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Farm and Retail Prices in the South African Poultry Industry: Do the Twain Meet?

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Abstract

The study intended to determine the producer (farm)-retail price transmission behavior in the South African poultry industry. At the heart of the study was to desire to establish whether there was symmetry or asymmetry in the price transmission. Using price data from 2000 to 2010 and employing both the Houck and Error Correction Model (ECM) approaches the study found that there was symmetry in the farm-retail price transmission of poultry in South Africa, where a change in farm price of chicken was observed to lead to a similar change in the retail price in South Africa. The price setting system in the poultry industry was further defined by estimating elasticities of price transmission and it was found that retail price is very sensitive to change in farm price, particularly falling prices.

Keywords: poultry, price transmission, farm and retail prices, time series

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Introduction

The recent food price crises, coupled with numerous allegations of price-fixing and other non-competitive practices by some role players in the food value chain in South Africa, have rekindled interest in how prices are transmitted along the value chain of agro-food products. There is widespread evidence to support that price transmission in agro-food products is asymmetrical (Lechanová, 2006; Piesse and Thirtle, 2010; von Braun, 2008). Peltzman (2000), for example, argues that asymmetric price transmission is the rule, rather than the exception and thus concludes that asymmetric price transmission is prevalent in the majority of producer markets and conventional economic theory that does account for this situation must be incorrect. Recently the price of food has seen unprecedented increases on the back of rising input costs and South Africa has not been spared (Altman 2009; NAMC 2007).

Price transmission studies have been used to understand the function of agricultural markets and how food prices are determined and transmitted along the entire value chain, particularly during times of food price crises. For example, Cutts and Kirsten (2006) study of price transmission and market concentration in four South African agro-food sectors was sparked by the high food prices of 2002 and 2003 in South Africa. The Cutts and Kirsten (2006) study found that, by and large, there was asymmetric price transmission in the South African agro-food industry sectors studies and this led to the identification of market concentration and possible abuse of this market dominance thus underscoring the importance of price transmission studies in unearthing uncompetitive behaviour in the market.

The price for inputs such as fertilizer more than doubled as a result of increasing fossil fuel (petroleum) price and this led to the price of commodities such as maize increasing accordingly (von Braun, 2008). The price of maize has a direct bearing on the poultry industry as it is the main ingredient in the formulation of animal feed. Another factor that has a bearing on the price of food is the growing population demanding more food, coupled with the recent economic growth which has pushed up consumers' purchasing power thus generating demand for high-value protein food such meat and dairy products.

The objective of this study is to uncover the producer (farm)-to-retail price transmission behaviour in the South African poultry industry. This was solely aimed at establishing whether there is symmetry or asymmetry in the price transmission. To achieve the above stated objective the paper is structured as follows: section two is the overview of the poultry industry in South Africa, section three presents a brief literature review on price transmission, section four presents the analytical approach used, section five presents the results and section six are the conclusions and recommendations.

Overview of the South African Poultry Industry

The poultry industry in South Africa accounts for more than 17% of the agricultural gross domestic product (GDP), making it the biggest agricultural sector with the gross value of R23 billion in 2009 (FAS 2010) thus making it an important sector in the South African quest to reduce unemployment and food insecurity. However, Joubert (2009) argues that the gross value of the poultry industry was more than R24 billion, in 2009. Furthermore, Joubert (2009) indicates that

the value of the industry at the retail level was more than R36 billion in 2009. Broiler meat is by far the main contributor to the poultry industry accounting for more than 70% of the industry.

Furthermore, poultry meat remains the most affordable source of animal protein relative to other meat protein sources (SAPA, 2009). In this regard, SAPA (2009) argued that the average producer price of pork (which is slightly lower than beef), for all classes, was R15.65/kg in 2009 while the producer price of broiler was R13.66/kg in the same period. The broilers and eggs subsectors are among those agricultural sub-sectors with high direct and indirect labor multipliers thus employing a higher number of people compared to other agricultural sub-sectors (Departments of Agriculture & Land Affairs 2006). In terms of direct labor multiplier, poultry meat and eggs are ranked at number ten and eleven while in terms of indirect labor multiplier they ranked number one and two, respectively. Poultry meat was estimated to rank number three while eggs ranked number ten in terms of number of people employed per agricultural sector. It is also interesting to note that the egg industry was even classified as attractive and competitive while the poultry meat was classified as attractive. The attractive and competitive classifications were done by the South African government and they are in the context of industries' abilities to create jobs thus their attractiveness to meeting government goals of creating more jobs. The poultry industry in South Africa employs an estimated 77, 000 (SAPA 2011).

In addition to its importance as a source of food and its contribution to the nation's Gross Domestic Product, the SA poultry industry remains an important contributor to job creation and employment opportunities, both in the formal and informal sector, with in excess of 80% of the industry consisting of SMMEs (Small, Medium and Micro Enterprises). Approximately 10% of all agricultural sector workers are employed in the poultry sector.

The South African poultry industry is broadly made up of 404 commercial broiler producers, of which 199 are independent individual producers and 205 are contract growers for the larger chicken producing companies (SAPA 2011). There are 267 known commercial egg producing farmers. It is worth reiterating that the South African poultry industry is an interesting in that it consists of a few large scale producers and a plethora of small scale farmers of which there are 1,554 small scale farmers comprised of previously disadvantaged individuals (blacks) and these have been established with the assistance of the South African government (SAPA 2011).

The performance of the poultry industry since 2006 has been impressive (SAPA 2009; 2011). However, the high input costs, high inflation, the global economic recession and a subsequent slowdown in consumer demand and job losses during 2007 to 2009, negatively impacted the broiler industry performance in South Africa (FAS 2010). The annual growth in average broilers produced/week decreased in 2009 to only 1.1%. During the period from 2007 to 2008 the number of broilers slaughtered/ week increased at an average annual rate of 6% (SAPA 2009).

As envisaged, the broiler meat demand started growing again in 2010 as the domestic economy recovered from the global recession. The two most important factors that drive demand for broiler meat are economic growth and competitive broiler meat prices. Economic growth is the main driver for increased demand for broiler meat as rising living standards are expected to push large numbers of consumers towards protein-rich diets, increase health awareness and desire for convenience. Other reasons for the expected increase in the consumption of broiler meat include in-

creased marketing by broiler producers, price competitiveness relative to other proteins on the market. There is still scope for growth in the South African poultry industry, given the still relatively low per-capita consumption of chicken meat in South Africa compared with other economies in the world (Sovereign Foods 2010).

It is also observed that there is growing trend towards processed chicken meat and more sophisticated value-added products will create further market opportunities. South Africa is a net importer of broiler meat, further underlying the argument that there is still room for the domestic poultry industry to grow and demand outstrips supply. The domestic per capita annual consumption of poultry meat in South Africa for 2009 was 32 kg compared to 15.77 kg for beef, 4.17 kg for pork and 3.21 kg for mutton and goat meat combined, and 8.6 kg for eggs (FAS 2010; Joubert 2009; SAPA 2009). Sovereign Foods (2010) argue that more consumers will demand chicken as the world continues to face higher food prices. The local poultry industry has a major role to play in ensuring that all South Africans have continued access to high quality, affordable protein. Given the foregoing overview, it is important to investigate the issue of price transmission in the poultry value chain.

Literature Review

Interest in marketing margins and price transmission has been around for some time now but has recently gained remarkable momentum and the amount of studies on this subject is rapidly growing (Vavra and Goodwin, 2005). There is a myriad of questions about prices and margins investigated by these studies, yet new questions are surfacing as markets and business practices change with an impressive speed. In South Africa, recent finding by the Competition Commission of collusion and price fixing by a number of agribusinesses has added impetus to the interest in the price transmission analysis. Wohlgenant (2001), who conducted a survey on marketing margins, identified a number of issued intriguing researchers and policy makers alike and these included issues such as: Are marketing margins too large? Why are margins different among products? How have margins changed over time? What is the incidence of marketing costs on retail prices and farm prices? How quickly are farm prices transmitted to the retail level and vice versa? What is the relationship between concentration and market power? Is increased concentration detrimental or beneficial to producers?

With quickly changing market structures, growing concentration of processing and retail firms and the recent evidence of collusion and price fixing in the food industry in South Africa and elsewhere, these types of questions are attracting greater public scrutiny. Against the background presented thus far, it becomes imperative to be able to answer the question of how quickly and to what extent are changes in farm prices transmitted to the retail level and vice versa.

Vavra and Godwin (2005) stress the importance of distinguishing between the analyses of evolution of margins over time and price transmission as these topics are closely related but are not identical. Conclusions about price transmission that are drawn from the evolution of marketing margins over time, but that do not incorporate other information such as the changes in the costs of other inputs, such as cost related to processing, packaging, transportation, advertising and storage, may well be misleading as such conclusions would have been made based on limited

information. This paper limits itself to an analysis of vertical price transmission within the South African poultry industry.

The adjustment to price shocks along the chain from producer to wholesale and to retail levels (price transmission), and vice versa, is an important characteristic of the functioning of markets. As such, the process of price transmission through the supply chain has long attracted the attention of agribusiness practitioners (managers and agricultural entrepreneurs), agricultural economists, and policy makers. Recently, the subject of price transmission internationally and particularly in South Africa, has been increasingly linked to the discussion about benefits from agricultural reform including the competitiveness of the food industry. Policy makers have been interested in whether it is true or not that due to imperfect price transmission, often ascribed to be market power and oligopolistic behavior, a price reduction at the farm level is only slowly, and possibly not fully, transmitted through the supply chain. In contrast, price increases at the farm level are thought to be passed more quickly on to the final consumer. The afore-mentioned scenario is known as asymmetric price transmission.

An implication of asymmetry in price transmission, where it exists, is that an analysis of growth and development in a particular sector is likely over-estimates the benefits to the primary producer and consumers because the reduction in farm prices might not be immediately or fully transmitted to final consumers. Consequently, there would be smaller positive effects on primary producer and consumer welfare and a possible increase in rents for the firms in the downstream sector. Thus, it is important to understand the processes related to transmission (pass-through) of price changes as price transmission assumptions along the supply chain play an important role in determining the size and distribution of welfare effects of marketing policy.

Cognizance should be given to fact that market power might be an important explanation for any evidence of asymmetries in price transmission, but it may not be the only causal factor. That is, incomplete or asymmetric price transmission may take place for a number of other reasons. In support of this assertion, Peltzman (2002) argues that asymmetric price transmission may be characteristic of competitive, as well as oligopolistic market structures, and it cannot simply be concluded that presence of asymmetric price transmission automatically implies market power. It is worth reiterating that the aim of this paper to provide empirical evidence of the farm-to-retail price transmission behavior in the South African poultry industry.

Analytical Approach

There are a number of approaches that can be used to study price transmission from farm-to-retail and vice versa. For example, the mark-up pricing model has been used in several studies over the years (e.g. Heien1980; Kinnucan and Forker 1987; and Ferris 1988). Another approach is the relative price spread specification model which has been purported to be superior in performance compared to the mark-up price (Gardner 1975; Wohlgenant and Mullen 1987). The superiority of the price spread specification over the mark-up pricing model emanates from the fact that farm-to-retail price spread changes with shifting retail food demand, changing farm product supply or the changes in marketing services.

Given the complexity of policy applications, Wohlgenant and Mullen (1987) suggested that the relative price is more ideal to the measurement of price symmetry in the food industry. However,

other workers who compared the mark-up pricing and relative price models (see Dickerson 2003 and Tey,2009 for examples) found that the mark-up pricing performed better than the relative price model in that the former model gave more plausible elasticities of price transmission. The mark-up pricing model can be written as:

$$(1)\quad MM_t = c + \beta_1 P_{rt-1}$$

where MM_t is the retail price (P_{rt}) less farm price (P_{ft}) in month t (R/kg), and P_{rt} is retail and P_{ft} is farm prices of chicken (R/kg).

The expression in equation (1) can be estimated using generalized least squares or ordinary least squares. As a rule of thumb, generalized least squares are used if serial correlation is evident and ordinary least squares if serial correlation not evident. The ultimate benefit of the mark-up price model is its ability to produce elasticity of price transmission and in this the elasticity of price transmission for poultry in South Africa for the time series is of particular interest. The formula for calculating the elasticity of price transmission is given as:

$$(2)\quad EPT_t = \frac{1}{(1-\beta_1)} * \frac{P_{ft}}{P_{rt}}$$

A number of studies have assumed symmetry in price transmission when calculating price transmission elasticities (e.g. Heien, 1980; Kinnucan and Forker, 1987) implying that retail prices behave similarly to farm prices in terms their direction of movement (both decreases and increases). However, there have also been a similar number of studies that have found the relationship, in terms of price transmission, between retail and farm prices to be asymmetrical. For example, von Cramon-Traubadel and Meyer (2000) found asymmetry in price transmission and purported that such asymmetry can be construed as evidence of market failure or the abuse of market power (dominance). It has also been reported that, generally, price transmission elasticities associated with rising farm prices are larger than corresponding elasticities associated with falling farm prices (Kinnucan and Forker, 1987; Hahn, 1990; Bernard and Willett, 1996; and Capps and Sherwell, 2007). Interestingly, this preceding view has been contradicted by other researchers who argue that the relationship should be vice versa (Ward, 1982; Punyawadee *et al*., 1991).

Given the recent food price crises (von Braun, 2008; Piesse and Thirtle, 2010) and the assertions of von Cramon-Traubadel and Meyer (2000), it is imperative to investigate if there has been market failure or the abuse of market power in the South Africa poultry market. This is particularly interesting given that the South African poultry industry has never been regulated in South Africa thus not directly affected by the deregulation of agricultural markets that took place in the mid 1990s in South Africa. It is prudent and proper to first investigate whether price transmission in the poultry industry in South Africa is symmetric or asymmetric before delving into the analysis of farm-to-retail price spread for the poultry industry. Following Capps and Sherwell (2007), the Houck (1977) model was chosen as the most appropriate model as backed by compelling empirical evidence (e.g. Boyd and Brorsen, 1998; Kinnucan and Forker, 1987; Bailey and Brorsen, 1989; Zhang *et al*., 1995; Mohanty *et al*., 1995; Bernard and Willett, 1996; Willett *et al*., 1997; Peltzman, 2000; Aguiar and Santana, 2002). The Houck model is premised on idea that

retail prices are a function of farm prices and farm prices being a function of retail prices and it can be expressed as:

$$(3)\quad \Delta P_{rt} = \alpha_0 + \alpha_1 \Delta P_{ft}^{+} + \alpha_2 \Delta P_{ft}^{-} + \in_t$$

Where P_{ft} is farm price of poultry (R/kg), $t = 1,2,...,$ Δ is the first difference operator, ΔP_{ft}^{+} is the cumulative of $P_{ft} - P_{ft-1}$, if $P_{ft} > P_{ft-1}$ and 0 otherwise, and ΔP_{ft}^{-} is cumulative of $P_{ft} - P_{ft-1}$, if $P_{ft} < P_{ft-1}$ and 0 otherwise.

However, in reality, perfect efficiency in price transmission[1] as depicted in Equation (3) is hard to come by. While the poultry industry in South Africa is completely unregulated it is still dominated by a few large producers strategically placed throughout the country. These few large poultry producers involve a number of relatively smaller producers through contract farming which may be viewed simultaneously as providing market outlets to these smaller producers while reducing competition (the few large producers). Most of the smaller producers are, bound by contract to larger producers, relatively uneducated and rely on their larger counterparts and word-of-mouth for price information which normally takes a long time to filter through. Thus, Equation (3) can be modified by incorporating a time lag which can be estimated through generalized or ordinary least squares and thus be written as:

$$(4)\quad \Delta P_{rt} = \alpha_0 + \sum_{i=0}^{M1} \alpha_1 \Delta P_{ft}^{+} + \sum_{i=0}^{M2} \Delta P_{ft}^{-} + \in_t$$

Where *M1* and *M2* are the length of the lags, and other variables are as described in Equation (3). It is necessary to determine if the price transmission in the South African poultry industry is asymmetric, as already discussed. A formal test on the asymmetry hypothesis (Equation 5) can be conducted using a *t*- or *F*-test, following the specification of Gardner (1975).

$$(5)\quad H_0 : \sum_{i=0}^{M1} \alpha_{1i} = \sum_{i=0}^{M2} \alpha_{2i}$$

Failure to reject the null hypothesis would mean that the price transmission is symmetrical. Conversely, a rejection of the null hypothesis suffice as proof there is asymmetry and the implication would be that Equation (5) can be estimated by using error correction model (ECM).

The ECM approach is based on the assumption of cointegration between retail price and farm price, and if that is the case the residuals of the ECM can be incorporated in the Engle-Granger Theorem expression of the price transmission process as:

$$(6)\quad \Delta P_{rt} = \alpha_0 + \alpha_1 \Delta P_{ft} + \alpha_2 ECT_{t-1} + \sum_{i=1}^{M1} \alpha_{3i} \Delta P_{rt-i}^{+} + \sum_{i=1}^{M2} \alpha_{4i} \Delta P_{ft-1} + \in_t$$

where ECT is the residuals from the cointegrating relationship between P_{rt} and P_{ft} and other variables are as defined already.

[1] Perfect efficiency in price transmission refers to a situation where there is complete symmetry between the farm (producer) price and retail price of a particular product in a particular market.

The model represented by equation (6) was improved upon by Granger and Lee (1989) who modified it by segmenting the ECT into positive and negative components. Further improvements were made by von Cramon-Taubadel and Loy (1999) to allow the incorporation of ΔP_{ft} results in the asymmetric error correction model being expressed as:

$$(7)\quad \Delta P_{rt} = \alpha_0 + \sum_{i=1}^{M1} \alpha_{1i} \Delta P_{rt-i} + \sum_{i=0}^{M2} \alpha_{2i}^{-} \Delta P_{ft-i}^{-} + \alpha_3^{+} ECT_{t-1}^{+} + \alpha_3^{-} ECT_{t-1}^{-} \in_t$$

The expression in Equation (7) yields long-run or cumulative effect of rising and falling farm-retail price transmission. However, in the interest of providing a well-rounded view, this study also looks at the short-run effect of rising and falling farm-retail price transmission thus the final model can be given as:

$$(8)\quad \begin{aligned} \Delta P_{rt} = {} & \alpha_0 + \sum_{i=1}^{M1} \alpha_{1i} \Delta P_{rt-i} + \alpha_{2i} \Delta P_{ft-i}^{+} \sum_{i=0}^{M2} \alpha_{3i}^{+} \Delta P_{ft-i}^{+} + \alpha_{4i}^{-} \Delta P_{ft-i}^{-} + \sum_{i=0}^{M3} \alpha_{5i}^{-} \Delta P_{ft-i}^{-} \\ & + \alpha_6^{+} ECT_{t-1}^{+} + \alpha_7^{-} ECT_{t-1}^{-} \in_t \end{aligned}$$

The ECM approach is better than the Houck approach if any of the coefficients, α_{1i}, α_6^{+}, and α_7^{-} are statistically different from zero when Equation (8) is estimated via generalized or ordinary least square estimation. To further ascertain if the poultry price transmission is asymmetrical, the F-test or t-test can be performed on the hypothesis:

$$(9)\quad H_0 : \alpha_{2i}^{+} = \alpha_{4i}^{-} \text{ or } \sum_{i=0}^{M2} \alpha_{3i}^{+} = \sum_{i=0}^{M3} \alpha_{5i}^{-} .$$

Finally, short-run and long-run elasticities of price transmission can be derived from Equation (8) and the formulae are as follows:

Short-run elasticity of price transmission for raising farm prices:

$$(10)\qquad \varepsilon_{sr}^{+} = \alpha_{2i}^{+} * P_{ft} / P_{rt}$$

Short-run elasticity of price transmission for falling farm prices:

$$(11)\qquad \varepsilon_{sr}^{-} = \alpha_{4i}^{-} * P_{ft} / P_{rt}$$

Long-run elasticity of price transmission for rising farm prices:

$$(12)\qquad \varepsilon_{LR}^{+} = \sum_{i=0}^{M2} \alpha_{3i}^{+} * P_{ft} / P_{rt}$$

Long-run elasticity of price transmission for falling farm prices:

$$(13)\qquad \varepsilon_{LR}^{-} = \sum_{i=0}^{M3} \alpha_{5i}^{-} * P_{ft} / P_{rt}$$

Data and Preliminary Results

Monthly data from January 1994 to December 2010 for farm and retail prices of chicken and relevant macroeconomic variables such as rand/dollar exchange rate, interest rate, prices of substi-

tutes (pork, beef and mutton), import and export values of chicken meat, etc. were obtained from various sources. The price data were deflated by the price index for meat to make them temporally compatible (in real terms). The mark-up price was calculated as the difference between farm (producer) and retail prices and this will be discussed further under the results section that follows.

Table 1 shows summary statistics of the data. The mean farm price was R9.64/kg and the retail price was R22.51/kg over the studied period. Looking at the cumulative values, it can be clearly seen that the prices for chicken meat rose (11.41) more than they fell (-7.18) between 1994 and 2009, which hardly surprising as food prices are not known to fall at regular intervals. Another insight that can be gleaned from the descriptive statistics is that retail price, on average, was more than double the producer price indicating some possible asymmetry in price transmission in the South African poultry industry, although this should not be taken at face value. This point will be further discussed in the discussion section of the paper.

Table . Descriptive statistics, 1993 - 2010

Mean price (R/kg)		**Cumulative**	
Farm	Retail	Rising	Falling
9.64	22.51	11.41	-7.18

Further information on the spread of farm and retail prices of chicken is presented graphically in Figure 1.

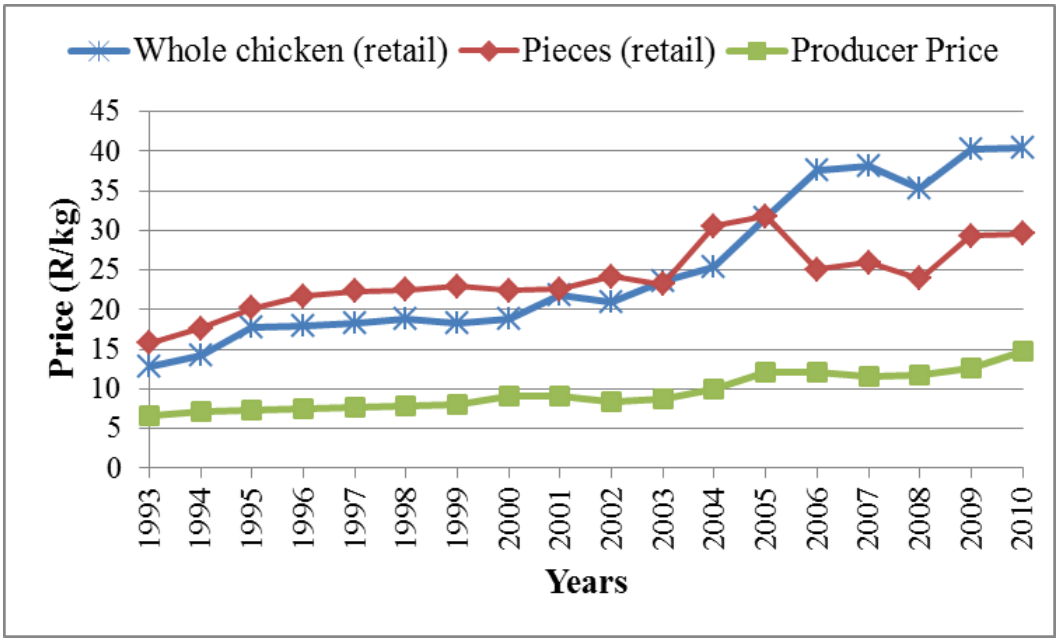

Figure 1. Farm-retail price spread for poultry in South Africa for 1994 to 2010

The spread is an aggregate representation of marketing costs and profits. Conventional economic theory suggests that the price spread is equal to the equilibrium of demand and supply of marketing services and materials per unit of product, where marginal value of the marketing services

and materials per unit of product (hereafter referred to as marketing margin) is equal to marginal cost (Ferris, 1998). From Figure 1 it can be seen that the price received by poultry farmers (producer price) has doubled over the 18 years under observation from about R7.50/kg in 1995 to about R15/kg in 2010. However, the retail price for whole chicken grew from R13/kg in 1993 to more than R40/kg in 2009 and 2010 while the retail price of chicken pieces followed a similar trend rising from just over R15/kg in 1993 to R30/kg in 2009 and 2010. The disproportionate increase in retail price compared to the producer price led to an exorbitant increase in the marketing margin. It would be interesting to elucidate whether such an increase was precipitated by increasing marketing cost on merely retailers' mark-up prices leading to more profits and increased food prices. Another point worth mentioning is that the apparent increase in producer price is deceptive because the price of inputs, particularly chicken feed and fuel escalated to unprecedented levels during 2007 to the beginning of 2009.

Figure 1 also shows another interesting trend in the retail prices for chicken meat in South Africa. Up until 2001, the price for pieces (selected chicken portions) was higher than that of whole chicken but the trend has changed with whole chicken now being more expensive. This may be an indication that consumers now demand more whole chicken than portions as whole chicken in mainly sold as fresh meat while portions are mainly sold as frozen. Another plausible explanation for the reduction in the price of portion could be the influx of cheap, low quality cuts imports that are largely sold to the lower end of the market in downtown retail outlets and rural stores.

Economic theory postulates that the price of substitutes has a direct bearing on the price of products. In this study, beef, pork and mutton were identified as substitutes for chicken meat (poultry) and Figure 2 shows the price trends of these products in relation to the price of chicken meat. It can be seen from Figure 2 that the prices of all the three substitutes for chicken meat followed the similar trends as those exhibited by the price of chicken meat. From the data, it is apparent that pork was the closest substitute to chicken meat in South Africa, in terms of prices. However, it should be borne in mind that not everyone can substitute pork for chicken meat as a substantial portion of the South African population does not consume pork, mainly for religious reasons (i.e. the Muslim community and the various Zionist Christian Movements – which jointly command a large following in the country). Be that as it may, one would expect the demand for chicken meat to be affected by the price of pork. However, the data show that this is unlikely given that the two products are very close to each other in their retail prices.

It is interesting to note that the two "white" meat types (chicken and pork) are very close to each other move in the same direction, except in 2006 when pork retail prices took a dip. The 2006 slump in the retail price of pork could be attributed to the swine flu scare that gripped the world at the time. Similarly, the two "red" meat types, beef and mutton, moved in the same direction and gap in their retail prices remained virtually constant, with mutton being the more expensive of the two. South Africa is a net importer of both beef and mutton.

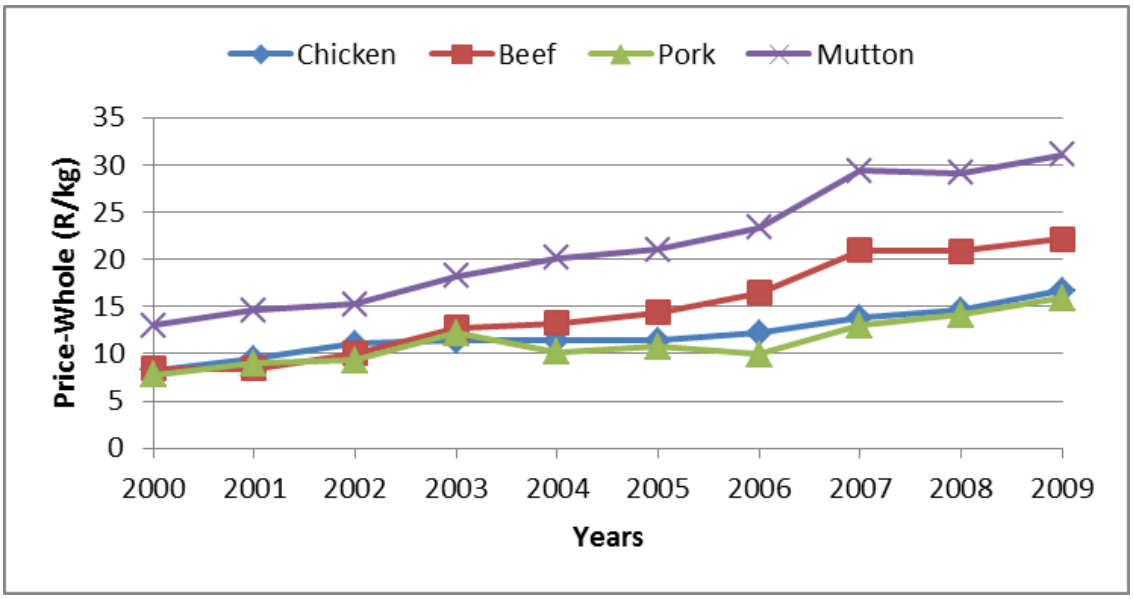

Figure 2. Comparison of retail price for chicken and its substitutes (beef, pork and mutton) from January 2000 to December 2009

Results

It was hypothesized that marketing margin, as measured by the mark-up price, and retail price of chicken meat would be linearly related. In order to test the relationship between these two variables a correlation test was done to establish the degree to which they are related as shown in Table 2. The estimated correlation coefficient of 0.9048 vindicated the hypothesis and showed that there is a strong and positive correlation between retail price and marketing margin in chicken meat industry in South Africa. The implication of the strong and positive correlation between the two variables is that it is logical to expect that as marketing costs (such as transportation cost and packaging cost) rise/fall so will the mark-up rise/fall and ultimately leading the retail price to follow the same trend.

Table 2. Kendall's rank correlation[2] among producer price, retail price and mark-up of chicken meat in South Africa, 1993 - 2010

Variable	Producer Price	Markup	Retail Price
Producer Price	1.0000		
Markup	0.7143	1.0000	
Retail Price	0.8095	0.9048	1.0000

The next logical step was to estimate the mark-up price model as depicted in Equation 1 and this was performed using generalized least squares and the results are given in Table 3. The results show that the both the retail and producer prices have significant and positive effect on the mark-

[2] The Kendall's rank correlation (ktau) was selected because of its suitability for small to moderately- sized samples (StataCorp, 2007).

up price of chicken meat in South Africa. Both retail and producer prices are only significant at the 5% level. Lagging the retail price one period yields interesting results.

Table 3. Parameter estimates of the mark-up[3] pricing model, 1993 - 2010

Variable	Coefficient	Std. Error
Dependent variable: Mark-up price		
Intercept	-2.2533	0.5019
Retail price (P_{rt})	0.6647	0.4815**
Retail price_lagged (P_{rt-1})	0.8979	0.0318***
Producer Price	0.7231	0.5019**
Adjusted R-squared	0.78880	
Akaike info criterion	0.4711	
Schwarz criterion	0.5466	
Durbin-Watson stat	2.1688	

***Statistically significant at 1% level of significance; **significant at the 5% level.

lagged retail price variable is highly significant (at the 1% level of significance) with a coefficient of 0.8979. The implication of this finding could be that retailers base their mark-up decision on historic values rather than current producer prices. This is an important finding that could provide insight into the pricing behaviour within the poultry value and better prepare all stakeholders in the value chain to anticipate future trends.

The preceding discussion provided an overview of chicken meat retail prices behaviour in response to changing producer prices. However, it is more interesting to understand the dynamic behaviour of retail prices to rising and falling producer price of chicken. In order to study the behaviour of retail chicken price in relations to changes (rising and falling) producer price, the Houck approach was adopted. The Houck approach is represented by Equation 4. It was deemed proper and appropriate to determine the lag length period of some of the variables before formally estimating the Houck approach (Equation 4). The lag lengths were decided upon as informed by the Akaike Information Criterion[4] (AIC) and the Shwarz Information Criterion[5] (SIC). Both the AIC and the SIC are used for selecting the most parsimonious correct model thus avoiding misspecified and over-parametrized models (Luddem et al., 1994). Following the Houck approach, it was found that the most reasonable time lag associated with both rising and falling farm prices was one. The results of the parameter estimates derived following the Houck approach specification are reported in Table 4. A t-test was performed on the coefficient of cumulative rising lagged farm price (ΔP^{+}_{ft-1}) of -0.3851 and the cumulative falling lagged farm price (ΔP^{-}_{ft-1}) of -0.3586 and it showed that the South African farm-to-retail price transmission for poultry was symmetric because the null hypothesis (Equation 5) could not be rejected at the 5% level of significance.

[3] Mark-up price was calculated as the difference between retail price (average of the retail price of whole chicken and pieces/cuts) and farm (producer) price at a given time period.
[4] The Akaike Information Criterion is based on the seminal work of Akaike (1974).
[5] Shwarz Information Criterion is premised on the work of Shwarz (1978) and since the Schwarz information criterion is derived using Bayesian arguments, this criterion is also known as the Bayesian Information Criterion (BIC).

Table 4. Parameter estimates of the Houck approach, 1993 - 2010

Parameter	Coefficient	Standard Error
Intercept	-0.3693	(0.5101)
ΔP_{ft}^{+}	-0.4606	(0.2298)**
ΔP_{ft-1}^{+}	-0.3851	(0.2233)*
$\sum \Delta P_{ft}^{+}$	1.2594	(0.1723)***
ΔP_{ft}^{-}	-0.6542	(0.3131)**
ΔP_{ft-1}^{-}	-0.3586	(0.2896)
$\sum \Delta P_{ft}^{-}$	1.2229	(0.2036)***
AR(1)	0.7960	(0.0524)***
R-square	0.9153	
Akaike Info Criterion	1.7151	
Schwarz Info Criterion	1.8816	
Durbin-Watson stat	2.1245	

***Statistically significant at 1%; **Significant at 5% level of significance

Since lagged price values were used it was deemed necessary to test to autocorrelation. The Durbin-Watson[6] statistic test was administered and it revealed that there was neither autocorrelation nor serial correlation since Durbin-Watson statistic value was 2.1245. The Durbin-Watson statistic value should be close to 2.0 if there is no correlation. If the statistic is near 0.0, there is evidence of positive autocorrelation and if the statistic is close to 4.0 then there is evidence of negative autocorrelation.

Following the estimation of parameters for the Houck approach, a further cointegration test was performed on the relationship between farm and retail prices following the error correction model (ECM) for Equation 8. The ECM test showed that farm and retail prices for poultry in South Africa, for period under review, were cointegrated. The results of the ECM approach are given in Table 5. The coefficients of ECT_{t-1}^{+}, ECT_{t-1}^{-}, and $\sum \Delta P_{rt-1}$

were statistically different from zero and the R-square value show that the ECM approach performed better than the Houck. The ECM approach also confirms that the South farm-retail price transmission is symmetric as indicated by the significant coefficients (at the 5% level of significance) of $\sum \Delta P_{ft}^{+}$ (0.3647) and $\sum \Delta P_{ft}^{-}$ (0.3645).

Ensuing from the findings of both the Houck and ECM approaches that suggested symmetry in the farm-retail price transmission of the poultry industry in South Africa, elasticities of price transmission from the markup model were estimated. Figure 3 shows the elasticities of price transmission for poultry from 1993 to 2010. The elasticity of price transmission is the percentage change in retail price due to one percent change in farm price. Thus the average elasticity of price transmission of 1.42, as shown in Figure 3, calculated at the sample mean can be interpret-

[6] The Durbin-Watson statistic tests for autocorrelation of the residuals which occurs when the residuals are correlated with the lagged values of themselves. That is, when e_t tends to be correlated with e_{t-1}. Thus the Durbin-Watson statistic tests for correlations between e_t and e_{t-1}, which is called serial correlation.

ed as meaning that one percent increase/decrease in farm price would lead to a 1.42 percent increase/decrease in retail price of poultry in South Africa.

Table 5. Parameter estimates of the ECM approach

Parameter	Coefficient	Standard Error
Intercept	-0.0037	0.1048
ΔP_{ft}^{+}	0.1990	0.2551
ΔP_{ft-1}^{+}	-0.4947	0.2484**
$\sum \Delta P_{ft}^{+}$	0.3647	0.0959***
ΔP_{ft}^{-}	0.6337	0.3046**
ΔP_{ft-1}^{-}	0.3716	0.3169
$\sum \Delta P_{ft}^{-}$	0.3645	0.1006***
ECT_{t-1}^{+}	0.2008	0.1920
ECT_{t-1}^{-}	-0.3718	0.1457**
$\sum \Delta P_{rt-1}$	0.7850	0.0613***
R-square	0.9234	
Akaike Info Criterion	1.6372	
Schwarz Info Criterion	1.8444	
Durbin-Watson stat	2.1432	

***Statistically significant at 1%; **Significant at 5% level of significance

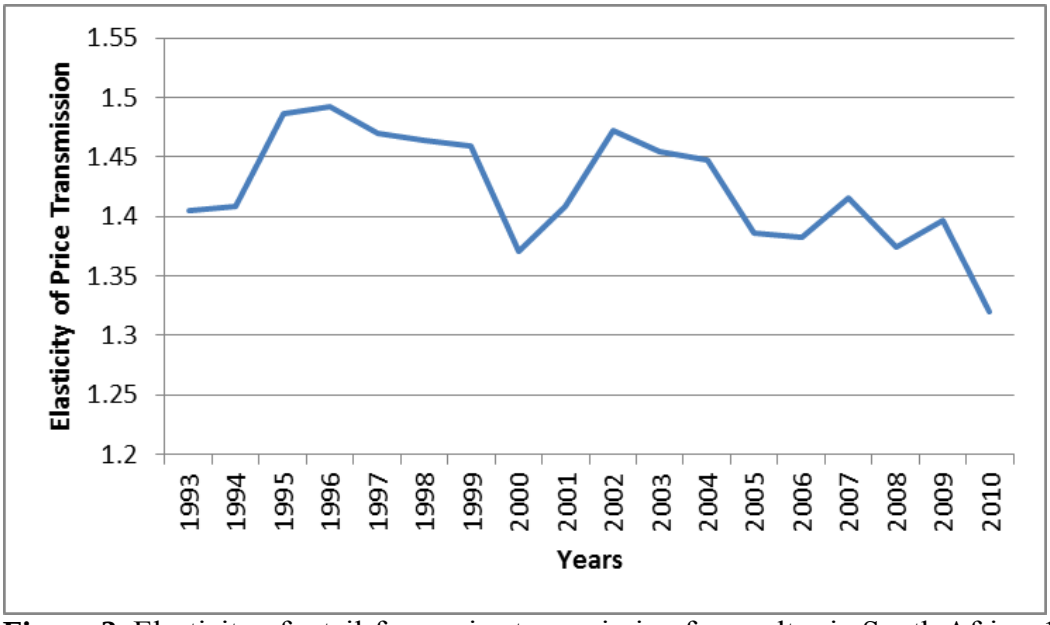

Figure 3. Elasticity of retail-farm price transmission for poultry in South Africa, 1993 - 2010

It would also be interesting to observe changes in the elasticities of price transmission over time thus Figure 3 illustrates, graphically the elasticities of South African poultry over an 18 year period (1993 to 2010). Recall that the mean elasticity of price transmission computed at the sample mean was 1.42, which interestingly was the same value as at the beginning of the observation period (1993). The period between2000 to 2002 saw the elasticity of price transmission increase from 1.42 to a1.48, signalling that an increase in producer price of chicken did not translate to a proportionate increase in the retail price of chicken meat. This could have been because of retailers keeping their mark-up price unchanged while producer prices were increasing as they might have anticipated that the increased prices were short-lived as imports of cheaper frozen chicken meat increased.

From 2002 to 2010 the elasticities of price transmission decreased from about 1.47 to a record 1.32 implying that retailers had increased their markup prices disproportionately higher than farm prices were increasing. Interestingly, this period was a built-up to the unprecedentedly high food prices of 2007 to early 2009.

A number of plausible explanations can be given for this phenomenon of increases in retail prices outstripping farm prices: 1) retailers could have been on a recovery mode following periods of reduced markup prices in the preceding years; 2) farm prices were continuing to increase and retailers were responding accordingly in anticipation of sustained increases in farm prices as prices for agricultural inputs continued to escalate, particularly crude oil which a ripple effect on production. As the food price crisis began in full swing, elasticities of price transmission for poultry began to drop as markup prices struggled to keep up with the pace of farm prices and consumers lost more and more purchasing power thus dampening demand for consumption goods, including food items, such as meat (both red and white meat); 3) lastly, the period of increasing elasticities of price transmission coincides with the period immediately after the SARS (bird flu) outbreak which saw an astonishing shift away from poultry consumption the world over, forcing retailers to cut their marketing margins (markup prices). So, the period from 2002 onwards could be viewed as a recovery period when consumers returned to consuming poultry products and the market correcting itself to reward retailers with commensurate marketing margins.

All in all, price transmission was elastic for the period under review with the lowest being 1.319 in 2010 and the highest being 1.49 in 1996 (Figure 3). After presenting the ECM approach as the most suitable model, the discussion would be incomplete without reporting on both short-run and long-run price transmission behaviours. Table 6 presents the short- and long-run elasticities of price transmission estimated at the sample mean of the data used (from 1993 to 2010). The short-run elasticities of price transmission for both rising (0.1650) and falling (0.3178) farm prices are less than unit implying inelasticity. This finding is hardly surprising as retailers are unlikely to change their marketing margins in the short-run as producer prices tend to have a triggering effect on retail prices with some time lag. Retailers are weary to increase their prices until they have a sense that their competitors will follow-suit (this is true only in a competitive market environment with many players at both the producer and retail levels). However, in the long-run, elasticities of price transmission show a different picture. The long-run elasticities of price transmission for both rising (1.1836) and falling (1.3426) prices are more than unity indicating that they are elastic. The implication for this elasticity of price transmission means that in the

long-run retail prices will respond to changes in farm price and the converse is expected to be true. Interesting to note is that retail price of poultry in South Africa is more responsive to falling farm prices than it is to rising farm prices, both in the short- and long-run. The difference is more marked for the short-run compared to the long-run.

Table 6. Estimates of short-run and long-run elasticities of farm-retail price transmission for South African poultry, 1993 - 2010

Method	Short-run elasticity of price transmission		Long-run elasticity of price transmission	
	Rising farm prices	Falling farm prices	Rising farm prices	Falling farm prices
ECM Model	0.1650	0.3178	1.1836	1.3426

Conclusions and Policy Recommendations

This paper reported on the quantitative analysis of price transmission from farm to retail in the South African poultry market using price data from 1993 to 2010. The farm-retail price transmission of poultry in South African was found to be symmetric using both the Houck and ECM approaches implying that change in farm price of poultry elucidated a similar change in the retail price of poultry in the South African market and vice versa. Furthermore, the price setting mechanism of poultry can thus be quantified by the estimated price transmission elasticities where retail price is responsive to changes in farm price. Thus, other things being constant, a unit change in farm price of chicken is expected to result in more than unit change in retail price of chicken. This finding has important policy and food security issues in South Africa given that most of the chicken feed consumed in the country is imported from uncertain and expensive markets. Unless a cheaper source of poultry feed, albeit of good quality, is found, farm prices for chicken will continue to rise unabated and this will be transmitted to the final consumer, exacerbating food insecurity at household level. For the poor in South Africa, an increase in the price of animal protein leads to consumers consuming less protein-rich food or switching to non-animal sources, which invariably affects the nutrition of vulnerable groups (i.e. children and people living with AIDS).

The South African poultry industry is dominated by few large operators with a plethora of small-scale poultry producers who rely on the large commercial poultry producers for markets through contract farming and outgrower schemes. Other market outlets for small-scale poultry producers are the informal and unreliable markets. Given the symmetry in the price transmission within the poultry value-chain, it is possible to increase the benefits accruing from such to small-scale farmers through the adoption of leaner and shorter value-chains. The shortening of the value-chain can be achieved through directly linking small-scale farmers to retail market, be it supermarkets or fast-food outlets such as Kentucky Fried Chicken, Chicken Licken and others. Another promising strategy for shortening the poultry value-chain in South Africa and similar economies elsewhere is to directly link farmers with institutions such as state hospitals and correctional centres (prisons). This strategy is beginning to bear fruits in South Africa as more and more small-scale farmers now have reliable market outlets through such institutions. However, since most small-scale farmers are too small, in terms of the volumes that they produce, horizontal integration would be beneficial in reducing transaction costs and increasing production levels, col-

lectively. Small-scale farmers coming together would also make it easier for them to access inputs and discount prices as their bargaining power would be increased.

As was discussed in the introduction section, poultry industry is important to the South African economy in more ways than one, it would be desirable for policy makers to take note of the symmetric price transmission that exists in the midst of rampant price transmission asymmetry in other industries. The symmetric price transmission in the poultry industry renders the industry one of the sectors that is more equitable in terms of income distribution between farm and retail levels. Such equity should be used by policy makers in the quest for a more egalitarian society in South Africa thus the poultry industry warrants government support and prioritizing for reducing inequality and creating more jobs. There is wide scope for further developing and growing the poultry industry in South Africa given that that South Africa is a net importer of chicken even though the capacity exists within to supply enough chicken meet. The existence of surplus demand for poultry presents a golden opportunity for agribusiness to invest in poultry production and allied activities such as the manufacture of chicken feed, establishment of abattoirs and processing plants given the growing market. However, the agribusiness manager and proprietor require certain preconditions before investments could be made. What is needed is a conducive and enabling marketing and trade dispensation to improve the competitiveness of the South Africa poultry industry both domestically and internationally. There is enough room, even within the World Trade Organisation (WTO) rules, to assist and protect the poultry industry thus also protecting consumers by ensuring more affordable prices at both farm and retail levels. Lastly, the restaurant and eat-out industry are growing with growing income levels in South Africa and this presents an opportunity for the industry to burgeon.

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