IMPACT ON SOUTH AFRICAN MEAT DEMAND OF A POSSIBLE FREE TRADE AGREEMENT WITH THE EUROPEAN UNION

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The Rotterdam model is used to estimate a demand system for South African (SA) beef, chicken, mutton and pork during 1971-1995 and identify the potential impacts on demand for these meat types of a Free Trade Agreement (FTA) between SA and the European Union. Conditional cross-price Slutsky elasticity estimates show that for a given 1% change in each meat price under an FTA, the beef price change would have the largest impact on consumption of the other meats. The net effect of the FTA would depend on the extent to which different meat prices fall if meat imports increase. Import competition may be felt particularly from poultry imports as most of SA beef imports are of a low quality.

DIE IMPAK VAN 'N MOONTLIKE VRYEHANDELSOOREENKOMS MET DIE EUROPESE UNIE OP DIE VRAAG NA VLEIS IN SUID-AFRIKA

Die Rotterdam model is gebruik om 'n vraagsisteem vir Suid-Afrikaanse (SA) bees-, hoender -, skaap- en varkvleis vir die 1971-1995 periode te skat en die potensiële impakte van 'n vryehandelsooreenkoms (VHO) tussen SA en die Europese Unie op die vraag na hierdie vleissoorte te identifiseer. Voorwaardelike beramings van kruiselingse pryselastisiteite toon dat vir 'n gegewe 1% verandering in elke vleisprys onder 'n VHO, die beesvleisverandering die grootste impak op die verbruik van die ander vleissoorte sal hê. Die netto-effek van die VHO sal afhang van die mate waartoe verskillende vleispryse sal val indien vleisinvoer toeneem. Invoermededinging mag ervaar word, veral van pluimvee-invoere aangesien meeste SA beesvleisinvoere van 'n lae gehalte is.

1. INTRODUCTION

A key trade issue facing South African (SA) policymakers is the impact on local meat demand of a Free Trade Agreement (FTA) which is currently being negotiated between SA and the European Union (EU). Beef imports from the EU in 1995 rose to 41 000 tons, up from 3 500 tons in 1992. Past research by Hancock *et al*. (1984), Uys (1986), and Van Heerden *et al*. (1989) has estimated demand for meat and investigated meat price inter-relationships and price leadership in SA. This study complements past work by presenting the first published empirical work to quantify the potential impact of a possible FTA on the SA meat sector. South Africa is a net importer of red meat and periodically imports chicken. A substantial volume of total SA beef, pork, and

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chicken imports is from the EU, while mutton imports from overseas (excluding Botswana, Lesotho, Namibia and Swaziland (BLNS)) come mainly from Australia. Beef and pork imports are mainly of manufacturing grades used for processed meat, while chicken and mutton imports are for direct consumption. Conversely, SA exports high quality beef cuts to its neighbouring countries (Wessels, 1996). South Africa's import tariff structure for the livestock industry is far below the agreed bound rate required by the World Trade Organization. Import tariffs have been reduced to 40%, 27%, 40% and 15% for beef, chicken, mutton and pork, respectively.

An eventual FTA between SA and the EU could encourage the expansion of meat trade which will particularly affect the quantity of beef, chicken and pork meat available in the local market. Given that SA markets for beef, chicken, pork, and mutton are interrelated (Uys, 1986), changes in particular meat imports would probably cause the prices of all meats to change simultaneously over time. To analyze this issue, the study will estimate a meat demand system for SA by using the Rotterdam model (Theil, 1978). The estimated cross-price elasticities of meat demand will then be used to quantify the potential impacts on demand for these meat types of the likely outcomes of the FTA negotiations. These outcomes include a full reduction of current meat import tariffs and/or reduction in EU meat export subsidies. The extent of the reduction depends on the EU's meat export zone classifications. The EU presently regards SA as a non-meat producer/ importer who was, up until February 1997, classified in zone 2 and 8 where the highest beef export subsidies are paid. South Africa was thereafter reclassified from zone 8 to 9 which involved a mere 10% subsidy reduction on a particular beef cut (boneless individually wrapped) only. Had SA been regarded as a meat producer/importer she would be in zone 4 where the lowest export refund applies (Otto, 1997). The paper first summarizes trends in SA meat production, consumption and trade and then outlines the Rotterdam meat demand system. The last two sections outline model results and policy implications.

2. TRENDS IN SOUTH AFRICAN MEAT PRODUCTION, CONSUMPTION AND TRADE

Some 85% of SA farm land is covered by natural grazing which offers very few alternatives to red meat production (Nieuwoudt, 1997). Low and intermittent rainfall cause red meat production to fluctuate and the need for SA to import red meat. Subsidies on meat imports to SA from major trading partners, especially the EU, prompted the SA government to adopt measures like import tariffs to protect local meat producers. Over the period 1990-1995,

beef production declined from 644000 to 520000 tons and beef imports increased from 65000 to 106700 tons. During severe drought, the supply of beef and mutton increases and overseas imports decline, while the opposite holds true after drought as herds and flocks are rebuilt. Meat imports come mainly from BLNS countries and the EU. Per capita beef consumption fell sharply from 23.57 kg/year to 14.56 kg/year during 1971-1995, while real average retail (RAR) price rose from R9.60/kg to R12.60/kg. The increase in the RAR price of beef relative to that of chicken has most probably led to lower per capita beef consumption. Consumers may permanently reduce beef consumption as they acquire a taste for chicken and learn new chicken recipes (habit formation), and also perceive beef as containing higher cholesterol.

The annual production of chicken increased markedly during 1971-1995 from 140000 to 736000 tons and per capita consumption tripled from 5.85 kg/year to 18.97 kg/year, probably due to the fall in the price of chicken relative to beef and mutton prices. The RAR price of chicken fell from R6.50/kg in 1971 to R5.00/kg by 1990. However, from 1990 to 1995 it rose by about 20% to R5.90/kg, possibly due to Newcastle disease and labour strikes in the poultry industry. Up until 1984, SA was a net exporter of chicken but thereafter became an importer, mainly from the EU, Canada and Hungary. Chicken imports increased rapidly from 2000 tons to 55000 tons during 1990-1995. The import tariff on frozen chicken (not cut into pieces) was reduced to 27% in 1995 (Sutton, 1995).

As is the case with beef, mutton production oscillated during the 1971-1995 period. From 1991 to 1995 annual production fell by 40%, probably due to climatic variations, a lower wool price and theft which forced farmers in some regions to withdraw from mutton production (Standard Bank, 1996). Domestic production is also affected by declining per capita mutton consumption which fell from 9.12 kg/year in 1971 to 3.59 kg/year in 1995. The RAR price rose from R8.50/kg to R13.00 over 1971-1995. During this period, imports of mutton rose nine-fold, with the major increase occurring over 1990-95 (mainly from BLNS countries and Australia), possibly due to a reduction in import tariffs to 40% (Sutton, 1996).

The total production of pork rose from 77000 tons in 1971 to 121000 tons in 1995, with per capita consumption fairly stable at about 3.20 kg/year, while RAR prices fell slightly from R9.65/kg to R9.30/kg. The volume of pork imports, which come from the EU, America and Thailand increased from 4000 tons to 14900 tons during 1991-1995, probably due to import tariffs being lowered to 15% (Sutton 1996). Note that up until 1986, SA was a net exporter of pork.

3. RESEARCH METHODOLOGY

The absolute price version of the Rotterdam model is used to estimate demand equations for the four SA meat types simultaneously in terms of changes in budget share allocations, based on utility-maximization subject to a budget constraint. Following Theil (1978), the model assumes block-independent preferences which imply that the consumer first determines expenditure on meat as a group, and then allocates expenditure to beef, chicken, mutton and pork, which shape the group, based on relative prices. The estimated demand interrelationships for beef, chicken, mutton and pork under block-independence are known as 'conditional' because they depend on the level of expenditure allocated to meat as a group. The Rotterdam model for the four conditional SA meat demand equations is written as:

$$\frac{\overline{w}_{it}}{\overline{W}_{gt}} Dq_{it} = c + \frac{\mu_i}{M_g} DQ_{gt} + \sum_{j=1}^{4} \pi^*_{ij} Dp_{jt} + \varepsilon^*_{it} \qquad (3.1)$$

where:

$\overline{w}_{it}$ = $(w_{i,\ t-1} + w_{it})/2$ (average budget share of meat i (w_i) over periods t and t - 1),
$\overline{W}_{gt}$ = $(W_{g,\ t-1} + W_{gt})/2$, (average budget share of all meats (W_g) over periods t and t - 1),
g = all four meats as a group,
i, j = individual meat (1 = beef, 2 = chicken, 3 = mutton and 4 = pork),
Dq_{it} = log $(q_{it}/q_{i,\ t-1})$ (log change in per capita consumption of meat i (q_i) over periods t and t -1),
t = time (in years),
c = constant term
DQ_{gt} = sum of $(\overline{w}_{it} / \overline{W}_{gt})Dq_{it}$ over all i meats,
μ_i = marginal share of meat i,
M_g = sum of marginal shares over all i meats,
μ_i/M_g = conditional marginal share of meat i,
Dp_{it} = log $(p_{it}/p_{i,\ t-1})$ (log change in average retail price of meat i (p_i) over periods t and t - 1),
π^*_{ij} = conditional Slutsky price coefficients of meat i,
ε^*_{it} = disturbance term of the meat i equation.

The model therefore effectively estimates changes in the conditional budget share of each meat as a function of changes in expenditure on the meat group

and changes in the prices of all the meats. The conditional marginal share, μ_i/M_g, answers the following question: if income increases by one *rand*, so that an additional amount M_g is spent on meat as a group, what proportion of this amount is allocated to the *i*th meat? Each conditional Slutsky coefficient, π^*_{ij}, measures the effect of a change in the *j*th meat price on the demand for the *i*th meat when prices of all other meats and the volume index of meat (DQ_{gt}) as a group remain constant. The Rotterdam model satisfies the negativity condition ($\pi_{ij} < 0$), and the adding-up condition (the μ_i/M_g's sum to one). The coefficients $\mu_i / M_g, \pi^*_{i1}, \pi^*_{i2}, \pi^*_{i3}$ and π^*_{i4} are estimated by Generalized Least Squares regression of $(\overline{w}_{it} / \overline{W}_{gt})Dq_{it}$, on the four right-hand variables in (3.1) after imposing Slutsky symmetry ($\pi_{ij} = \pi_{ji}$) and the homogeneity condition (the π^*_{ij}'s sum to zero) using SHAZAM (1997). The π^*_{ij} (for $i = j$) coefficient should be negative, while all the other coefficients should be positive if beef, chicken, mutton and pork are substitutes in consumption. The constant term, *c*, captures the systematic effect of factors (e.g. habit formation) other than income and prices on the demand for the *i*th meat. These estimates can then be used to estimate the conditional income elasticity of the *i*th meat within the group, I_i, and the conditional Slutsky elasticities (cross-price elasticity proxies) for the *i*th meat within the group, S_{ij}, as (Theil 1978):

$$I_i = \frac{\mu_i / M_g}{\overline{w}_{it} / \overline{W}_{gt}} = \frac{\mu_i / \overline{w}_{it}}{M_g / \overline{W}_{gt}} \qquad S_{ij} = \frac{\pi^*_{ij}}{\overline{w}_{it} / \overline{W}_{gt}} \qquad (3.2)$$

The I_i estimate is equivalent to the ratio of the income elasticity of the *i*th meat to the income elasticity of meat as a group and shows which of the meats in the group are luxuries or necessities. The S_{ij} estimates the proportionate effect of a change in price of the *j*th meat on the demand for the *i*th meat when the demand for the group is unchanged ($DQ_{gt} = 0$) and prices of the other meats are constant. These estimates will give SA policymakers information on which meat price changes following increased meat imports under an FTA would have the largest relative impacts on demands for individual meats.

The system data consist of annual per capita consumption of beef, pork, chicken and lamb (Sharneck, 1996); annual average retail prices (Central Statistical Services, various issues) and per capita SA disposable income (Jansen, 1997) for the period 1971-1995. This period is chosen since there was a change in the response panel reporting to the Central Statistical Services in 1970, so that data prior to, and after, 1970 are not strictly comparable (Uys, 1986).

4. EMPIRICAL RESULTS

The calculated systemwide R^2 of .80 (McElroy, 1977), indicates a reasonably good model fit. The *runs* test confirmed that the model was free of autocorrelation at the 5% level. This is not surprising since the Rotterdam model fits data in first differences. The constant terms, symmetry-constrained conditional marginal shares and Slutsky parameter estimates (respective *t*-ratios in parentheses) are presented in Table 1. Using the Wald χ_2 test statistic, the cross-price Slutsky coefficients (π_{ij}'s) were statistically symmetrical at the 10% level.

Table 1: Estimated conditional marginal shares & Slutsky coefficients of SA meats

	Constant	μ_i/M_g	π_{i1}	π_{i2}	π_{i3}	π_{i4}
Beef	-.342 (-1.74)	.664 (13.59)	-.246 (-6.37)	.079 (3.43)	.133 (4.40)	.034 (2.44)
Chicken	.764 (3.69)	.069 (1.35)		-.066 (-2.75)	-.005 (-.19)	-.008 (-.78)
Mutton	-.391 (-1.44)	.234 (3.59)			-.132 (-3.36)	.004 (.28)
Pork	-.005 (-.07)	.040 (1.92)				-.030 (-1.93)

The constant terms show that even if meat prices and income do not change, per capita beef and mutton consumption will fall while that of chicken will rise. All marginal share estimates are positive and own-price parameters for all four meats are negative as expected. The signs of the π_{ij}'s indicate substitution between beef and chicken, mutton and pork in consumption. Most of the *t*-ratios are statistically significant at least at the 15% level. Estimates of conditional income elasticities for meats shown in the first column of Table 2 exceed one for beef and mutton, indicating that these meats are luxuries within the meat group while the opposite holds for chicken and pork.

The conditional Slutsky elasticity estimates indicate that a 1% change in beef price, following an FTA between SA and the EU, would have relatively greater impact on the consumption of other meats than would 1% changes in chicken, mutton or pork prices. For example, a 1% fall in beef price would cause chicken consumption to fall by 0.43%, while a 1% fall in chicken price would reduce beef consumption by only 0.14%. A major cause is that beef

Table 2: Conditional Income and Slutsky Elasticity Estimates of SA Meats[1]

		Conditional Slutsky elasticity with respect to the price of			
	Conditional income elasticity	*Beef*	*Chicken*	*Mutton*	*Pork*
Beef	1.16	-0.43	0.14	0.23	0.06
Chicken	0.37	0.43	-0.36	-0.02	-0.04
Mutton	1.42	0.81	-0.03	-0.81	0.02
Pork	0.51	0.45	-0.10	0.05	-0.39

[1] *Elasticity estimates are calculated at the sample mean*

accounted for a much greater proportion of *average* annual meat expenditure (57%) than did chicken (19%), mutton (16%) or pork (8%) during 1971-1995. However, the conditional budget shares of beef and mutton fell from 61.3% and 19.6% in 1971 to 50.8% and 12.8% in 1995, while that of chicken rose from 10.9% in 1971 to 28.4% in 1995. This indicates that if chicken continues to gain a greater share of annual meat expenditure at the expense of beef and mutton, the effect of a change in its price on consumption of other meats will grow. The net impact of an FTA will depend on which meat imports increase and by how much they would depress local meat prices. As most SA beef imports from the EU are of low quality and fill a need in the local market, competition from EU imports may be mainly from poultry (Nieuwoudt, 1997). Note that the conditional own-price Slutsky (compensated) elasticity estimate which assumes real income is unchanged, is smaller in absolute terms than the conventionally reported uncompensated own-price elasticity estimate which holds nominal income constant.

5. CONCLUSION AND POLICY IMPLICATIONS

This study examines the impacts on SA meat demand of a potential FTA between SA and the EU using the Rotterdam model. The conditional income elasticity estimates show that during 1971-1995, beef and mutton were luxuries while chicken and pork were necessities. Per capita consumer demand for beef and mutton seems to be falling while demand for chicken seems to be increasing (even if income and meat prices are unchanged). Conditional cross-price Slutsky elasticity estimates show that for a given 1% change in each meat price, the beef price change would have the largest

impact on consumption of other meats. If beef imports rise following an FTA, domestic beef prices would fall and consumption of beef would rise causing the demand for, and prices of, other meats to fall. If consumers, over time, then shift from beef to, say, chicken, the beef price will fall even further.

The net short term effect of the FTA on SA meat consumers would depend on the extent to which different meat prices change if SA is reclassified in zone 4 (where the lowest beef export refunds are paid by the EU) and if import tariffs on meat are reduced. Future import competition may be felt particularly via poultry imports and chicken price changes, as most of SA beef imports are of a low quality, although recent concern has been over high quality EU beef imports (especially from Ireland). Moreover, short-term benefits of (possible) lower prices to consumers from an eventual FTA must be weighed against potential long-term loss of investment in the domestic livestock industry. Finally, since the model specified in this study focuses on the demand side while the supply side is not explicitly recognized, an extension of this research to a general demand-supply equilibrium model would identify impacts of the FTA on SA meat producers.

REFERENCES

CENTRAL STATISTICAL SERVICES (Various Issues). *South African statistics*. Pretoria : Department of Statistics.

HANCOCK P.J., NIEUWOUDT W.L., & LYNE M.C. (1984). Demand analysis of meats in South Africa. *Agrekon*, 23(2):26-29.

JANSEN Z. (1997). *Personal communication*. Pretoria : South African Reserve Bank.

JOHNSON S.R., HASSAN Z.A. & GREEN R.D. (1984). *Demand systems estimation : Methods and applications.* Ames : The Iowa State University Press.

McELROY, M.B. (1977). Goodness-of-fit for seemingly unrelated regressions. *Journal of Econometrics*, 6:381-87.

NIEUWOUDT, W.L. (1997). *Personal communication.* Professor and Head, Department of Agricultural Economics, Pietermaritzburg :University of Natal.

OTTO R.J. (1997). *Personal communication.* Pretoria : National Department of Agriculture.

SCHARNECK, N. (1996). *Personal communication*. Pretoria : Directorate : Agricultural Statistics and Management Information, National Department of Agriculture.

SHAZAM. (1997). *User's reference manual Version 8.0*. McGraw Hill, Canada.

STANDARD BANK. (1996). *AgriReview*. Agricultural Department, Standard Bank of South Africa.

SUTTON, B. (1996). *Personal Communication.* Durban : Department of Trade and Industry.

THEIL, H. (1978). *Introduction to econometrics.* Englewood Cliffs : Prentice-Hall Inc.

UYS, P.W. (1986). Demand for meat in South Africa : A non-additive dynamic linear expenditure model. *South African Journal of Economics*, 54(2):207-219.

VAN HEERDEN, A.F., VAN ZYL, J. & VIVIER, F.L. (1989). Price inter-relationships in the South African meat market II : An empirical application. *Agrekon*, 28(1):71-76.

WESSELS, W. (1996). *Personal communication.* Pretoria : South African Meat Board.