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How Has Consumer Education Influenced Pork Consumption In South Africa? Instrumental Variable Regression Analysis

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Abstract: We evaluate the impact of consumer education on pork consumption in South Africa by using time series data on levy expenditure on consumer education over a ten-year period. Furthermore, we introduce quantitative measures of two non-economic factors (health and nutrition, and tastes and preferences) based on previous research which indicates that they are important drivers of meat consumption. We employ an instrumental variable regression analytical framework. To account for the dynamic response of consumer education effects on consumption patterns, a lagged variable for expenditure on consumer education is included in the specified model. The positive estimate (0.045) on consumer education is highly significant, implying that consumer education is associated with a 4.5% increase in pork consumption. In concurrence with previous studies, findings show that peoples' tastes and preferences for processed pork products positively impact on pork consumption while health and nutrition (*severe malnutrition*) exhibits a negative effect on pork consumption. As recommendation, consumer education should focus more on the low-income earners since this segment of the population accounts for a relatively small proportion (10%) of total pork consumed.

1. BACKGROUND

Since deregulation, the pork industry collects statutory levies as provided for by the Marketing of Agricultural Products Act, No. 47 of 1996 (MAP Act). A statutory levy is a charge per unit of an agricultural commodity at any point in the marketing chain between the producer and the consumer, which is collected to finance a number of functions, namely administration, information and liaison, transformation, research, consumer assurance and consumer education (NAMC, 2015). The promulgated statutory levies in the pork industry are administered by the Red Meat Levy Administrators (RMLA) on behalf of the South African Pork Producers Organisation (SAPPO). On average, an estimated annual levy of R 17.5 million is collected, of which slightly more than 50% is spent on consumer education/promotion. Through SAPPO, consumers

are educated about the health and nutritional benefits of pork and its products, and are assured of a safe product as a result of the quality assurance and traceability scheme.

According to DAFF (2016), the per capita consumption of pork in South Africa has increased by about 20.5% from 3.9kg in 2005 to 4.7kg in 2015, probably due to the consumer education/promotion initiative funded through the statutory levies income. Market research indicates that pork consumption offers an opportunity to increase further. To drive the consumption of pork, marketing efforts focus on increasing the visibility of pork through consumer education/promotions. The message that is conveyed to consumers is that pork is healthy, affordable and there is value for money. Loyal consumers as well as those that are not familiar with pork are encouraged to buy pork with confidence. Certain misconceptions, for example that pork is not healthy, too fat and varies in quality are addressed. The consumer education/promotion initiative also endeavours to restore consumer confidence about health and safety aspects and to build trust in the brand identity. According to SAPPO, pork produced in South Africa is scientifically bred to be leaner, providing a lower fat content than was previously believed. The message SAPPO sends out, is that pork is a nutrient-dense food and contains many essential nutrients such as protein, vitamins and minerals. Furthermore, the protein provided by pork contains all the essential amino acids. This makes it a complete protein in a highly digestible form.

Despite the increase in pork per capita consumption vis-à-vis the increasing statutory levy expenditure on consumer education, there is uncertainty about the extent to which the rise in per capita consumption of pork may be attributed to consumer education among other factors. Earlier work by Oyewumi and Jooste (2006) and Davids *et al* (2014) on pork consumption was anchored on survey data and exploratory research, respectively. Survey data per se is associated with difficulty in ruling out rival hypotheses and measurement errors. Aigner *et al* (1984) reckons that measurement errors lead to model under-identification. Furthermore, none of the studies carried out after the enactment of MAP Act took into consideration the fact that SAPPO, through statutory levy income financed the consumer education initiative. This initiative aims at increasing the industry's visibility and pork consumption amongst the citizenry.

BFAP (2013b) notes conflicting views between Luppnow (2007) and industry specialists about the success of SAPPO's marketing campaign that aimed at boosting pork consumption. Thus, the objective of this work is to evaluate the impact of the consumer education on pork consumption in South Africa. This paper's novelty lies in its attempt to quantify the impact of consumer education. Furthermore, the paper uses a time series analytical approach in which we try to quantitatively account for non-economic factors such as tastes and preferences as well as health and nutrition. Although Taljaard *et al* (2006) also used time series analysis, their analysis did not include the non-economic factors in the model but only implicitly assumed that the effect of non-economic factors was equivalent to residual proportion of the estimates. Hence, this is largely how our paper differs from their work.

The rest of this paper is presented as follows: In section 2 we provide a brief overview of South Africa's pork industry and trends in statutory levy expenditure on consumer education. Section 3 provides a synthesis of relevant literature reviewed while section 4 has the methodology used in the analysis. In section 5, results are presented and discussed while in section 6 conclusions and recommendations are drawn.

2. AN OVERVIEW OF THE INDUSTRY

The South African pork industry contributes about 2.15% to the primary agricultural sector. The gross value of pork production is dependent on the quantity produced and the price received by farmers (DAFF, 2014). The industry plays an important role in the production of pork and creation of job opportunities, employing about 10 000 workers, comprising of approximately 4 000 farm workers and 6 000 workers in the processing and abattoir sector (DAFF, 2014). On average over the last ten years, South Africa's pork *per capita* consumption increased from 3.1 kg to 4.5 kg per annum probably due to the consumer education/promotion initiative funded through the statutory levies income. The low per capita consumption implies that there are very few people consuming pork in the country. However, South African Pork Producers' Organisation (SAPPO) estimated that pork consumption to rise by 25% between 2008 and 2020.

Pork is produced throughout the country with Gauteng, Limpopo, North West and Mpumalanga being the largest commercial producers, collectively accounting for 63% of total production. In 2014, KwaZulu-Natal accounted for 10% while the Western Cape, Northern Cape, Free State and Eastern Cape, collectively accounted for 27%. There are at least five breeds that are predominantly produced for commercial purposes in South Africa, namely SA Landrace, Large White, Duroc, Pietrain and Kolbrook.

In South Africa, pig carcasses are generally classified as either Porkers or Baconers. On average, porkers weigh about 60 kilograms (kg) while baconers range between 70 kg and 100 kgs. Porkers are used as a source of fresh meat while baconers are produced to be used in the meat processing industry to manufacture processed products like polonies, russians, bacon, sausages, hams, meat rolls and spreads (Maurhart, 2011). Of the total number of pigs slaughtered (**Figure 1**), the ratio of baconers to porkers is estimated at 7:3, with an average slaughter mass of 78 kg (Grimbeek *et al.*, 2014; Davids *et al.*, *nd*).

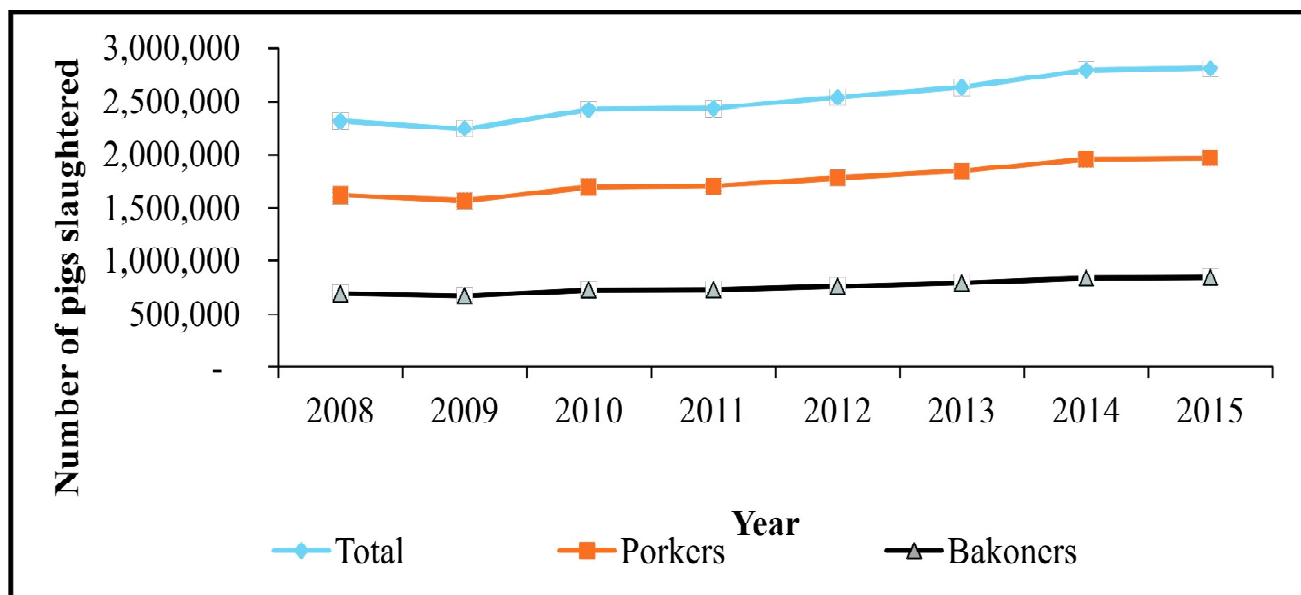


Figure 1: Number of pigs slaughtered by type

Source: Authors' calculations

2.1. Pork consumption

According to BFAP (2014), South Africa's pork consumption is small and accounted about 7% of the total meat consumption in 2013. Despite the small share of the meat complex, pork consumption registered a 53% increase over the past decade and it is expected to increase further in the coming years. This projection presents an opportunity for the industry to boost domestic production of quality pork and its related products so as to meet the increasing demand. However, it is worthwhile to note that the industry's competitiveness amongst other meat types will strongly depend on delivering high quality products that conform to consumers' tastes and preferences. Although pork is a preferred source of protein in many parts of the world, including China, Europe and Russia (OECD, 2014; BFAP, 2014), South Africa's per capita consumption is far below the trend in the above-mentioned countries. For instance, in 2014, pork per capita consumption per annum was estimated to be 69.7 kg in China - Hong Kong, 42.6 kg in Europe, 34.6 kg in China, 28.8kg in USA and 21.1 kg in Russia while for South Africa it was about 4.6 kg only. South Africa's increasing pork consumption trend is presented in Figure 2.

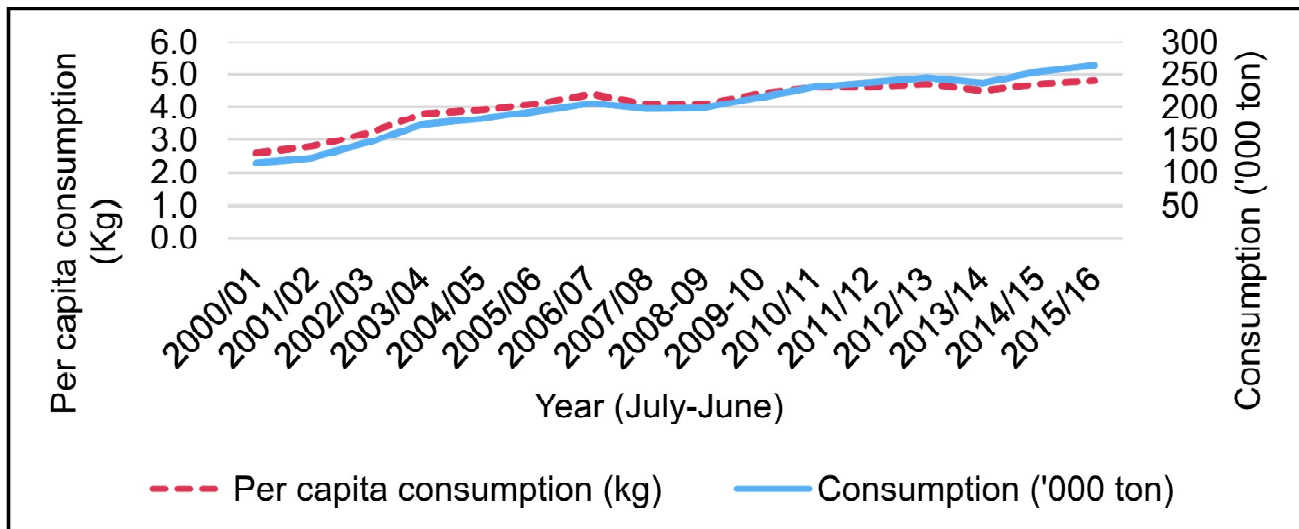


Figure 2: South Africa's pork consumption trend since 2000/01

Source: DAFF (2016)

2.2. Statutory levy expenditure on consumer education

According to the NAMC (2016), approximately 10.6 % (R52.1 million) of total levy expenditure was spent on consumer education in 2015, as compared to the R45.9 million (9.7 % of total expenditure) spent in 2014. The pork and red meat industries respectively allocate 55.8 % and 30.6 % of levy funds towards consumer education. Since deregulation, the pork industry has implemented on-going projects to communicate to consumers the health and nutritional benefits of pork, through SAPPO. Consumers are educated on the health and nutritional advantages of pork and pork products. According to SAPPO, market research has confirmed that pork consumption offers an opportunity to grow. The growth is likely to come from increased frequency rather than from increased penetration. To further drive pork consumption, marketing efforts focus on increasing the visibility of pork and the derived products. The message that is conveyed to consumers is that pork is healthy, affordable and value for money.

3. LITERATURE REVIEW

The demand for pork in South Africa was first modelled by Nieuwoudt (1998), who projected pork consumption between 2000 to 2022. While significant differences were evident in consumption patterns amongst population groups, Nieuwoudt (1998) posits that these differences were due to differences in living standards, as well as taste preferences. Due to the expectation that living standards among different population groups would become more equal overtime, final demand was projected for an aggregated population. Nieuwoudt (1998) concluded that the main factors that would drive demand for livestock products into the future were population growth, income elasticities, economic growth and urbanisation. A crucial finding from the study then is that the income elasticity of demand for pork products was found to be significantly lower than for other meat products, suggesting that the demand for pork is inelastic to changes in income and can therefore be considered to be influenced by other factors.

A similar notion was presented by Davids *et al.* (2014) who argue that a number of non-economic factors like animal welfare, environmental aspects, safety, taste and health also strongly influence the consumption of meats in any economy. Other variables identified include, disposable income, size and composition of the household, age, birthplace, education as well as the employment status of the housekeeper. Liu and Deblitz (2007) reported that economic and social as well as demographic variables such as price, urbanisation, education, and presence of a child, safety, preference, changing lifestyles, and health concerns affected meat consumption in China. According to De Silva *et al.* (2010), 1 % of respondents did not consume any type of meat due to religious beliefs (74 %), economic concerns (47%) and antipathy for killing animals (82 %) among other variables.

According to Bansback (1995) and Becker *et al.* (2000), economic factors (price and income) exhibit a declining effect on meat consumers' behaviour, thereby implying that non-economic factors such as health and quality issues are apparently more influential. Although MacBean (1996) posits that food safety concerns by far influence consumers' behaviour, Grunert (1997) and Lister (1996) argue that taste is the most important driver for meat consumers, particularly in Europe. McCarthy *et al.* (2004) note that although consumers are aware of food safety concerns such as chemical residue levels, cholesterol and Salmonella, many have a limited understanding of the associated threats and the extent to which they are spread. Jooste (2001) also acknowledges the influence of non-economic factors including product consistency and quality, food safety, health and nutrition concerns, and convenience in the red meat sector since the early 1980's during which the per capita consumption of beef was under increasing pressure due to the decrease or stagnation of per capita disposable income among other factors.

By using the ordinary least squares and Johansen cointegration approaches, Taljaard *et al.* (2006) quantified the effect of non-economic determinants of pork consumption, among other types of meat. The scholars found that non-economic factors collectively influenced pork consumption by 71% in South Africa for the 1985-2003 period. It was recommended that due attention should be accorded to consumer's tastes and preferences, among other non-economic factors influencing pork consumption. Oyewumi and Jooste (2006) used a logistic regression model to determine drivers of pork consumption at household level in central South Africa. Their findings reveal that the household's income, relative price of pork, price of other meat types and value-added pork products are key drivers of pork consumption.

4. METHODOLOGY

The analytical framework used in this paper was based on time series data given that such data can easily be used to establish cause and effect, coupled with the fact that it minimises chances of error as compared to cross sectional data. Other than the commonly identified economic factors which are urged to drive pork consumption patterns, our analysis also takes into consideration the role of non-economic factors influencing meat consumption¹ but due data limitations, only two factors (i.e. tastes and preferences as well as health and nutrition) are included in the model. To the best of our knowledge, this is the first paper to quantitatively include a proxy for non-economic factors in the empirical model. The short form of the model illustrated in equation (1) means that pork consumption (Pcons) is a function of both economic factors (E) and non-economic factors factors, denoted by Z.

$$Pcons = f(E, Z) \tag{1}$$

By assuming that variables are identically distributed (*iid*), that is, the first observation in the series X(0) has a uniform distribution $X(0) \sim Unif(0,1)$. Thus, all observations after X(0) for time *t* greater than one (*t*>1) can only take values of X(0) with probability of 0.5 and 1-X(0), which also has a probability of 0.5. This therefore means that all observations in the series are identically distributed. However, variables are not necessary independent, implying that they influence or interact with each other. Therefore, by introducing the various variables used to proxy the economic and non-economic factors, equation (1) can be expressed as follows: Description of the variables is presented in Table 1.

$$LN Pcons_{qt} = LN CoEd_{qt} + LN CoEd_{1_{qt-1}} + LN AY_HH_{qt} + LN PPrice1_{qt} + LN CPriceF2_{qt} + LN Pporker_{1_{qt}} + LN HN_{qt} + LN Pprocs_{qt} + \epsilon_{qt} \tag{2}$$

Table 1
Description of variables used in the specified model

Factor by type	Variable	Proxy used	Description	Source
Economic	LNCoEd	Consumer education	Consumer education statutory levy expenditure (R)	NAMC's statutory measures annual reports (2007-2016)
	LNCoEd_1	Consumer education	Lagged consumer education statutory levy expenditure (R)	NAMC's statutory measures annual reports (2007-2016)
	LNAY_HH	Disposable income	Average household income (R)	IRR (2016)
	LNPPrice1	Price of pork	Real urban price of pork chops - fresh per/kg (2015=base)	SAPPO
	LNCPriceF2	Price of substitutes	Frozen chicken portions mean/kg (R)	StatSA
	LNPporker_1	Production capacity	Real producer prices for porkers (R/kg) (2015 = base)	SAPPO
Noneconomic	LNHN	Health and nutrition	Severe malnutrition among children under 5 years	IRR (2016)
	LNProcs	Tastes and preferences	Processed pork (ton)	Authors' computation

Note: LN denotes the natural logarithm.

To proxy the pork industry’s production capacity, real producer prices for porkers were used given that 70% of the slaughtered pigs are porkers and are mostly used as a source of fresh meat (Maurhart, 2011; Davids *et al*, 2014; Grimbeek *et al.*, 2014;). Furthermore, the average real price of porkers and beconers exhibited multicollinearity with other variables. Davids *et al* (2014) reckon that the extremely high feed costs are a key driver of the industry’s production capacity. Inclusion of the real price of fresh pork chops was motivated by argument that increased pork consumption is driven by affordability of the product (Davids *et al*, 2014). The mean real price of frozen chicken portions was introduced in the model due to the fact that chicken is the major source of protein in South Africa, with the highest consumption growth rate (about 8% per year) for the last decade (BFAP, 2013a; Davids *et al*, 2014). Thus, the price of chicken was used to capture the effect of chicken as a substitute to pork meat.

To capture consumers’ changing tastes and preferences, a non-economic factor, the proportion of processed pork was used due to the fact that Oyewumi and Jooste (2006), also cited by Davids *et al* (2014) mention that consumers in South Africa prefer value added pork products unlike fresh pork. On average, 74% of whites and blacks prefer value added pork products while for coloureds and Asians, the mean value lies between 38% and 48% (Oyewumi and Jooste, 2006). Following DAFF (2012; 2015) who posits that the domestic markets’ demand for processed pork ranges between 50 and 55% of total pork production, the volume of processed pork obtained as 0.53 share of the total volume of pork produced. For the case of health and nutrition factors reported by Taljaard *et al* (2006), we use the level of severe malnutrition among children under five years. Choice of this proxy was based on the thinking that households faced with severe malnutrition coupled with little disposable income can readily afford pork since it is regarded as a less costly option (Davids *et al*, 2014), in comparison with other protein sources.

The role of consumer education was captured by using statutory levy expenditure on consumer education with the expectation that the more people are sensitised about pork and the related products, the more they consume it. However, given that people’s change in perceptions and attitudes about a product may occur overtime, a variable for lagged statutory expenditure on consumer education (LNCoEd_1) was also introduced in the model. Without anchoring our analysis on a strong assumption that the variation in peoples living standards will be more equal in the near future as posited by Davids *et al* (2014), we use the average household income as a proxy for disposable income. This is advantageous given that using household income provides a more realistic measure of household’s purchasing power. This paper takes cognisance of the role of the increasing urbanisation and population growth as noted by BFAP (2013b) but due to multicollinearity problems, these factors were not included in the analysis.

Table 2
Descriptive statistics of the variables (quarterly)

<i>Variable</i>	<i>Mean (n=36)</i>	<i>Minimum</i>	<i>Maximum</i>
Consumer education statutory levy expenditure (million R) (CoEd)	2.04	1.08	2.77
Average household income (000’ R) (AY_HH)	34.7	25.9	42.3
Real urban price of pork chops - fresh per/kg (2015=base) (PPrice1)	80.15	70.50	100
Frozen chicken portions mean/kg (R) (CPriceF2)	24.97	22.04	28.98
Real producer prices for porkers (R/kg) (2015= Base) (Pporker_1)	75.78	58.60	100
Severe malnutrition among children under 5 years (HN)	4.72	4.1	5.5
Processed pork (‘000 ton) (Procs)	12.03	2.49	16.23

Source: Authors’ calculations

5. RESULTS AND DISCUSSION

Since all variables were transformed into natural logs, all coefficients are interpreted as elasticities. Our analysis used 35 observations and as indicated by R² statistic, the specified model explains 99% of pork consumption trend in South Africa, meaning that the model's estimates are an excellent fit of the actual consumption values over the period considered in the analysis. According to the Durbin-Watson statistic at 5% significance level, the critical value lies between 0.971 and 2.054 yet the calculated statistic is 0.877, a value less than the critical values. Hence, the series exhibit no autocorrelation.

Table 3 shows the impact of consumer education on pork consumption, among other factors. The estimate (0.045, p<0.001) on consumer education reveals that pork consumption has a statistically significant positive impact on pork consumption. This implies that a unit increase in consumer education expenditure is associated with a 0.045 (less than one) increase in pork consumption, a clear indication that pork consumption is inelastic with respect to changes in statutory levy expenditure on consumer education. In this context, the small but increased pork consumption is due to consumers' better understanding of benefits of pork in contrast to perceived misconceptions that pork is not healthy and too fat, for instance. In addition, consumer education instilled consumers' confidence in pork and its related products, hence the rising per capita consumption levels.

Table 3
Impact of consumer education on pork consumption

<i>Dependent variable = Consumption ('000 ton)</i>			
<i>Variable</i>	<i>Coefficient</i>	<i>Robust Standard Error</i>	<i>t</i>
LNCoEd	0.045***	0.013	3.34
LNCoEd_1	-0.006	0.008	-0.75
LNAY_HH	0.788***	0.099	9.75
LNPPrice1	1.569***	0.281	15.80
LNCPriceF2	-0.786***	0.070	-11.29
LNHN	-0.289***	0.035	-8.19
LNPporker_1	-0.940***	0.125	-7.54
LNProcs	0.027***	0.004	7.43
cons	-4.861***	0.631	-7.70
R-squared	0.991		
Root MSE	0.0096		
Observations	35		
Durbin-Watson test statistic	0.8773		

Source: Authors' calculations

Of the other economic variables, average household disposable income and real urban retail price of pork chops also have statistically significant positive effects on pork consumption while the mean real price of frozen chicken portions (*cheapest alternative source of protein*) and the real producer prices for porkers (*a proxy for production capacity*) exhibit significant deterrent effects on pork consumption. The estimate on the

average household disposable income (0.788, $p < 0.001$) suggests that a unit change in disposable income leads to about 0.79 change in volume of pork consumed, a clear indication that pork consumption is also inelastic to changes in disposable income. The inelastic change in pork consumption in relation to increasing disposable income may be attributed to the fact that some consumers may still have misconceptions about pork and its related products. The positive effect of increasing disposable income on pork consumption identifies with findings by Duffy (1999) who mention that a rise in disposable income generally leads to consumption of more meat products.

For real urban retail price of pork chops, the coefficient (1.569, $p < 0.001$) means that a one percent change in the own price of pork is associated with an increase in pork consumption by slightly over 156%. This finding may be explained by Oyewumi and Jooste's (2006) view that pork is relatively cheaper at producer price level. However, even in instances where value addition has been made on pork, the high quality of derived products suits the consumers' tastes and preferences, hence the increased consumption of pork. A unit change in the mean real price of frozen chicken portions was found to lead to a 0.786 reduction in the volume of pork consumed given that it is the cheapest source of protein in South Africa. This finding relates to Duffy (1999), Oyewumi and Jooste (2006), and Davids *et al.* (2014) who note that consumption of meat (pork) will decline if the price relative to meat substitutes rises.

Similarly, increasing producer prices of porkers lead to a significant decline in the volume of pork consumed by about 94%. This may be attributed to the fact that production costs are high due to the high cost of feeds (BFAP, 2013b), thereby negatively affecting the industry's capacity to supply pork. Louw *et al.* (2013) profiles a detailed account of intricacies in animal feeds' supply chain in South Africa. According to Davids *et al.* (2014), feed costs alone assume about 75% of variable production costs. As posited by Taljaard *et al.* (2006), Oyewumi and Jooste (2006), and Davids *et al.* (2014) that pork consumption is also driven by consumers' tastes and preferences for valued added pork products, the estimate (0.027, < 0.001) indicates that a one percent change in the volume of processed pork and its related products is associated with a 2.7% rise in the volume of pork consumption. This finding strongly affirms that non-economic factors, especially quality are very important drivers of pork consumption in South Africa.

6. CONCLUSION AND RECOMMENDATIONS

Following the enactment of the MAP Act No. 47 of 1996, the pork industry has been spending statutory levies on education consumers about pork and its products since the mid-2000s. Coincidentally, per capita pork consumption has also increased by 17% from 4.1 kg in 2005/06 financial year to 4.8 kg in 2015/16. A number of both economic and non-economic factors are behind the increased consumption but little empirical evidence quantifying the impact of these factors on pork consumption exists. In this paper, we focused on analysing the attribution of consumer education, among other factors on the increasing pork consumption trend. Instrumental variable regression analysis based on a 2SLS estimator was used. Findings reveal that consumer education, proxied by statutory levy expenses on consumer education has an inelastic but statistically significant positive impact on increased pork consumption in South Africa. A unit increase in statutory levy expenditure on pork consumption is associated with a 0.045 increase in pork consumption.

Other economic drivers positively impacting on the increasing pork consumption trend include the rising household disposable income and the real urban retail price of fresh pork chops. The high porker producer prices (*a proxy for the industry's production capacity*) and the price of pork substitutes as protein

sources (mean retail price of frozen chicken portions) negatively impact on pork consumption. Amongst the non-economic factors, the volume of processed products (a proxy for tastes and preferences) has a positive impact on pork consumption while severe malnutrition among children under five years (a proxy for health and nutrition) presents a negative impact on pork consumption.

A number of recommendations are derived from the analysis. First, given the relatively low per capita consumption of pork in South Africa in comparison with other types of meat and at international level (e.g. China, Europe, and USA), there is need to further sensitise the populace about the benefits of pork and its related products to demystify any misconceptions and perceptions. Second, consumer education should focus on the low-income earners given the fact that this segment of the population accounts for only 10% of total pork consumed in the country (BFAP, 2013b). Furthermore, consumers with higher disposable incomes (i.e. middle class) may not necessarily consume more pork even after being educated about it. This school of thought arises from the fact that pork consumption has been noted to be income inelastic (*see*: Duffy, 1999; Nieuwoudt, 1998). Yet according to BFAP (2013b), low income consumers (emerging consumers) are bound to spend a significant proportion of their income on food items, pork and its derived products inclusive.

Third, consideration should be accorded to devising ways of reducing production costs. This could be through policy support in order to ensure increased competitiveness feed production in South Africa. Four, careful consideration should be given to increasing the processing of pork into valued added products so as to cater for consumers' tastes and preference for high quality pork products. Areas for further research in relation to determinants of pork consumption include assessment of consumers' views about how the identified factors affect consumers attitudes towards pork consumption vis-à-vis other meat types with higher per capita consumption levels. A deeper understanding of drivers influencing consumers attitudes about pork consumption might lay a strong foundation for a more effective consumer education initiative. Assessment of consumers' preferences for pork is another area for further research in order to ensure supply of preferred products.

NOTE

1. Bansback (1995), Huston (1999) and Dickinson et al (2003) articulate the role of non-economic factors in influencing meat consumption.

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