DEMAND AND SUPPLY FACTORS IN THE EXPORT OF SOUTH AFRICAN FRESH ORANGES TO THE UNITED KINGDOM: 1976-1993

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Two Stage Least Squares and principal component analysis were used to estimate the export demand and supply of South African (SA) fresh oranges in the United Kingdom (UK) during 1976-1993. Export demand was negatively related to the SA fresh orange price relative to the price of fresh oranges from Israel, and positively related to lagged orange exports (consumer brand loyalty proxy). Export supply was positively related to lagged net export realisation price relative to domestic orange price, the SA fresh orange price in the UK relative to the SA fresh orange price in France, lagged exports (export orientation), and supply shocks. The relative price elasticity of export demand was inelastic in both the short- and long-run, indicating that Capespan International and other future exporters may need to diversify fresh orange exports to alternative export markets to increase real revenue. Long-run export supply was inelastic with respect to relative price, implying that if SA fresh orange exports are included in a Free Trade Agreement with the EU, they are unlikely to have a marked adverse affect on EU fresh orange producers.

VRAAG- EN AANBODFAKTORE IN DIE UITVOER VAN SUID-AFRIKAANSE VARSLEMOENE NA DIE VERENIGDE KONINKRYK : 1976-1993

Tweestadium kleinste kwadrate en hoofkomponentanalise is gebruik om die uitvoervraag en -aanbod van Suid-Afrikaanse (SA) vars lemoene in die Verenigde Koninkryk (VK) vir die periode 1976-1993 te skat. Uitvoervraag was negatief verwant aan die prys vna SA varslemoene relatief tot die prys van varslemoene uit Israel, en positief verwant aan gesloerde lemoenuitvoere (fopveranderlike vir verbruikers se handelsmerklojaliteit). Uitvoeraanbod was positief verwant tot die gesloerde netto uitvoerprys relatief tot plaaslike lemoenprys, die SA varslemoenprys in die VK relatief tot die SA varslemoenprys in Frankryk, gesloerde uitvoer (uitvoeroriëntasie) en aanbodskokke. Die relatiewe pryselastisiteit van uitvoervraag was onelasties oor beide die kort- en langtermyn; dit toon dat Capespan International en ander toekomstige uitvoerders dit nodig sal vind om hul varslemoenuitvoere na alternatiewe uitvoermarke te diversifiseer teneinde reële inkomste te verhoog. Die langtermyn uitvoeraanbod was onelasties teenoor relatiewe prys en dit impliseer dat indien SA varslemoenuitvoere by 'n vryehandelsooreenkoms met die EU ingesluit sou word, dit onwaarskynlik is dat dit 'n merkbare invloed op EU varslemoenprodusente sal hê.

1. INTRODUCTION

The South African (SA) citrus industry is export orientated with 354 731 tons of the total 755 831 ton fresh orange crop in 1993 being exported (Directorate

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Agricultural Economic Trends, 1996). Some 82% of SA fresh orange exports went to the European Union (EU) in 1993, with the UK being the major market (25% of exports). The SA import share of this market rose from 13% to 23% during 1976-1993, with nominal fresh orange export revenue up from R23 827 110 to R61 879 910. South Africa and the EU are currently negotiating a Free Trade Agreement (FTA) and citrus is presently excluded from the SA products proposed by the EU for a FTA. Given that SA wants citrus to be included, this paper aims to estimate factors affecting the demand for and supply of SA fresh orange exports in the major UK market to analyze the implications of lower EU import tariffs under a FTA.

Hayward-Butt and Ortmann (1994) estimated that *domestic* demand for fresh oranges in SA during 1959-1992 was highly price elastic and income elastic. No study has yet estimated the relative price elasticity of *export* demand and supply of SA fresh oranges. The relative price elasticity of export demand shows how shifts in export supply will affect export revenues, while the export supply function shows the relative influence of relevant price and non-price factors on export supply. By focussing on a major country market, this study will contrast with Sparks' (1992) analysis of the competitive relationship among the US and other orange exporters in the European Community (EC) during 1962-1987. Her results showed that Spain and Morocco would increase their fresh orange market shares in the EC as the market grows, while SA would increase its exports but lose market share.

The next section describes UK trade regulations applicable to fresh orange imports and specifies a simultaneous-equation model of SA fresh orange export demand and supply. Model estimation results are presented and discussed in Section 3. A concluding section discusses the policy implications of the results.

2. MODEL SPECIFICATION AND DATA SOURCES

The UK, as a member of the EU operates in a custom union in which member countries have removed all import tariffs and other trade restrictions with respect to each other, and set up a common and uniform tariff against outsiders. Tariffs for imported fresh oranges range from 4-19.3% depending on the the EU season (Outspan International, 1994). Some concessionary rates for third countries, through the Lomé Convention, Generalised System of Preference and Mediterranean third country agreements, are limited by tariff quota and often by calender period (Hinton, 1991).

Fresh orange export trade with the EU is also affected by Common Agricultural Policy (CAP) regulations which consist of EU border protection through import

duties and reference prices. The reference price is distinct to the operation of the Common Customs Tariff (CCT). It is effectively a reference or minimum import price system whereby, when entry prices of oranges from a particular country fall below the reference price, a countervailing duty equal to the difference between the reference and entry prices may be imposed in addition to the CCT. The countervailing duty is applied to the exporting country until the entry price has been at least equal to the reference price for two consecutive market days or if there are no prices in respect of that country for six consecutive market days (Hinton, 1991).

The reference price system applies to fresh orange exports to the EU between 1 December and 31 May at the height of the EU season (Swinbank & Ritson, 1995). The marketing season of SA fresh orange exports starts in May and ends in November. The main competitors with SA (in the EU export markets) over this period are Chile, Argentina, Brazil and Uruguay. Supply times for SA fresh oranges also overlap with fresh orange exports from Israel, Morocco, Spain and Turkey who have EU concessionary fresh orange import tariffs limited by tariff quota. Capespan International markets SA fresh oranges in the EU markets outside of 1 December to - 31 May when the reference price system operates and countervailing charges can be imposed if the reference price is not met. All SA fresh orange exports to the UK must have a phytosanitary certificate from the Directorate of Plant and Quality Control, which specifies that the oranges have been inspected according to appropriate procedures and are considered to be free from quarantine pests and from other injurious pests, and to conform to the current phytosanitary regulations of the importing country (Outspan International, 1996).

Given the above trade regulation background, separate export demand and supply functions for SA fresh orange exports to the UK are specified in a simultaneous-equations model in order to differentiate the demand response of exports from the supply response (Goldstein and Kahn, 1978). Export demand for SA fresh oranges in equation (1) depends upon the price of SA fresh oranges relative to the price of fresh oranges from Israel (major competitor), lagged exports and per capita income. There should be a negative relationship between relative price and export demand. Lagged exports should be positively related to export demand, as foreign buyers are unlikely to adjust their consumption habits immediately following a price change. This could be due to a preference for the quality of SA fresh oranges and their May-November specific availability. Therefore, after a price increase, consumption habits would not change immediately as this may cause some disutility (Gujarati, 1995). Export demand and per capita income should be positively related if fresh oranges are a normal good:

$$OREX_t = f([PSA_{UK} / PIS_{UK}]_t ; OREX_{t-1} ; [Y_{UK} / POP_{UK}]_t ; e_t) \quad (1)$$

where $OREX_t$ = SA annual fresh orange exports (tons), PSA_{UK} = price of SA fresh orange exports in the UK (European Currency Units per ton, ecu/ton), PIS_{UK} = price of Israel fresh orange exports in the UK (ecu/ton), $OREX_{t-1}$= SA annual fresh orange exports (tons) lagged one period, Y_{UKt}= annual National Disposable Income in UK, and POP_{UKt}= annual population in the UK.

Export supply of SA fresh oranges in equation (2) depends upon lagged relative export price (ratio of net export realisation price to domestic market price), the SA fresh orange price in the UK relative to the SA fresh orange price in France, lagged exports, and random shocks in total SA fresh orange supply:

$$OREX_t = f([\frac{RNERP}{RDP}]_{t-3} ; [PSA_{UK} / PSA_{FR}]_t ; OREX_{t-1} ; [S - \bar{S}]_t \; e_t) \quad (2)$$

where

$OREX_t$	=	SA annual fresh orange exports (tons),
$RNERP_{t-3}$	=	real net export realisation price lagged three periods (R/ton),
RDP_{t-3}	=	real domestic fresh orange price lagged three periods (R/ton),
PSA_{UK}	=	price of SA fresh orange exports in UK (ecu/ton),
PSA_{FR}	=	price of SA fresh orange exports in France (ecu/ton),
$OREX_{t-1}$	=	SA fresh orange exports lagged one period (tons), and
$[S-\bar{S}]_t$	=	supply shocks (deviation of production from trend).

Domestic producer decisions to export fresh oranges are shown by the lagged relative price term $[RNERP/RDP]_{t-3}$ which reflects the higher relative profitability of producing for export. Desired long-run export supply in period t is a function of expected relative price. In the short-run, however, export supply cannot adjust completely to the desired level due to the lag between planting and harvesting. The short-run relative price term $[PSA_{UK}/PSA_{FR}]_t$ captures the relative profitability of the UK and France export markets. Once exports arrive in the UK, agents can allocate fresh oranges amongst these two key EU markets by relative profitability. A positive relationship between export supply and the lagged relative prices is expected (relatively higher net export price would induce a lagged increase in exports). The higher relative UK price would increase quantity supplied to that market relative to France.

Lagged export supply reflects export orientation as it represents partial adjustment of producers to desired export levels. Fresh oranges are perennial crops and supply is likely to be very inflexible in the short run. Over the long run, output of fresh oranges can vary through shifts in production capacity resulting from changes in the number of orange-bearing trees. Actual export supply in period t is thus a function of expected relative price and the level of exports in the previous period. Supply shocks capture the impact of variable weather conditions on exports and are estimated as the residuals from a regression of total SA annual orange production on time. Exports should be positively correlated with supply shocks (Gunawardana, *et al.*, 1995).

Data on fresh orange exports (tons and price/ton) by country to the UK (1976-1993) were sourced from Eurostat (1995). South African export tons and price/ton for fresh oranges (1965-1993) were obtained from Outspan International (1994). The net export realisation price (R/ton) and domestic price (R/ton) for the export supply equation were obtained from the Directorate Agricultural Economic Trends (1996). United Kingdom national disposable income and annual population figures were obtained from the Europa World Yearbook (various issues) and International Financial Statistics (various issues).

3. RESULTS

3.1 Correlation coefficients

There were no statistically significant correlations amongst the independent variables in the export demand equation. However, $OREX_{t-1}$ and supply shocks $[S-\bar{s}]_t$, and relative export price $[RNERP/RDP]_{t-3}$ and $[S-\bar{s}]_t$,were significantly positively correlated (0.5907 and 0.5995, respectively) at the 5% level in the export supply equation.

3.2 Model Estimation

Two Stage Least Squares (2SLS) was used to estimate the parameters of the export demand and supply equations in the system using SPSS (1995). The signs of all coefficients estimated for the export demand model agreed with *a priori* expectations:

$$OREX_{tt} = \underset{(1.85^{***})}{27651.8289} - \underset{(-2.02^{***})}{9102.8931}\left[\frac{PSA_{UK}}{PIS_{UK}}\right]_t + \underset{(3.16)^{*}}{0.7457}\,OREX_{T-1} \qquad (3)$$

where adjusted R^2=35%, t-values are in parentheses, and *** and * indicate significance at the 1% and 10% levels, respectively. Serial correlation in this autoregressive model could not be assessed by the Durbin *h* statistic (Gujarati, 1995:605) as the formula for estimating *h* included the square root of a negative number. Following Pindyck and Rubinfeld (1991:147), the residual in equation (3) was, therefore, regressed on the lagged residual and the two explanatory variables to remedy this situation. The estimated coefficient for the lagged residual was 0.0809 with a non-significant t-value, implying no serial correlation.

The positive lagged exports coefficient shows that UK consumers do not adjust consumption of SA fresh oranges immediately when the relative price rises. Income per capita was dropped from equation (3) as the coefficient was not statistically significant. This could be due to the 'mature' nature of the UK market for fresh oranges - consumers may have reached a desired fresh orange intake level beyond which demand becomes inelastic with respect to income (Warr and Wollmer, 1996).

The export supply model initially estimated by SPSS (1995) gave negative sign for the supply shock variable which is not consistent with a priori expectations. This could be due to multicollinearity. Principal components (PC's) extracted from the *standardized* explanatory variables (shown by Z) in the supply equation to remedy multicollinearity and restate the regression coefficients in original scale form (Chatterjee and Price, 1977) using SPSS (1995) are shown in Table 1. Only the first three PC's, explaining 91.59% of the variation in the data, were retained for the export supply model (PC4 which showed the linear relationship between the explanatory variables responsible for multicollinearity was omitted).

Table 1 Principal Components for the Export Supply Model

Variable	Principal	Component		
	PC1	PC2	PC3	PC4
$Z[RNERP/RDP]_{t-3}$	-0.5369	0.1089	-0.7221	0.4225
$Z[PSA_{UK}/PSA_{FR}]_t$	0.3910	-0.7750	-0.4806	-0.1246
$ZOREX_{t-1}$	-0.4656	-0.6079	0.4949	0.4109
$Z[S-\overline{S}]_t$	-0.5849	-0.1343	-0.0524	-0.7982
Latent Root	2.246	0.876	0.541	0.336
% Variation	56.15	21.91	13.53	8.41

The standardized annual fresh orange export supply, $ZOREX_t$, is first regressed on PC_1, PC_2 and PC_3:

$$ZOREX_t = -0.2750PC1 + -0.4990PC2 + -0.3670PC3 \quad (4)$$

The $ZOREX_t$ could also be estimated by 2SLS regression on the standardized export supply explanatory variables as

$$ZOREX_t = \beta_1 Z[\frac{RNERP}{RDP}]_{t-3} + \beta_2 Z[\frac{PSA_{UK}}{PSA_{FR}}]_t + \beta_3 ZOREX_{t-1} + \beta_4 Z[S - \bar{S}]_t \quad (5)$$

Following Chatterjee and Price (1977), this implies that the β coefficients in equation (5) can be estimated from equation (4) coefficients and the PC_1, PC_2 and PC_3 coefficient loadings in Table 1 as

b1= (-0.5369 x -0.2750) + (0.1089 x -0.4990) + (-0.7221 x -0.3670) = 0.3583
b2= (0.3910 x -0.2750) + (-0.7750 x -0.4990) + (-0.4806 x -0.3670) = 0.45556
b3= (-0.4656 x -0.2750) + (-0.6079 x -0.4990) + (0.4949 x -0.3670) = 0.24972
b4= (-0.5849 x -0.2750) + (-0.1343 x -0.4990) + (-0.0524 x -0.3670) = 0.24708.

The t values and significance levels for the standardized parameters are found by dividing the coefficients by their standard errors which are obtained from equation (6) as:

$$Var(\beta) = \sum_{i=}^{3}(PC \text{ Loading})^3 * Var\ \alpha_i \quad (6)$$

where the variances of the α_i's are estimated by

$$Var(\alpha_i) = \frac{1 - \sum_{i=1}^{3} \lambda_i \alpha_i^2}{(n - k - 1)\lambda_i} \quad (7)$$

where λ_i= Eigen value, α_i = coefficient estimates for the four PC's in equation (4), n= sample size, and k = the number of PC's retained.

The t values for the standardized coefficients are equivalent to those for the variables in original scale since the correlations of the variables are unaffected by scaling (Chatterjee and Price, 1977). Furthermore, the β's can be transformed back into their original scale (β's) by multiplying by (S_{OREXt}/S_{Xi}), the standard deviation of export supply divided by the standard deviation of the explanatory variable concerned. This gives the export supply model in original scale (free of multicollinearity) as:

$$OREX_t = 8973.2311 + \underset{(1.33)^*}{15847.7246}\left[\frac{RNERP}{RDP}\right]_{t-3} + \underset{(1.71)^*}{16173.0527}\left[\frac{PSA_{UK}}{PSA_{FR}}\right]_t + \underset{(1.03)}{0.2545}\ OREX_{t-} + \underset{(2.41)^{**}}{0.0307}[S - \bar{S}]_t$$

where adjusted R^2=37%, t-values are shown in parentheses and ** and * indicate significance at the 5% and 10% levels respectively. All the coefficient signs in equation (8) are now positive as expected. The $OREX_{t-1}$ variable is retained as the coefficient t-value is greater than one (Gujarati, 1995).

Based on the coefficient estimates in equations (3) and (8), the relative price elasticity of export demand for SA fresh oranges in the UK was inelastic in both the short- and long-run (-0.187 and -0.734, respectively). Long-run export supply is driven mainly by the expected net export realisation price relative to domestic market price (elasticity coefficient of 0.352). Short-run fresh orange supply was price inelastic (0.248), reflecting a time lag between the decision to plant trees and actual fruit production. Supply shocks apparently play a relatively minor role in explaining export supply (coefficient of 0.004).

4. CONCLUSION

The demand for SA fresh orange exports in the UK should benefit from lower import tariffs under a FTA because the price of SA fresh oranges would fall relative to the price of fresh oranges from Israel. Efforts by Capespan International and other future exporters to reduce marketing costs would further increase the competitive position of SA fresh orange exports. The inelastic relative price elasticity of demand for SA fresh orange exports, however, implies that SA exporters may need to diversify fresh orange exports to alternative markets (such as Eastern Europe and the Far East) to increase real revenue. The relatively price inelastic export supply of SA fresh oranges indicates that exports to the UK, if fresh oranges are included in a FTA, are unlikely to increase markedly in the long run. This should ease EU fears that tariff concessions on citrus would have a marked adverse effect on EU producers.

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