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THE INFLUENCE OF DEMAND AND SUPPLY SHIFT FACTORS ON THE SOUTH AFRICAN RED MEAT INDUSTRY

A. Jooste[1] and H.D. van Schalkwyk[1]

In this paper a spatial partial equilibrium (SPE) model is used to determine the impact of changes in population from a "with" and "without" HIV/AIDS point of view, as well as changes in per capita income. The possible impact of abolishing the Lomé Convention is also investigated. In a "Without HIV/AIDS" population growth scenario demand for beef, sheep meat and pork will increase by 12.01 per cent, 12.22 per cent, and 11.92 per cent, respectively. In a "With HIV/AIDS" population growth scenario demand will only increase by 7.19 per cent, 7.31 per cent and 7.28 per cent for beef, sheep meat and pork, respectively. Most of the increase in demand is met by overseas imports. When per capita income increases the increase in pork consumption is lower than the increases in demand for beef and sheep meat. This can be attributed mainly to the fact that the aggregated income elasticity is considerably lower for pork than it is for the other two red meats. The welfare analysis shows, firstly that HIV/AIDS will have a considerable impact on the general welfare of the country, and secondly the important role government has to play in setting the table for improved economic conditions that will result in increases in the per capita income of people. Finally, the study shows that the abolishment of the Lomé Convention will not have any severe repercussions for the beef sub-sector in South Africa.

1. INTRODUCTION

Changes in agricultural policy, domestic deregulation, international liberalisation, the move towards economic integration and various other socio-economic changes, such as population growth and increased economic growth, will undoubtedly influence the way that the agricultural market in South Africa operates.

Within this environment, producers, agri-business, policy makers and consumers have to take decisions that will ultimately affect their future. One of the major problems is the lack of reliable and timely information on market variables, and probably more importantly, the absence of information on how markets will react to different socio-economic changes. Not only are producers, agri-business and consumers dependent on this information to position themselves strategically, but policy makers need this information to guide policy, to negotiate trade

[1] *Department of Agricultural Economics; University of the Free State, P O Box 339, Bloemfontein 9300.*

agreements and to create an environment for the improvement of general welfare.

In this paper a spatial partial equilibrium (SPE) model is used to determine the impact of demand and supply shift factors on red meat prices, as well as the associated changes in welfare. As far as demand shift factors are concerned, this article investigates the impact of changes in population from a "with" and "without HIV/AIDS" point of view. Due cognisance is also taken of possible changes in per capita income. In terms of supply shift factors the possible impact of abolishing the Lomé Convention is investigated.

2. METHODOLOGY AND DATA USED

The SPE model used distinguishes between cattle, sheep and pigs as primary products, and beef, mutton and pork as secondary products. Products from different regions are assumed to be perfect substitutes, and consequently buyers are assumed to be indifferent as to the sources of supply.

The model consists of 12 regions among which livestock and meat are shipped. Eleven are classified as domestic regions and one as a foreign region. Domestic regions consist of the Western Cape, Eastern Cape, Kwazulu-Natal, Northern Cape, North West, Free State, Gauteng, Mpumalanga and Northern Province. Namibia and Botswana are also regarded as part of the domestic regions. Foreign regions consist of a Rest-of-the-World component. In addition three transit points, namely Cape Town Harbour, Port Elizabeth Harbour and Durban Harbour are included. Production is assumed to originate at a single location in each region (except in the transit regions). Likewise, consumption and processing are assumed to occur at a specific location. Within the current modelling framework, production, consumption and processing are assumed to take place at the same location and correspond to that used by Jooste (1996). This convention was also adopted by Wallace and Judge (1959), Bawden (1966), Commer (1991), Halbrendt, Jundong, Aull-Hyde and Webb (1995) and Yavuz, Zulauf, Schnitkey, and Miranda (1996).

Herd numbers, slaughtering of animals and demand data were obtained from the Meat Board (1997), SAMIC (2000) and the NDA (2000). From this, domestic regional off-take rates were calculated to account for differences in commercial and non-commercial slaughtering, as well as imports from Namibia. Regional off-take rates were then used to arrive at livestock supply per province. Demand for different red meats per province was also calculated to reflect differences in consumption patterns between different population groups (see Nieuwoudt, 1998 for a detailed discussion of these differences).

Since the model used in this study is based on the Takayama and Judge (1971) approach to calculating a net quasi-welfare function, the construction of demand and supply functions were specified accordingly. Demand and supply elasticities for South Africa as a whole were taken from Nieuwoudt (1998).

Furthermore, the model is designed to determine, for each area, equilibrium quantities produced and consumed, prices, and imports or exports for each commodity. These are obtained by a welfare function that maximises consumer and producer welfare, whilst accounting for transport cost and tariffs. The welfare function to be maximised is denoted as follows:

$$W(QD^{is}, OS^{ip}, QC^i) = [\sum_{i=1}^{n} \lambda^{is} QD^{is} - \tfrac{1}{2}\omega^{is}(QD^{is})^2 - \alpha^{ip}QS^{is} - \tfrac{1}{2}\beta^{ip}(QS^{ip})^2$$

$$- \theta^i QC^i - \tfrac{1}{2}\nu^i (QC^i)^2] - \sum_{r,rl=1}^{n} X^i \times (TC^i + Tariff^i)$$

where:

W denotes the welfare function dependent on demand quantity QD^{is}, supply quantity QS^{ip} and quantity converted QC^i

λ^{is} and ω^{is} denotes the intercept and slope coefficients respectively for the demand function of secondary commodity *is* in region *r*.

α^{ip} and β^{ip} denotes the intercept and slope coefficients respectively for the supply function of primary commodity *ip* in region *r*.

θ^i and ν^i denotes the intercept and slope coefficients respectively for the demand and supply functions of primary and secondary commodities in the processing sector in region *r*.

X^i denotes the variable quantity of a commodity *i*, shipped between regions.

TC^i denotes the transport cost of commodity *i*, shipped between regions.

$Tariff^i$ denotes the tariff applied on imported commodity *i*.

It is assumed that no stock is carried from one year to the next. In addition, imposed constraints are that total production and consumption must be equal, and that each region's imports or exports must be consistent with the net difference between domestic consumption and production in the base year.

3. IMPACT OF AN INCREASE IN POPULATION ON THE RED MEAT INDUSTRY

In this section the impact on the red meat industry of population growth until 2004 is investigated. Due cognisance is also taken of the possible impact of HIV/AIDS on population growth. The reason for using 2004 in particular is that a recent study by Balyamujura, Jooste, Van Schalkwyk, Geldenhuys, Crew, Carstens, Bopape and Modiselle (2000) has estimated the divergence between population growth rates from a "With HIV/AIDS" and "Without HIV/AIDS" point of view in this year.

Cognisance should be taken of the fact that this section only uses total population figures, i.e. no distinction is made between different population groups. The reason for this stems from the fact that there is a paucity of data regarding the divergence between population growth rates per population group from a "With HIV/AIDS" and "Without HIV/AIDS" point of view. Using the ASSA 600 model Balyamujura *et al* (2000) estimated the possible impact of HIV/AIDS on population growth rates for 2004. Maintaining the present level of HIV/AIDS infection, South Africa's population would be 48,5 million in 2004. From a "Without HIV/AIDS" point of view, the population would have been 50,5 million people. This translates into a 4.96 per cent difference in the growth of the population. This deviation in population growth rates was used in this study to reflect the impact of HIV/AIDS on the consumption of red meat in South Africa for 2004. Since 1996 is used as base year, population growth had to be calculated from 1996 to 2004. In this regard population estimates by Van Aardt, van Tonder and Sadie (2000) was used. They estimated the population growth rate between 1996 and 2004 at 12.7 per cent.

The possible changes of per capita income on the red meat industry were also be investigated. Van den Berg (1996) as cited by Nieuwoudt (1998) showed that under a scenario of total income growth of 3 per cent and 5 per cent, the per capita incomes of various population groups are expected to increase. Nieuwoudt (1998) also cited McGrath (1996) and Spies (1996) with respect to changes in real per capita income growth under different scenarios. It was, however, decided to use the estimates by Van den Berg (1996) since it distinguishes between the different population groups, i.e. his estimates indicate different increases in real per capita income for all the different population groups. This is important since consumption patterns vary between different population groups, and hence different population groups will also use increases in per capita income differently when purchasing food (red meat). In other words, the income elasticity of red meat in respect of the demand for different red meat products by different population groups is an important factor when estimating the response

of consumers when their incomes change. Nieuwoudt (1998) pointed out that income elasticities of pork for blacks are low. The implication of this is that a very small proportion of increases in the per capita income of blacks will be used to purchase additional pork on a per capita basis. Since this study only accounts for total population it was necessary to derive aggregated (weighted) income elasticities for the different red meats. This was done by using the ratio between total expenditure per product group and the expenditure per population group. The calculated aggregated income elasticities for beef, pork and sheep meat are 0.77, 0.28 and 0.79 respectively, and was used in this study.

Table 1 shows the impact of population growth on the red meat industry. As stated two different population growth rates were used to gauge the possible impact of HIV/AIDS. In the "Without HIV/AIDS" scenario demand for beef, sheep meat and pork will increase by 12.01 per cent, 12.22 per cent, and 11.92 per cent, respectively. In the "With HIV/AIDS" scenario demand will only increase by 7.19 per cent, 7.31 per cent and 7.28 per cent for beef, sheep meat and pork, respectively. It should also be noted that the increase in demand for the different red meat products is only met marginally by increases in domestic supply. Most of the increase in demand is met by overseas imports. Similar results were found by Nieuwoudt (1998). Imports of beef from overseas will increase from 47 135 tons to 106 793 tons in the "without HIV/AIDS" scenario. In terms of pork and sheep meat, imports will increase with 11 820 tons and 14 475 tons, respectively in the "Without HIV/AIDS" scenario. In the "With HIV/AIDS" scenario imports will also increase, but to a lesser extent.

Table 1:   **Impact of population growth on the red meat industry (2004)**

Product	Base run	Scena-rio	Change	Base run	Scena-rio	Change	Base run	Scena-rio	Change
	Supply (tons)			Demand (tons)			Price (R/kg)		
Growth in population (without HIV/AIDS) (12.7%)									
Beef	394077	394720	0.16%	454573	509150	12.01%	12.74	12.83	0.64%
Sheep meat	86845	86887	0.05%	117158	131474	12.22%	16.79	16.81	0.15%
Pork	128667	128894	0.18%	139576	156213	11.92%	10.42	10.45	0.28%
Growth in population (With HIV/AIDS) (7.74%)									
Beef	394077	394591	0.13%	454573	487272	7.19%	12.74	12.81	0.48%
Sheep meat	86845	86883	0.04%	117158	125728	7.31%	16.79	16.81	0.13%
Pork	128667	128803	0.11%	139576	149742	7.28%	10.42	10.45	0.21%

Furthermore, prices of red meat on the domestic market only show marginal increases. The reason for this state of affairs is the fact that red meats have relatively low supply elasticities as a result of its biological production attributes and are hence not able to respond to increases in demand as rapidly as might be

desirable. Furthermore, cognisance should be taken of the fact that domestic prices are also a function of international prices, i.e. any expected increase in domestic prices due to an increase in demand will be dampened by the level of international prices. This also results in supply increases not being as high as might be expected since prices for red meat on the domestic market only increases marginally.

Table 2 shows the impact of an increase in per capita income on the red meat industry. Demand increases is as expected. Note that the increase in pork consumption is lower than the increases in demand for beef and sheep meat. This can be attributed mainly to the fact that the aggregated income elasticity is considerably lower for pork than it is for the other two red meats, for reasons already explained. As was the case in the population growth scenario, there is limited supply response domestically and therefore the increases in demand are met mainly by imports. For example, in the case of a per capita income increase of 3.18 per cent, beef, sheep meat and pork imports from overseas will increase by 9 296 tons, 2 923 tons and 1 196 tons respectively. These imports are destined mainly for the Gauteng market and coastal areas. Prices also change marginally, if at all, due to the fact that most of the demand increases are met by imports.

Table 2:   **The impact of different per capita income growth scenarios on the red meat industry**

Product	Base run	Scenario	Base run	Scenario	Change	Base run	Scenario
	Supply (tons)		Demand (tons)			Price (R/kg)	
Growth in income of 3.18 percent							
Beef	394077	394521	454573	463636	1.99%	12.74	12.80
Sheep meat	86845	86847	117158	120081	2.49%	16.79	16.79
Pork	128667	128675	139576	140780	0.86%	10.42	10.43
Growth in income of 5.35 percent							
Beef	394077	394575	454573	470975	3.61%	12.74	12.81
Sheep meat	86845	86859	117158	121900	4.05%	16.79	16.79
Pork	128667	128707	139576	141480	1.36%	10.42	10.43

Table 3 shows the changes in welfare in the red meat sector attributable to an increase in the population and per capita income. It is clear that consumer surplus will increase substantially when there is growth in population. Notable, however, is the difference between consumer surplus in a "Without HIV/AIDS" and "With HIV/AIDS" scenario. This clearly shows that HIV/AIDS will have a considerable impact on the general welfare of the country. Obviously, this impact will be much greater when other sectors are also accounted for. The difference in

the increase in welfare when per capita income increases by 3.18 per cent and by 5.35 per cent clearly shows the important role government has to play in setting the table for improved economic conditions that will result in increases in the per capita income of people.

Table 3: The impact of different scenarios pertaining to population growth and increase in per capita income on welfare (R million)

Different scenarios	Consumer surplus	Producer surplus
	Increase (R million)	
Growth in population of 12.7% without HIV/AIDS	377	19
Growth in population of 7.74% with HIV/AIDS	223	15
Growth in per capita income of 3.18%	53	11
Growth in per capita income of 5.35%	100	13

- *Lomé*

According to Corbett (2000) the Lomé Convention grants free entry to European markets on a non-reciprocal basis for a wide range of products from the ACP countries. The EU offered South Africa a qualified membership in the Lomé Convention that came into force following the approval of the ACP/EU Council in April 1997, and after the ratification of the Lomé IV in May 1998. It should be noted that, although several articles within the framework of the Convention is applicable to South Africa, special protocols on bananas, rum, beef and veal, sugar, coal and steel products were not afforded to South Africa. However, the protocol on beef is applicable to several of South Africa's neighbouring countries and could have an influence on the South African red meat industry should the Lomé be abolished.

Table 4 shows historical trends in EU imports of boneless beef from ACP countries free of customs duties and at a reduced rate of the EU import tariff. It is clear that in most years the mentioned countries were not able to fulfill their quotas, except Zimbabwe, who exported well over its quotas in 1994 and 1995. It should also be noted that if any ACP country is not able to supply its annual quota, a decision may be taken to allocate the quantities between the other states concerned, up to a limit of 30 000 tons, for the same or the following year. The other interesting thing is that, in total, the quotas exported to the EU declined continuously from 1994. This can be attributed to, amongst other factors, the stringent health regulations applied by the EU, e.g. the stringent animal health

rules of the EU have on several occasions led to the suspension of beef exports, in particular from Botswana and Swaziland. Zimbabwe has also had problems with health regulations applicable to beef exports to the EU (CAP-monitor, 1995).

Table 4: EU beef imports (tons) from ACP states (1994 - 1998)

Year	Total	Botswana	Namibia	Mada gascar	Swazi-land	Zimbabwe
Allocated quota	52 100	18 916	13 000	7 579	3 363	9 100
1994	42 484	12 425	11 087	2 087	642	16 242
1995	41 146	16 521	12 369	4 024	720	10 512
1996	31 298	11 511	9 770	1 753	533	7 753
1997	25 181	10 670	6 026	435	225	7 825
1998	26 302	11 859	8 292	15	149	5 986

Source: Bruwer, 2000

In this paper a scenario is tested for which Namibia and Botswana are no longer afforded their preferential access to the EU market, in order to determine the impact on the South African beef industry. The underlying assumption of this scenario is that both these countries decide to export their surplus beef (Lomé quotas) to South Africa over the short run, i.e. processing of beef still resides in the countries mentioned whilst they investigate other markets for exports. Table 5 shows the results.

Table 5: Impact of the abolishment of Lomé on the South African beef industry

Primary industry	Base run	Scenario	Change	Base run	Scenario	Change	Base run	Scenario	Change
	Supply (numbers)			Demand (numbers)			Price (R/kg)		
Cattle	1972749	1971620	-0.06%	2251875	2252596	0.03%	7.56	7.54	-0.18%
Secondary industry	Supply (tons)			Demand (ton)			Price (R/kg)		
Beef	394077	393829	0.02%	454573	456953	0.11%	12.74	12.73	-0.15%

It is clear that the effect on the South African market is minimal. Prices of beef and cattle reduce by less than 0.5 per cent. It should also be noted that these two countries could export beef free of tariffs to South Africa. Thus, increased imports from these two countries will not have any effect on the marginal tariff level at the levels used in this scenario, and hence the relatively small effect on domestic beef prices.

4.   CONCLUSION

This paper shows that growth in population is a more important determinant of growth in demand for red meats than growth in per capita income, or at least concerning the short to medium term. Secondly, increases in demand are mainly met by overseas imports due to the inherent slow supply response of the industry over the short to medium term. However, an important issue of which cognisance should be taken, is that off-take rates in the developing sector are very low, i.e. should the developing sector be in a position to increase its off-take rate it could take advantage of the increase in demand. Hence, given the expected increases in the demand for red meat in South Africa, government and the private sector should seriously consider additional programmes and initiatives to improve productivity (off-take) in the developing red meat industry. This can, however, not take place in isolation. The red meat industry needs to consider the efficiency of the red meat value chain and ways to improve the image of red meat amongst consumers.

Finally, the study shows that the abolishment of the Lomé Convention will not have any severe repercussions for the beef sub-sector in South Africa.

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