PRICE TRANSMISSION IN THE BEEF VALUE CHAIN – THE CASE OF BLOEMFONTEIN, SOUTH AFRICA

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Abstract

A concern that is frequently raised by livestock farmers is the relationship between the producer- and retail prices. A perception also exists among producers that the market prices are set by the retailers. The objective of this study thus is to determine if these problems do exist. According to the results obtained from the statistical analysis it is clear that the allegations of the red meat farmers and feedlots is not true in most of the cases. The analysis indicated that three of the four investigated retailers do follow the same price trend and that there is a bi-directional relationship between the retail and carcass prices in two of the instances. It is however recommended that asymmetry in price transmission in the Bloemfontein beef value chain be tested as more data becomes available.

Keywords: beef, value chain, price transmission

1. Introduction and problem statement

Since the deregulation of the agricultural markets in South Africa there has been an increasing trend of concentration in certain businesses in agricultural value chains and in turn could result in anti-competitive behaviour. A frequently proxy used for oligopolistic or monopolistic behaviour is the nature of price transmission in a particular value chain (Spies, 2011).

Due to the above, a concern that is frequently raised by livestock farmers is the relationship between the producer- and retail prices, or the variation in the price margin between the carcass price that the farmer or feedlot receive and the retail price that the consumer pays. A perception also exists among producers that the market prices are set by the retailers. The Free State Red meat Producers Organisation (FSRPO) has tasked the department of Agricultural Economics at the University of the Free State to investigate the price transmission in the Bloemfontein area of the Free State Province, South Africa.

The objective of this study is to determine if the retail prices are derived from the carcass price and if these prices follows the same trend. To achieve the above mentioned the following have to be done:

- determine the order of integration of price variables,
- determine the long run relationship between carcass and retail prices,
- determine the direction of causality between the price variables.

2. The South African beef value chain and price formation

The South African beef value chain is represented in Figure 1. Although there may be some parts of the value chain that was not included in the figure, this version was simplified to focus more specifically on the problem of price transmission and the specific linkages that are addressed in this study. The main role players in the South African beef value chain are the:

- **Farmers (Producers).** There are approximately 37 500 commercial, 240 000 emerging and 3 million subsistence beef cattle farmers in the country (Spies, 2011). The breeds and production methods differ between farms and production regions. Most of the farmers make use of the weaner production system, where the weaned calves of approximately 7 months of age are sold to a feedlot. Some of the indigenous breeds can however be raised on the natural grazing and are directly send to an abattoir for slaughtering.
- **Feedlot sector.** Between 65 and 70% of all cattle that are slaughtered in South Africa come from the feedlot sector. Feedlots buy the weaned calves at an approximate weight of 230kg (live) and then increase the weight to 400kg (live) over a period of approximately 113 days before it is slaughtered. Feedlots with different standing capacities, from a few animals to more than 110 000 animals, exist in South Africa. The total standing capacity of the feedlot industry is about 450 000 animals at any given point in time, delivering approximately 1.5 million animals annually (Spies, 2011).

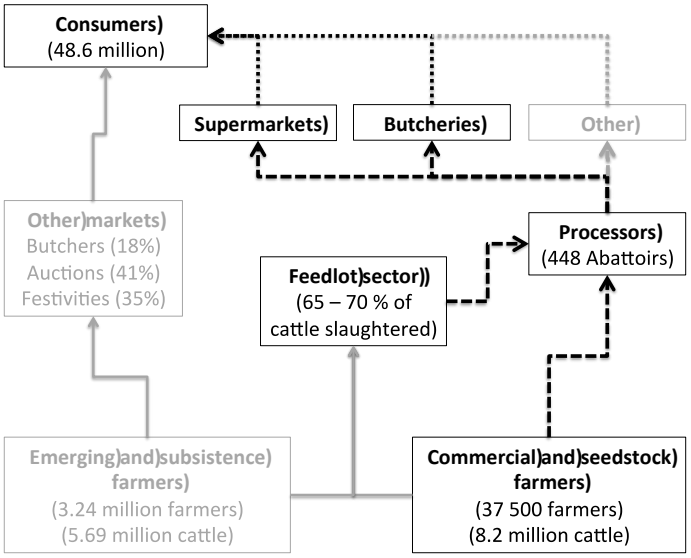

Figure 1. South African beef value chain
Source: Adapted from Spies 2011

- **Other markets.** The other markets in the beef value chain include, but are not limited to, informal butchers (18%), auctions (41%) and festivities (35%). Most of the cattle from the emerging or small-scale sector enter these markets but some animals from commercial farmers may also be sent through these channels.
- **Abattoirs (Commodity processors).** The abattoir sector plays a very important role in the beef value chain as it transforms live animals to meat. Throughout South Africa there are approximately 488 red meat abattoirs slaughtering from 2 to 1500 units per abattoir per day (Spies, 2011). Many of the large feedlots own their own abattoirs and are thus vertically integrated.
- **Retailers (Food product processors).** Retailers in this study are considered as all outlets selling red meat products and include, but is not limited to, supermarkets and butcheries. There are 4 large supermarket chains in South Africa and numerous independent butcheries and other outlets of beef. The supermarkets usually have a butchery that processes the carcasses

to different cuts of meat and other products. The consumer buys the final product direct from one of the retailers.

- **Consumers.** In South Africa there are approximately 48.6 million consumers of beef with an average per capita consumption of 17,96 kg / year.

The black areas and linkages in Figure 1 are those that form part of this study while the grey areas were omitted. The one set of price data that was used for this study was received from the Red Meat Abattoir Association (RMAA) and are the carcass prices that they pay to the producer or feedlot. The abattoir then sells these carcasses to the supermarkets and butcheries for the same price they bought it for as their profit comes from the fifth quarter of the carcass that is sold separately. The other set of price data is the retail prices for meat that was collected on a weekly basis at three supermarkets and a butchery in Bloemfontein. The supermarkets and butchery process the carcasses and then sell the individual cuts at a price that reflects the value of the specific cut, the margin of the supermarket and the Value Added Tax (VAT) on the product.

If the carcass price and the retail price rump steak are compared in a graph it is clear to see that there seems to be a problem. Figure 2 indicates that the retail price of rump steak do not follow the same trend as the carcass price. The retail price used in the graph is only representative of one supermarket, but allowing small differences the prices of the other supermarkets and butchery basically looks the same.

It must however be remembered that a carcass consists of more than one cut and that assumptions cannot be made on the comparison of only one of the higher value cuts. The representative retail price of the carcass that the supermarket sells it for must be calculated using the retail prices of different (high and low value) cuts.

Table 1 gives an indication of the standard "Block Test" that is used by abattoirs to determine the retail prices for the different cuts. The factor assigned to each cut gives an indication of the value of the specific cut. The percentage of the cut as related to the total carcass stays the same, but retailers may vary the factor according to the demand for the product. The factor multiplied

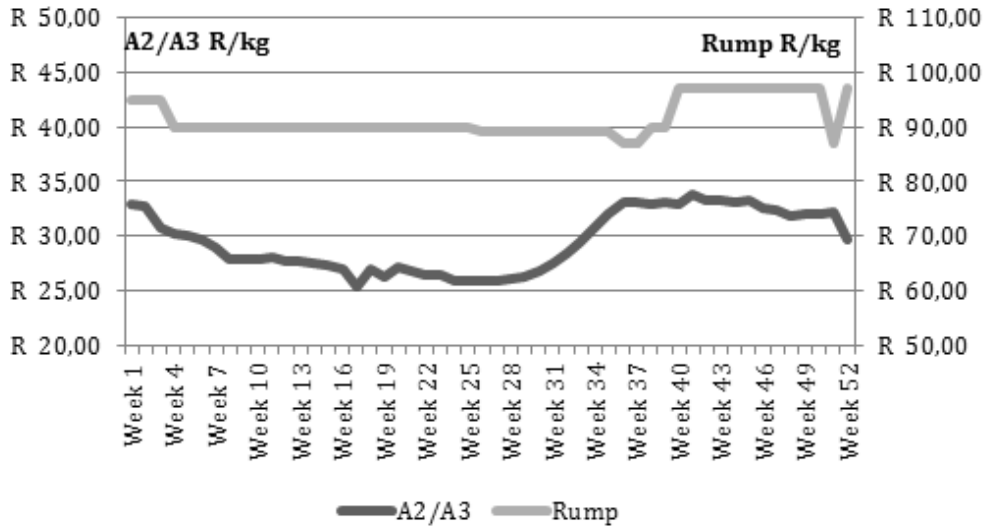

Figure 2. Comparison between the carcass price and retail price of rump
Source: RMAA (2012) and own data

Table 1. Block test for beef price formation

Carcass	R32.86/kg		220 kg									
Fore quarter 52%							Hind quarter 48%					
Cut	%	Kg	Factor	R/kg		R/kg 30% Margin Incl. VAT	Cut	%	Kg	Factor	R/kg	R/kg 30% Margin Incl. VAT
Whole quarter/Kg	100	114.4	1	R	23.82	R 35.31	Whole quarter/Kg	100	105.60	1.00	R 41.90	R 62.09
Body fat	2.82	3.23	0.5	R	11.91	R 17.65	Body fat	3.73	3.94	0.52	R 21.79	R 32.29
Shoulder	34.66	39.65	1.6	R	38.12	R 56.49	Bone lean	14.7	15.52	0.12	R 5.03	R 7.45
Bone lean	19.77	22.62	0.2	R	4.76	R 7.06	Bone with meat	2.42	2.56	0.97	R 40.64	R 60.23
Bone with meat	0	0.00	0.5	R	11.91	R 17.65	Cutting loss	1	1.06		R -	R -
Brisket	14.5	16.59	0.9	R	21.44	R 31.78	Fillet	2.4	2.53	2.62	R 109.77	R 162.68
Chuck	0	0.00	1.3	R	30.97	R 45.90	Short loin	0	0.00	1.80	R 75.41	R 111.76
Cutting loss	1	1.14		R	-	R -	Rump	5.14	5.43	1.96	R 82.12	R 121.70
neck,bone in	1	1.14	1.3	R	30.97	R 45.90	Shin	4.13	4.36	0.97	R 40.64	R 60.23
Prime rib	3.76	4.30	1.3	R	30.97	R 45.90	Silverside	9.82	10.37	1.50	R 62.84	R 93.14
Back fillet	0	0.00	2.5	R	59.56	R 88.27	Sirloin	4.48	4.73	1.95	R 81.70	R 121.08
Shin bone in	0	0.00	0.8	R	19.06	R 28.25	Short rib	5.79	6.11	0.97	R 40.64	R 60.23
Short rib	4.93	5.64	0.8	R	19.06	R 28.25	T-bone	7.58	8.00	1.80	R 75.41	R 111.76
Bolo	1	1.14	1.3	R	30.97	R 45.90	Thick flank	3.69	3.90	1.40	R 58.66	R 86.93
Trimmings	16.56	18.94	0.89	R	21.20	R 31.42	Topside	7.59	8.02	1.50	R 62.84	R 93.14
							Trimmings	27.53	29.07	0.52	R 21.79	R 32.29
Closing balance	100	114.4		R 2 726.51		R 4 040.69	Closing balance	100	105.60		R 4 424.82	R 6 557.58
							Total (Carcass)				R 7 151.33	R 10 598.27

Source: Spies (2011) and own calculations

with carcass price calculates the price the retailer will sell the specific cut for after including a margin (approximately 30%) and Value Added Tax (14%).

3. Data and methods

The carcass price in Table 2 of grade A2/A3 carcasses was received from the RMAA on a weekly basis for the year 2012. These prices represent the average price that abattoirs paid producers (farmers/feedlots) for the carcasses in South Africa. Although these prices may differ a bit between regions the difference is relative small and the country average price thus remains a good indication.

The retail prices in Table 2 were collected from three supermarkets (S1, S2 & S3) and a butchery (B) in Bloemfontein on a weekly basis by visits to these outlets once a week. The retailers that were used are all situated in one extension of Bloemfontein and thus attract buyers with more or less the same purchasing power and preferences. The prices of three different cuts were used in the analysis. To calculate good representative carcasses price the data for fillet (high value), rump (medium value) and stew (low value) were used. The prices of the individual cuts were divided by the factor and the average calculated price then serves as the carcass price the retailer sells the beef for. The data is already adjusted for a two-week lag interval between the carcass price and the retail price allowing for the time it takes to process the carcasses and get the individual cuts on the shelves.

The methodology employed in this paper entailed three steps. The first step was the unit root test. This step is to confirm the order of integration of the variables used. The unit root test was conducted by the Augmented Dickey-Fuller (ADF) test statistics under the assumption that the series in question is non- stationary around fixed time trend (Dickey and Fuller, 1981). If the hypothesis cannot be rejected then a single difference will be performed to ensure that all variables are stationary.

The second step, once statistical properties of variables are confirmed, is to conduct the co-integration tests. The Johansen (1998) methodology is applied in this study. The test is about testing the rank of π in equation1:

$$\Delta x_t = \pi x_{t-1} + \sum_{i=1}^{k} \Delta x_{t-i} + \psi_t \qquad (1)$$

Table 2. Abattoir carcass and calculated retail carcass prices

Week	A2/A3	S1	S2	S3	Butchery	Week	A2/A3	S1	S2	S3	Butchery
1	R32.86	R55.81	R51.15	R54.59	R49.24	27	R25.95	R50.36	R52.01	R48.97	R44.95
2	R32.74	R55.81	R51.15	R54.59	R49.24	28	R26.05	R50.36	R46.92	R48.97	R44.95
3	R30.86	R55.46	R51.14	R54.59	R49.24	29	R26.23	R50.36	R46.92	R48.97	R44.95
4	R30.29	R55.44	R51.15	R51.68	R50.53	30	R26.90	R50.36	R46.92	R48.97	R44.95
5	R30.00	R55.44	R51.17	R52.37	R50.53	31	R27.53	R50.36	R46.92	R48.97	R45.60
6	R29.70	R55.44	R51.17	R52.37	R48.54	32	R28.36	R51.39	R46.92	R48.97	R46.01
7	R29.04	R55.44	R51.17	R52.37	R48.54	33	R29.53	R51.39	R46.92	R48.97	R46.01
8	R27.97	R55.44	R51.17	R52.37	R48.54	34	R30.85	R54.10	R48.64	R48.97	R49.12
9	R27.96	R55.44	R51.93	R52.37	R48.54	35	R31.96	R54.10	R48.64	R53.11	R49.12
10	R27.96	R54.41	R53.65	R52.37	R46.48	36	R33.03	R54.10	R48.64	R52.77	R52.10
11	R28.00	R54.41	R51.93	R51.22	R46.48	37	R33.18	R55.08	R50.09	R52.37	R52.10
12	R27.70	R53.38	R51.93	R51.22	R46.48	38	R32.98	R55.42	R49.05	R53.60	R52.22
13	R27.65	R53.00	R51.93	R51.22	R46.48	39	R33.14	R55.42	R49.05	R53.60	R51.11
14	R27.57	R53.01	R51.93	R51.22	R46.48	40	R33.01	R55.42	R50.09	R56.83	R51.11
15	R27.35	R51.73	R51.93	R49.16	R45.43	41	R33.79	R56.44	R50.09	R57.08	R51.11
16	R26.98	R51.73	R51.93	R49.16	R45.43	42	R33.26	R56.44	R49.05	R56.83	R51.11
17	R25.41	R51.73	R48.62	R49.16	R45.43	43	R33.30	R56.44	R50.09	R56.83	R51.11
18	R27.01	R51.73	R48.62	R50.53	R45.43	44	R33.07	R56.44	R49.05	R56.49	R51.11
19	R26.20	R51.73	R48.62	R50.53	R46.48	45	R33.22	R56.44	R49.05	R56.49	R52.22
20	R27.19	R51.73	R53.71	R50.53	R46.48	46	R32.60	R56.44	R49.05	R56.49	R52.22
21	R26.88	R51.73	R53.71	R50.53	R46.48	47	R32.38	R56.44	R49.05	R56.49	R52.22
22	R26.49	R51.73	R53.71	R49.16	R46.48	48	R31.89	R56.44	R49.05	R56.49	R52.22
23	R26.49	R51.73	R53.71	R49.16	R46.48	49	R31.96	R55.76	R49.05	R56.49	R52.22
24	R25.99	R51.63	R50.82	R47.76	R46.48	50	R32.05	R55.76	R49.05	R56.49	R52.22
25	R25.94	R51.63	R50.31	R47.76	R46.48	51	R32.14	R56.10	R49.05	R54.78	R52.22
26	R25.87	R50.36	R50.31	R48.97	R46.48	52	R29.67	R56.10	R49.05	R56.49	R52.22

Source: RMAA (2012) and own data collection and calculations

Where x_t is an (n×1) vector consisting of a random variable which are $I(1)$, π is an (n×n) matrix, ψ_t is an (n×1) vector of disturbance terms, and k is lag length to be determined based on various model selection criteria such as the Bayesian information criterion (BIC) and Akaike information criterion (AIC). Co-integration is said to be confirmed when the *rank* (π) ≠ 0.

The final step is the determination of causal directions among variables to identify whether causality runs from producers to retailers or vice versa using the Granger causality test (Granger, 1969). The F-statistics was employed to test the causal relationships based on the bivariate autoregressive model. The bivariate regression is of the form:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + ... + \alpha_l y_{t-1} + \beta_1 x_{t-1} + ... + \beta_l x_{t-l} + \psi_t \quad (2)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + ... + \alpha_l x_{t-1} + \beta_1 y_{t-1} + ... + \beta_l y_{t-l} + \varepsilon_t \quad (3)$$

For all possible pairs of (x, y) series in the group. The reported F statistics are the Wald statistics for the joint hypothesis:

$$\beta_1 = \beta_2 = ... = \beta_l = 0 \quad (4)$$

4. Results and discussion

By comparing the carcass price with the different retail prices (data from Table 2) on a graph (Figure 3) it is clear to see that S1, S3 and the Butchery follows more or less the same trend as the carcass price. S2 however, do not even come close to the trend of the other prices. The graph thus indicates that there may be a larger problem with price transmission between the carcass price and S2 than between the carcass price and the other retailers. To proof this statement it is necessary to discuss the findings of the statistical analysis.

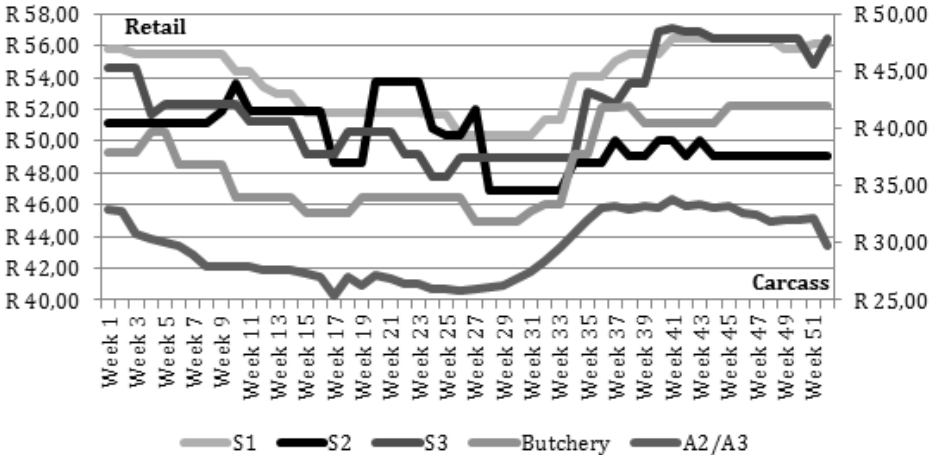

Figure 3. Comparison of carcass and retail prices
Source: RMAA (2012) and own calculations

5. Stationary test result

Table 3 shows the Augmented Dickey Fuller (ADF) tests for unit root. The null hypothesis for this test is that there is a unit root (non-stationary), with the alternative of stationarity. The test is carried out at both levels and first differences with intercept and trend components included where applicable. The results show that only S2 is stationary at levels while other prices are stationary at first difference. This means that S2 do not varies over time since the fluctuation of the price in both directions (increase and decrease) are equal. The carcass (A2/A3) price and the prices of the other retailers (S1, S3 and Butchery) do vary over time and the possibility of a long-term relationship between the carcass price and any one of these retailers does exist.

Table 3. ADF Unit root test: H_0: There is unit root

Prices	Lag Length	ADF Statistics	Critical Value (95%)	Lag Length	ADF Statistics	Critical Value (95%)
	Levels			First Difference		
A2/A3	2	-1.5514	-3.1818	1	-2.6349	-2.5992
S1	0	-1.3363	-3.1796	0	-7.0456	-3.1807
S2	0	-3.1819	-3.1796	0	-7.8780	-3.1807
S3	0	-1.9070	-3.1796	0	-7.8656	-3.1807
B	2	-2.0440	-3.1818	1	-3.9428	-3.1818

6. Johansen Co-integration tests result

The main objective of this section is to determine whether the linear combination of producer (A2/A3) and retail (S1, S2, S3 & B) prices has a long-run relationship; that is, if in the long-run, the prices move together. Johansen (1998) approach was adopted in this study. The Trace statistic and the maximal eigenvalue (λmax) statistic are used to determine the co-integrating rank, i.e. the number of co-integrating vectors. The results of the co-integration tests are presented in Table 4 below.

In Table 4, the Trace and Maximum Eigen Statistics indicate two co-integrating equations at 5% level for A2/A3 and S1 and one co-integrating equation for A2/A3 and S3 and A2/A3 and B respectively. However, there exists no cointegrating equation between A2/A3 and S2. The existence of co-integration implies that the variables have a stable equilibrium relationship(s) to which they return after short-run deviations. It also indicates that they share a certain type of behaviour in terms of their long-term fluctuations.

Table 4. Johansen Co-integration Test: Trace and Max-Eigen Statistics

Null hypothesis	Trace statistic	5% critical value	Max-Eigen Statistic	5% critical value
A2/A3 and S1				
H_0: r = 0	24.6980**	15.4947	17.8020**	14.2646
H_0: r ≤ 1	6.8959**	3.8415	6.8959**	3.8415
A2/A3 and S2				
H_0: r = 0	24.4836	25.8721	18.0045	19.3870
H_0: r ≤ 1	6.4791	12.5180	6.8959	12.5180
A2/A3 and S3				
H_0: r = 0	26.7912**	25.8721	20.4643**	19.3870
H_0: r ≤ 1	6.3269	12.5180	6.3270	12.5180
A2/A3 and B				
H_0: r = 0	28.1932**	25.8721	20.2079**	19.3870
H_0: r ≤ 1	7.9853	12.5180	7.9853	12.5180

** denotes rejection of the hypothesis at the 5% significance level

The results thus indicate that of the four retailers only S2 do not have a long term stable equilibrium relationship with the carcass price.

7. Granger Causality test result

This section aims at determining the direction of causality between the retail and carcass prices. Table 5 presents the result of the test. It is clear from the table that Granger causality ran both ways for A2/A3 and S1, one way for A2/A3 and S2, both ways for A2/A3 and S3 and finally one way for A2/A3 and B. The retail prices of S1, S3 and B do thus follows the same trend as the carcass price, while the price of S2 does not. The bi-directional behaviour of the beef market shows

Table 5. Granger Causality Test Results

Null Hypothesis	F Statistic	Probability
A2/A3 ⇏ S1	11.6040	0.0000*
S1 ⇏ A2/A3	3.6811	0.0331**
A2/A3 ⇏ S2	0.8216	0.4462
S2 ⇏ A2/A3	7.9235	0.0011*
A2/A3 ⇏ S3	4.4399	0.0174**
S3 ⇏ A2/A3	7.9235	0.0015*
A2/A3 ⇏ B	10.0581	0.0002*
B ⇏ A2/A3	1.8487	0.1692

* and ** denote significance at 1 and 5% significance level respectively.

that the perception of farmers that the retailers set the market price is not entirely true. The retail price is determined by the carcass price and the bi-directional behaviour comes from supply and demand differences in the beef market throughout the year.

8. Conclusions and recommendations

According to the results obtained from the statistical analysis it is clear that the allegations of the red meat farmers and feedlots is false in most of the cases. The analysis indicated that only one of the four retailers who's data was used do not maintain a steady price margin over time and thus do not follow the same price trend as the carcass prices. It further indicates that the perception of retailers setting the market price is false as well as the results indicated that there are a bi-directional influence between the carcass and retail prices that are brought about by the changes in the demand and supply of the beef market through the year.

The results of the study do not provide any direct solutions for the producers of beef, as they receive the same price for their product no matter in through witch retailer it will be sold. It does however shows that the largest part of the retail market do not indicate on any sign of problems with the price transmission from the producer to the consumer. The one retailer that do show problems with price transmission should however be brought under the attention of consumers. By educating consumers on the pricing mechanism of meat and the differences that exist between the prices of the different retailers the consumers will be able to make a more informed purchasing decision.

The data set that was used for this study only contains the weekly price data for a year (52 observations) and was too short to test for asymmetric price transmission. It is however recommended that it should be done as more data sets become available.

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