meat products and meat classification on each other. The marketing system of red meat has changed since Du Toit (1982) determined the equation, mainly from carcasses sold at auctions to producers selling directly to abattoirs (contract sales) or meat producers owning their own abattoir (Kristen, 2003; Labuschagne, Louw & Ndanga, 2011; Vermeulen et al., 2008). With beef and mutton carcasses, there is an increased number of carcasses that is being sold on the JSE (<https://www.jse.co.za/content/JSEBrochureItems/BeeInfoBrochure.pdf>). The aim of this analysis was to identify the effects and interactions between type of meat (beef, mutton and lamb, and pig) and carcass classes on purchase price (R/kg cold carcass mass) over a selected period. The hypothesis was that specific meat classes within the meat carcass classification system influence the price dynamics of red meat but that not all meat classes are equally important. The aim of this analysis was to identify the effects and interactions between the type of meat (beef, mutton and lamb, and pig) and carcass classes on purchase price (R/kg cold carcass mass) over a selected period in South Africa. It was hypothesised that specific meat classes within the meat carcass classification system influence the price dynamics of red meat but that not all meat classes are equally important.

2. Methods and materials

Data comprising 259 sets was obtained via the Red Meat Abattoirs Association (RMAA) for the period 2013 to 2017. The data was collected from abattoirs that voluntarily sent their information to the RMAA. This data consisted of weekly data from the abattoirs on the number of carcasses bought, average mass, average purchase price, average selling price, and minimum and maximum selling price of each carcass class (pig, cattle and sheep). The following variables were used for pig, sheep and cattle carcasses: the number of carcasses bought, average purchase price and average mass per carcass price. The tonnage of meat was calculated by multiplying the average purchase price with the total number of carcasses bought for the specific red meat type.

Since the number of abattoirs that supplied data over the period 2013 to 2017 fluctuated, the observed values, for example, the average mass of carcasses bought, also varied. Calculating moving averages for the various time series did not present smoother trends. Hence the weekly data was summarised by computing averages across every four non-overlapping weeks. This resulted in 65 observations per variable.

The data were analysed utilizing SAS® (Version 9.4). Pearson's R correlations were determined between the variables of the red meat carcasses. Each red meat carcass type (pig, beef and sheep) was compared in terms of tonnage of meat and average purchase price of

carcasses (R/kg) of pork, beef and sheep. A 95% confidence level was set for the correlations.

The following model was used for the correlation:

$$P_{x,y} = \text{cov}(x,y) / \sigma_x \cdot \sigma_y;$$

Where;

- $P_{x,y}$ is the correlation coefficient
- $\text{cov}(x,y)$ the two variables compared
- σ_x, σ_y are the standard deviations of the variables.

Linear regressions were determined with a 95% confidence level. For each type of red meat carcass (pig, beef and sheep) and the average purchase price was compared to the tonnage of meat and average purchase price of carcasses (R/kg) for pig, beef and sheep carcasses and carcass class.

The multivariate linear regression model for each of the variables was as follows:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} \dots \beta_p x_{ip} \text{ for } p = 1, 2, \dots, n;$$

where;

- y_i is the dependent variable
- x_{ip} the independent variable
- $\beta_1, \beta_2, \dots, \beta_p$ the applicable partial regression coefficient of the variable
- β_0 the intercept.

Because of the small sample size ($n = 65$), the regression models were performed on one or two explanatory variables at a time. For example, a regression analysis was performed on the average purchase price of pork (dependent variable) and tonnage (explanatory variable) of pork per carcass class to determine which carcass classes affected the average purchase price of pork. Similar regression models were fitted with tonnage of beef and mutton and lamb as explanatory variables and the average purchase price of pork as the dependent variable. The tonnage of carcass classes that showed significant parameter estimates according to these three regression models was then combined in one regression model with the average purchase price of pork as dependent variable. The tonnage of the carcass classes with the highest p-values associated with its parameter estimates was then systematically removed from the regression model until the model included only explanatory variables with parameter estimates significant at the 5% level.

The influence of tonnage of beef, lamb and mutton (sheep) per carcass class on the average purchase prices of beef, mutton and lamb (sheep) respectively were analysed similarly. This process was followed in all the regression analyses for different explanatory variables.

Ethical approval reference EC160519-31 was granted for the use of internal and external data sets in research with the RMAA and South African Pork Producer organisation (SAPPO) as respondents.

3. Results and discussion

Livestock production faces numerous challenges that place constraints on the ability of agriculture to grow and prosper in a sustainable way. Some of the factors that influence the sustainability of animal agriculture include rising and volatile input costs, potential for severe equity drain, and broader economic influences (Geyser & Cutts, 2007; Monk et al., 2010; Schulz, 2013). According to Schulz (2013), if a recession occurs, all prices of all commodities including meat fall drastically, which usually requires approximately two years to recover and reach a new high.

The results of the study show that beef carcasses have the highest average tonnage of meat sold (2877.86 ± 1320.99), followed by pig carcasses (669.54 ± 496.73), and the lowest tonnage of red meat sold

Table 1

The Pearson's R correlations between tonnage and purchase price of red meat (pork, beef, and mutton and lamb) for the period 2013 to 2017.

	Tonnage of meat			Average purchase price (R/kg)		
	Pork	Beef	Sheep	Pork	Beef	Sheep
Tonnage of meat	Pork	0.73**	NS	0.69**	0.81**	0.76**
	Beef		0.39**	0.68**	0.75**	0.70**
	Sheep			NS	NS	NS
Average purchase price (R/kg)	Pork				0.87**	0.88**
	Beef					0.95**
	Sheep					

NS: Non-significant, * significant at the 5% level of significance, ** significant at the 1% level of significance.

is sheep carcasses (320.91 ± 142.62). With mass of the carcasses playing the main role in the different tonnages, as discussed later, cattle carcasses are the heaviest and sheep carcasses the lightest. It can be observed that sheep carcasses (47.24 ± 9.09) cost the most, followed by cattle (32.64 ± 6.46) and then pigs (21.04 ± 2.98).

Table 1 represents the Pearson's R correlations between tonnage and purchase price of red meat (pork, beef, and mutton and lamb) for the period 2013 to 2017. It can be observed from the table that tonnage of mutton and lamb was not significantly correlated to average purchase price of red meat, as well as pork tonnage, although positively correlated to beef tonnage. Sheep is vulnerable to the climate. During the period of the study a drought occurred in South Africa which resulted in a large number of sheep carcasses being sold, and thus price was not a factor in the decision making of the producers and farmers.

The partial regression coefficients derived from the given linear regression model between average price (R/kg) of types of red meat over the 2013 to 2017 period and total tonnage of meat appear in Table 2. These show the dynamics between average price and the tonnage within and between types.

The price dynamics for supply of pork carcasses sold at the abattoir, compared to other red meat carcasses sold at the abattoir, were influenced by average purchase price of mutton and lamb carcasses sold (0.23), tonnage of beef carcasses sold (0.001), and tonnage of mutton and lamb carcasses sold (-0.006). This analysis showed that the average purchase price had the highest influence on pork price. Both these had a positive relationship, whereas the tonnage of pork, beef, and mutton and lamb had an inverse (negative) relationship.

The price dynamics for supply of beef carcasses sold at the abattoir, compared to other red meat carcasses sold at the abattoir, were influenced by the average purchase price of mutton and lamb carcasses sold (0.43), average purchase price of pork carcasses sold (0.31), and tonnage of meat of beef carcasses sold (0.01). This analysis showed that the average purchase price of the other red meat carcasses had the highest influence, with a positive relationship. Whereas tonnage of pork, beef, and mutton and lamb had an inverse relationship.

The price dynamics for supply of mutton and lamb carcasses sold at the abattoir, compared to other red meat carcasses sold at the abattoir, were influenced by the average purchase price of beef carcasses sold (1.91) and the average purchase price of pork carcasses sold (0.58). The analysis showed that the purchase price of the other red meat carcasses

had the highest influence followed by the mass of mutton and lamb. All the previous factors had a positive relationship, whereas the number of pork and beef carcasses had an inverse relationship. All the results observed are due to the correlation between cattle, pig and sheep carcasses, as discussed earlier.

The average mass and number of units sold were not included in these equations, as tonnage of meat represents the combined influence of these two factors, and including these factors will only result in multicollinearity. However, a linear regression equation was performed with average mass, number of units sold and average price of carcass classes on the price dynamics of red meat. From this equation it was determined that the effects that are seen in Table 2 on tonnage are mirrored in the number of units sold, and mass does not influence the price dynamics of red meat prices.

The equations that resulted from this analysis show the interactions between the different types of red meat (pork, beef, and mutton and lamb) and tonnage of red meat, and purchase price (R/kg) on the price that the abattoir paid for red meat carcasses. All these equations are observational equations that can be used to understand the relationships better.

The study showed that the tonnage of meat, and average purchase price of red meat carcasses sold at the abattoir had an influence on the average price of red meat carcasses sold at the abattoir. It was expected that the different types of red meat carcasses would influence the price dynamics of each other. It was, however, not expected that the tonnage of meat and average purchase price would not contribute equally or, in some cases, would not contribute to the resulting price dynamics of meat supplied to the abattoirs.

From the following equations it can be seen how each factor influenced the price of red meat carcasses according to the different red meat carcasses classes. This gives an indication of factors per class that need to be considered by the abattoir before the purchase price is determined. All the results observed are due to the correlation between cattle, pig and sheep carcasses, as discussed earlier.

The partial regression coefficients derived from the linear regression model between purchase price of red meat over the period 2013 to 2017 and the tonnage of red meat carcass classes appear in Table 3. These show the dynamics between the average purchase price and the tonnage between carcass classes. The price dynamics for the supply of red meat carcasses sold at the abattoir are mainly influenced by the

Table 2

Partial regression coefficients of linear regression equations for price dynamics of red meat carcass types compared to other red meat carcass factors (tonnage of meat and average purchase price of carcasses sold) over the period 2013 to 2017.

	Tonnage of meat (supply)			Average purchase price of carcasses sold (R/kg)			R ²	
	Pork	Beef	Sheep	Pork	Beef	Sheep		
Average purchase price (R/kg)	Pork	NS	0.001**	-0.006**	X	NS	0.23**	0.82
	Beef	0.01**	NS	NS	0.31*	X	0.43**	0.93
	Sheep	NS	NS	NS	0.58*	1.91**	X	0.91

NS: Non-significant, * significant at the 5% level of significance, ** significant at the 1% level of significance.

Table 3 Partial regression coefficients of linear regression equations for the price dynamics of the supply of red meat carcass types compared to the tonnage of meat of each red meat carcass class over the period 2013 to 2017.

Average purchase price (R/kg)	Tonnage of meat										Beef classes						R ²
	Pork classes					Sheep classes					Beef classes						
	BP	BO	BR	BC	BU	BS	SAS	PP	PO	PR	PC	A2	A3	AB2	AB3		
Pork	0.01**	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.53**	0.001**	NS	NS	NS		
Beef	0.01**	NS	NS	NS	NS	NS	0.04**	NS	NS	NS	NS	NS	NS	0.04**	NS		
Sheep	NS	NS	NS	NS	NS	NS	0.09**	NS	NS	NS	NS	0.01**	-0.02**	NS	NS		

Average purchase price (R/kg)	Tonnage of meat										Sheep classes						R ²
	Beef classes					Sheep classes					Sheep classes						
	B2	B3	C2	C3	A0	A1	A2	A3	A4	A5	A6	AB2	AB3	C2	C3		
Pork	NS	0.07**	NS	NS	NS	NS	NS	NS	NS	NS	-0.46**	NS	NS	NS	NS		
Beef	NS	NS	NS	NS	NS	NS	0.03**	-0.12**	NS	NS	-0.52**	NS	NS	NS	NS		
Sheep	NS	0.16**	NS	NS	NS	NS	0.06**	-0.21**	NS	NS	-0.43**	1.09**	NS	NS	NS		

BP: Baconer P, BO: Baconer O, BR: Baconer R, BC: Baconer C, BU: Baconer U, BS: Baconer S, PP: Porker P, PO: Porker O, PR: Porker R, PC: Porker C, SAS: Sausage, NS: Non-significant, * significant at the 5% level of significance, ** significant at the 1% level of significance.

tonnage of the A6 sheep carcass class. The price dynamics for the supply of pig carcasses sold are significantly influenced by the tonnage of Baconer P (0.01), Porker C (2.53), cattle A2 (0.001), cattle B3 (0.07) and sheep A6 (-0.46). The price dynamics for the supply of cattle carcasses sold are significantly influenced by tonnage of Baconer P (0.01), sausage pigs (0.04), cattle AB2 (0.04), sheep A2 (0.03), sheep A3 (-0.12) and sheep A6 (-0.52). The price dynamics for the supply of sheep carcasses sold are significantly influenced by tonnage of sausage pigs (0.09), cattle A2 (0.01), cattle A3 (-0.02), cattle B3 (0.16), sheep A2 (0.06), sheep A3 (-0.21) and sheep A6 (-1.09).

The partial regression coefficients derived from the linear regression model between the purchase price of red meat over the period 2013 to 2017 and the number of red meat carcass classes appear in Table 4. These show the dynamics between the average purchase price of red meat carcasses and the number of carcasses sold by the different carcass classes. From these equations it can be observed that A6 sheep play a significant negative role in the price of red meat. The linear regression of the pig average price shows that the number of Baconer P (0.001), Baconer U (0.14) and AB2 cattle (0.01) carcass classes plays a significant positive role, whereas Baconer O (-0.002), AB3 cattle (-0.02) and A6 sheep play a significant negative role. The beef average purchase price is significantly influenced by Baconer P (0.001), Sausage pigs (0.01), Porker C (0.15), AB2 cattle (0.01), A2 sheep (0.001), A3 sheep (-0.002) and A6 sheep (-0.01) carcass classes. The dynamics of the sheep average purchase price are significantly positively influenced by Sausage pigs (0.12), A2 cattle (0.001), B3 cattle (0.05) and A2 sheep (0.001) carcass classes, and significantly negatively influenced by A3 cattle (-0.01), A3 sheep (-0.01) and A6 sheep (-0.02) carcass classes.

The partial regression coefficients derived from the linear regression model between the purchase price of red meat over the period 2013 to 2017 and the average mass of red meat carcass classes appear in Table 5. These show the dynamics between the average purchase price of red meat carcasses and the average mass of carcasses sold of the different carcass classes. From these equations it can be observed that Baconer C and C3 cattle carcass classes play a significant negative role in the price of red meat. The linear regression of the pig average price shows that the number of A5 sheep (0.65) carcass classes plays a significant positive role, whereas Baconer P (-0.82), Baconer C (-0.20), Sausage pigs (-0.05) and C3 cattle (-0.08) play a significant negative role. The beef average purchase price is significantly influenced by Baconer R (-0.53), Baconer C (-0.37), Sausage pigs (-0.10), Porker P (0.29), AB2 cattle (0.13), AB3 cattle (-0.14), C3 cattle (-0.05) and A0 sheep (1.46) carcass classes. The dynamics of the sheep average purchase price are significantly positively influenced by Porker P (0.59), AB2 cattle (0.32), A5 sheep (1.28) and C2 sheep (0.73) carcass classes, and significantly negatively influenced by Baconer C (-0.59), AB3 cattle (-0.23) and C3 cattle (-0.25) carcass classes.

Table 6 shows the partial regression coefficient of the linear model between the average purchase price of red meat carcasses (pork, beef, mutton and lamb) and the average purchase price of carcass classes sold (R/kg) over the period 2013 to 2017. From this table the dynamics between the red meat types average purchase price and the red meat carcass classes purchase price can be observed. With this equation, multiple combinations of the independent variables are possible due to high multicollinearity that exists between them. This equation was performed by eliminating the variables with the highest multicollinearity one by one until there were no more variables with multicollinearity. The price dynamics of pork carcasses sold during this period are significantly influenced by the carcass class price of Baconer R (0.39), Baconer U (0.14), Sausage (0.19), Porker R (0.30), C3 cattle (-0.09) and A1 sheep (0.06) carcass classes. The price dynamics of beef carcasses sold during this period are significantly influenced by the carcass class price AB3 cattle (0.61), and C2 cattle (0.61) carcass classes. The price dynamics of mutton and lamb carcasses sold during this period are significantly influenced by the carcass class price of

Table 4
Partial regression coefficients of linear regression equations for the price dynamics of the supply of red meat carcass types compared to the number of red meat carcasses sold for each red meat carcass class over the period 2013 to 2017.

Average purchase price (R/kg)	Number of units sold										R ²				
	Pork classes					Beef classes					PC	AB2	AB3		
	BP	BO	BR	BC	BU	BS	SAS	PP	PO	PR	AB3	B2	C2	C3	R ²
Pork	0.001**	-0.002**	NS	NS	0.14**	NS	NS	NS	NS	NS	NS	NS	NS	0.01**	-0.02**
Beef	0.001*	NS	NS	NS	NS	NS	0.01**	NS	NS	NS	0.15*	NS	NS	0.01**	NS
Sheep	NS	NS	NS	NS	NS	NS	0.12**	NS	NS	NS	NS	0.001**	-0.01**	NS	NS

Average purchase price (R/kg)	Number of units sold										R ²				
	Sheep classes					Beef classes					AB3	B2	C3	R ²	
	B2	B3	C2	C3	A0	A1	A2	A3	A4	A5	A6	AB2	AB3	C3	R ²
NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-0.01**	NS	NS	NS	0.83
NS	NS	NS	NS	NS	NS	NS	0.001**	-0.002**	NS	NS	-0.01*	NS	NS	NS	0.91
NS	0.05**	NS	NS	NS	NS	NS	0.001**	-0.01**	NS	NS	-0.02**	NS	NS	NS	0.87

NS: Non-significant, *: significant at the 5% level of significance, **: significant at the 1% level of significance.

Baconer O (0.37), A0 sheep (0.32) and B2 sheep (0.60) carcass classes. All the results observed are due to the correlation between cattle, pig and sheep carcasses.

The main factors to look at are the number of units sold and the price of each red meat carcass class. The results of this study show that there are significant influences between the different carcasses of the different red meat species on each other's prices. This interaction is due to specific meat classes and not all the red meat carcass classes play a role in the resulting effect. Labuschagne et al. (2011) confirm that different meat types compete. Different meat types therefore influence the prices of each other. They do not only compete with other meat types, but with other protein sources as well (Labuschagne et al., 2011).

The study shows that the tonnage of meat, average mass, average number of carcasses, and average purchase price of red meat carcasses sold at the abattoir have a significant influence on the average price of red meat carcasses sold at the abattoir. Different red meat carcasses influence the price dynamics of red meat. The carcass factors (tonnage of meat, average mass, average number of carcasses sold and average purchase price) did not contribute equally or, in some cases, no significant contribution was observed on the resulting price dynamics of supply.

Commodity prices in general are considered to have a high volatility; this volatility increases the risk of paying higher prices for a specific commodity. For various reasons, commodity prices, and in particular agricultural prices, are subjected to significant fluctuations on both domestic and international markets (Ayankoya, Calitz & Greyling, 2016; Geysers & Cutts, 2007; Jordaan & Grové, 2007).

The demand for basic commodities tends to be stable and generally is more responsive to changes in income and taste than changes in price. In this situation, a small shift in supply or demand conditions can have a major impact on market prices. The demand for most raw agricultural commodities is steady throughout the year. Demand estimation is important for informed decision making by industry stakeholders and policy makers (Lusk & Tonsor, 2016). The main factors that affect the price of a product have to do with factors affecting the supply and demand of that product. The factors that affect the supply of a product include the production system, the efficiency of production, feed costs (Schulz, 2013; Stotts, 2013). The factors affecting the demand of a product have to do with the consumer and include factors like the healthiness of the product, the budget of the consumer, income of the consumer, economic growth, and urbanization (Davids et al., 2013; Hahn, 2004; McCarthy et al., 2004, 2003; Zotte, 2002). Culture and religion also play a role in the demand of meat because some cultures and religions do not eat specific meat products, or eat specific meat products only at certain times of the year (Ackerman & Tellis, 2001).

A meat meta-analysis from data across the world was carried out on price elasticity of meat and it was concluded that the elasticity of demand for beef, lamb and fish tends to be more elastic compared to poultry. The elasticity of meat products is particularly sensitive to specification of demand, chosen estimation method and publication characteristics (Gallet, 2010). Gallet (2010) found that pork is significantly more responsive to price than the other meat types.

Furthermore, the analysis revealed that the influence that was observed was due to specific carcass classes and their specific factor (tonnage of meat, average mass, average number of carcasses sold and average purchase price) and not to all the carcass classes.

In the current system, producers sell their animals per contract for R/kg and do not know which carcass class the animals obtained (Alemu & Ogundeji, 2010). Since producers in South Africa only receive R/kg animal or carcass, and do not receive feedback from the abattoir on the carcass classes obtained for the animals marketed, it becomes more important for the buyer at the abattoir or the person determining the price to incorporate the different influences of the different carcass classes into the pricing of red meat.

Table 5
Partial regression coefficients of linear regression equations for the price dynamics of the supply of red meat carcass types compared to the average mass for each red meat carcass class over the period 2013 to 2017.

Average purchase price (R/kg)	Average mass												R ²				
	Pork classes			Beef classes			Sheep classes			Beef classes							
	BP	BO	BR	BC	BU	BS	SAS	PP	PO	PR	PC	A2	A3	AB2	AB3	AB2	AB3
Pork	-0.82**	NS	NS	-0.20**	NS	NS	-0.05*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Beef	NS	NS	-0.53**	-0.37**	NS	NS	-0.10*	0.29*	NS	NS	NS	NS	NS	NS	NS	NS	0.13*
Sheep	NS	NS	NS	-0.59**	NS	NS	NS	0.59**	NS	NS	NS	NS	NS	NS	NS	NS	0.32**
Average purchase price (R/kg)	Average mass												R ²				
	Pork classes			Beef classes			Sheep classes			Beef classes							
	B2	B3	C2	C3	A0	A1	A2	A3	A4	A5	A6	AB2	AB3	B2	C2	C3	R ²
Pork	NS	NS	NS	-0.08**	NS	NS	NS	NS	NS	0.65**	NS	NS	NS	NS	NS	NS	0.73
Beef	NS	NS	NS	-0.05**	1.46*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.81
Sheep	NS	NS	NS	-0.25**	NS	NS	NS	NS	NS	1.28**	NS	NS	NS	NS	0.73**	NS	0.76

NS: Non-significant, *: significant at the 5% level of significance, **: significant at the 1% level of significance.

Table 6
Partial regression coefficients of linear regression equations for the price dynamics of the supply of red meat carcass types compared to the average purchase price of carcasses sold of red meat carcass classes over the period 2013 to 2017.

Average purchase price (R/kg)	Average purchase price																		R ²																
	Pork class						Beef class						Sheep class																						
	BP	BO	BR	BC	BU	BS	SAS	PP	PO	PR	PC	A2	A3	AB2	AB3	B2	B3	C2	C3	A0	A1	A2	A3	A4	A5	A6	AB2	AB3	B2	B3	C2	C3	R ²		
Pork	NS	NS	0.38**	NS	0.14**	NS	0.19**	NS	NS	0.30**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.06*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.98
Beef	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.99
Sheep	NS	0.37**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.32**	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.99

BP: Baconer P, BO: Baconer O, BR: Baconer R, BC: Baconer C, BU: Baconer U, BS: Baconer S, PP: Porker P, PO: Porker O, PR: Porker R, PC: Porker C, SAS: Sausage, **: significant at the 5% level of significance, *: significant at the 1% level of significance.

4. Conclusion

The outcome of the study supports the hypothesis that carcass type is responsible for the differences in meat carcass prices in the South African context. The correlation matrix shows that the average purchase price of red meat is influenced by tonnage of red meat types as well as the price of other red meat types (as expected). The linear regression analysis shows that the average purchase price of red meat types is mainly influenced by the price of other red meat types. In order to provide producers with optimum prices, all factors influencing red meat prices must be taken into consideration when determining price. Further studies are required to determine the combined effect on price, supply and demand with regard to the internal factors and external factors affecting them.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

I wish to express my sincere gratitude to the Red Meat Abattoir Association for allowing access to the data of which they are the custodians.

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