THE DEMAND FOR AND SUPPLY OF SOUTH AFRICAN DECIDUOUS FRUIT EXPORTS : A DYNAMIC ANALYSIS

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Abstract

This paper is the first empirical study of the factors affecting the demand for and supply of South African deciduous fruit exports. A simultaneous equations model of deciduous fruit export demand and supply was specified and estimated by Two Stage Least Squares using annual data for the period 1960 - 1990. Export demand was influenced by the world price (real) of deciduous fruit and real income of importing countries. Export supply was explained by the lagged relative price of deciduous fruit exports (ratio of net export realisation price to domestic price), lagged exports and random shocks in deciduous fruit supply (deviation of actual production from trend). Estimated price and income elasticities of export demand were high (-28.00 and 1.41 respectively). Export supply in the short run was price inelastic (0.07) and relatively less responsive to supply shocks. These results support *a priori* expectations that local deciduous fruit exporters are price takers and that export supply reacts sluggishly to changes in the relative price of exports. Real income growth in importing countries will markedly influence export performance.

Samevatting

Hierdie artikel verteenwoordig die eerste empiriese studie van die faktore wat die vraag na, en aanbod van, Suid-Afrikaanse sagtevrugte-uitvoere beïnvloed. 'n Gelyktydige vergelykingsmodel van sagtevrugtevraag en -aanbod is deur middel van twee-stadium kleinste kwadrate gespesifiseer en beraam aan die hand van jaarlikse data vir die tydperk 1960 - 1990. Uitvoervraag word beïnvloed deur die (reële) wêreldprys van sagtevrugte en reële inkomste van invoerlande. Uitvoeraanbod is verklaar deur die gesloerde uitvoer en stogastiese skokke in sagtevrugtevoorsiening. Geraamde prys- en inkomste-elastisiteit van uitvoervraag was hoog (onderskeidelik -28.00 en 1.41). Uitvoeraanbod op kort termyn was onelasties (0.07) en betreklik minder gevoelig vir aanbodskokke. Hierdie resultate ondersteun *a priori* - verwagtinge dat plaaslike sagtevrugte-uitvoerders prysnemers is en dat uitvoeraanbod traag reageer op veranderinge in die relatiewe prys van uitvoere. Ekonomiese groei in invoerlande se reële inkomste sal uitvoerprestasie beduidend beïnvloed.

1. Introduction

The South African deciduous fruit industry is export orientated, annually exporting some 65 percent of production (Laubscher, 1990). Empirical evidence on the determinants of export demand and supply is therefore needed to identify the major factors affecting export performance. The magnitude of income elasticity of export demand would show whether income growth in importing countries can boost deciduous fruit exports; the size of price elasticity of export demand determines how shifts in export supply will affect export revenues; finally, the export supply function shows the relative influence of relevant price and non price factors on export supply.

This paper is the first local study to estimate price and income elasticities of demand and the price elasticity of supply for South African deciduous fruit exports. The paper is organised as follows: Section 2 specifies a simultaneous-equation model of the deciduous fruit industry which includes export demand and supply functions. Model estimation results are presented and discussed in Section 3. A concluding section discusses the policy implications of the results.

2. Model Specification

Numerous studies of export demand and supply appear in the literature (Goldstein and Kahn, 1978; 1984; Bond, 1985; Haniotis *et al*, 1988; Islam and Subramanian, 1989). All of these studies specify simultaneous-equations models of export demand and supply, in order to differentiate the demand response of exports from the supply response. This approach is followed in the simultaneous- equation model of the South African deciduous fruit industry by specifying separate export demand and supply functions. The model also contains a domestic demand function, exchange rate determination equation and market equilibrium condition.

Per capita domestic demand for deciduous fruit is specified as a function of real deciduous fruit price, real price of sub-tropical fruit (substitute in consumption) and real per capita disposable income:

$$[DFDD]_t = f\{[DFPI/CPI]_t; [STPI/CPI]_t; [PDY/CPI]_t; e_t\}(1)$$

where $DFDD_t$ = *per capita* deciduous fruit consumption (tons),

         $DFPI_t$ = deciduous fruit price index,

         CPI_t = consumer price index,

         $STPI_t$ = sub-tropical fruit price index,

         PDY_t = *per capita* disposable income (Rands),

         e_t = error term, and

         t = 1,2, ... T observations.

Per capita domestic demand is expected to be negatively related to real own price and positively related to real sub-tropical fruit price and per capita disposable income.

A total supply response equation for deciduous fruit ($DFSS_t$), as proposed by Baritelle and Price (1974), could not be specified due to insufficient time series data on tree numbers and plantings. Total deciduous fruit supply was therefore estimated from the market equilibrium identity which closes the simultaneous equation model.

South African deciduous fruit export demand is specified as a function of real incomes of importing countries with developed market economies and the world price of deciduous fruit in the markets of those importers:

$$[DFEX]_t = f\{[WDFP/WCPI]_t; [WGDP/WCPI]_t; e_t\} \quad (2)$$

where
$DFEX_t$ = deciduous fruit exports (tons),
$WDFP_t$ = world deciduous fruit price index,
$WCPI_t$ = world consumer price index for developed countries,
$WGDP_t$ = gross domestic products index for developed market economies.

South African deciduous fruit exporters are likely to be price takers on world markets as they account for only a small proportion (2 percent) of total world supply (Cleasby, 1991). Export demand should be negatively related to world deciduous fruit price and positively related to real incomes of developed market economies.

Deciduous fruit export supply is specified as a function of the lagged relative export price (ratio of net export realisation price to domestic market price), lagged exports and random shocks in deciduous fruit supply:

$$[DFEX]_t = f\{[RDFRP/RDFPI]_{t-1}; [S-\delta]_t; [DFEX]_{t-1}; e_t\} \quad (3)$$

where
$DFEX_t$ = deciduous fruit exports (tons),
$RDFRP_t$ = real net export realisation price (Rands),
$RDFPI_t$ = real domestic deciduous fruit price (Rands),
$[S-\delta]_t$ = supply shock (deviation of actual production from trend), and
$DFEX_{t-1}$ = deciduous fruit exports (tons) lagged one period.

The relative price term captures the relative profitability of producing deciduous fruit for export compared to domestic consumption. A positive relationship between export supply and the lagged relative export price is expected (relatively higher net export price would induce an increase in exports). The supply shock term $[S-\delta]_t$ captures how random shocks in supply caused by variable weather conditions impact on exports (Islam and Subramanian, 1989). Estimated as the residuals from a regression of annual deciduous fruit production on time, $[S-\delta]_t$ should be positively correlated with exports. Lagged export supply reflects export orientation as it represents partial adjustment of producers to desired export levels. Adapting Nerlove's (1958) partial adjustment model, desired long-run export supply in period t is a function of expected relative export price. In the short-run, however, export supply cannot adjust completely to the desired level due to the lag between tree planting and fruit production. Actual export supply in period t is thus a function of the expected relative export price and the level of exports in the previous period.

Following Johnson *et al* (1977), real net export realisation price $RDFRP_t$ was estimated by subtracting export costs from gross world export price and then converting the net price into Rands at the official exchange rate. The monetarist model of exchange rate determination was used to estimate the official exchange rate, XR. This model contains two economies - South Africa and the Rest of World (ROW) - both having a nominal money stock (money plus near money) and a demand-adjusted rate of money growth. Exchange rate determination runs from actual and expected money supply through real incomes and prices (equation 4):

$$[XR]_t = f\{[MS/MS^*]_t; [NIR/NIR^*]_t; [RGDP/RGNP^*]_t; e_t\}$$

where
MS_t = nominal money supply,
NIR_t = nominal interest rate,
$RGDP_t$ = real gross domestic product,
$RGNP_t$ = real gross national product, and
* = represents the Rest of the World.

Monetary equilibrium is achieved when the price level is equal to the ratio of nominal money stock and the real demand for money in both economies. The purchasing power of parity doctrine equalises prices in both economies via the exchange rate. Therefore, if expectations are that future demand-adjusted money growth will rise, price expectations rise causing the nominal interest rate (treasury bill rate) to increase and the demand for real cash balances to decrease. The result, since money supply now exceeds money demand, is that spending increases, driving up domestic prices relative to foreign prices (Dushmanitch, 1991). To restore the purchasing power of parity, the exchange rate depreciates as the demand for the foreign currency increases due to increased demand for relatively cheaper foreign goods. Prices and the exchange rate continue to adjust until parity is restored. The exchange rate is defined in terms of Rands per special drawing right to give a better indication of the rands overall competitive position.

An increase in the relative nominal money stock would cause the exchange rate to decrease. Similarly, a relative increase in nominal interest rate (reflecting inflationary expectations) would cause the exchange rate to depreciate. Real incomes in the ROW and South African economies were represented by real gross national product and domestic products respectively. Following Fuller (1976: 393-397), a grafted polynomial variable, π_t, was defined to explain movements under three different regimes (Dushmanitch, 1991): fixed exchange rates (1960-1971), flexible exchange rates (1972-1978) and managed floating (1979-1990). Defined as zero for the fixed exchange rate period, π_t explains movements in the exchange rate only after 1971. Prior to this, exchange rates were controlled directly by the monetary authorities and exchange rate movements were, therefore, not a function of monetary variables.

The market equilibrium condition which closes the simultaneous equation model and enables estimation of total deciduous fruit supply, $DFSS_t$ is:

$$[DFSS]_t + [DFIMP]_t = ([DFDD]_t \times [POP]_t) + [DFEX]_t \quad (5)$$

where $DFIMP_t$ = deciduous fruit imports (tons).

3.   Results

Consistent structural equation parameters were estimated by two stage least squares using annual data for the period 1960-1990. Table 1 reports the estimated structural equations (round brackets below the reported coefficients give estimated t-statistics).

The signs of all estimated coefficients agree with *a priori* expectations. All coefficients are significant at the 5 percent level except those for $[S-\delta]_t$ (export supply equation) and the nominal interest rate ratio (exchange determination equation) which are significant at the 10 percent level.

The relatively large price elasticity of export demand indicates that South African deciduous fruit exporters are price takers on world markets. The income elasticity coefficient, greater than unity, implies that economic growth in importing countries will markedly influence deciduous fruit export performance. Export supply is highly price inelastic in the short run. This result is expected as producers cannot increase fruit supply in the short run due to the time lag between planting and fruit production. Lagged exports, reflecting partial adjustment to desired export levels, play a greater role than supply shocks in explaining export supply.

Table 1: Simultaneous equations model of the South African deciduous fruit industry, 1960-1990.

Per capita deciduous fruit demand

$[DFDD]_t =$

$4.035 \times 10^{-4} - 4.660 \times 10^{-6} [DFPI/CPI]_t + 6.887 \times 10^{-7} [STPI/CPI]_t +$
(6.992)   (-8.881)   (8.077)

$7.495 \times 10^{-7} [STPI/CPI]_t$
(3.566)

$R^2 = 0.87$ df = 26   d = 1.86

Deciduous fruit export demand

$[DFEX]_t = -2.927 \times 10^3 - 7.965 \times 10^2 [WDFPI/WCPI]_t +$
(-0.361)   (-2.828)

$1.329 \times 10^2 [WPDY/WCPI]_t$
(5.434)

$R^2 = 0.88$ df = 28   d = 1.75

Deciduous fruit export supply

$[DFEX]_t = 5.926 \times 10^4 + 1.799 \times 10^3 [RDFRP/RPFPI]_{t-1} +$
(2.518)   (2.087)

$0.831 \times 10^2 [S-\bar{S}]_t + 0.691 [DFEX]_{t-1}$
(1.807)   (5.313)

$R^2 = 0.88$ df = 28   d = 1.65

Exchange rate determination equation

$[XR]_t = 0.724 + 1.652 \, \pi_t + 0.609 [MS/MS^* \times \pi]_t +$
(27.360)   (2.087)

$0.039 [NIR/NIR^* \times \pi]_t - 2.167 [RGDP/RGNP^* \times \pi]_t$
(1.182)   (-10.652)

$R^2 = 0.99$ df = 26   d = 1.93

Table 2 shows estimated export demand and supply elasticities derived from the estimated coefficients reported in Table 1 for equations (2) and (3).

Table 2: Export demand and supply elasticities

Export demand	Price	Income	
Equation (2)	-28.07	1.41	
Export supply	Relative export price	Supply shocks	Exports$_{t-1}$
Equation (3)	0.07	0.01	0.43

4.   Conclusion

Export demand for South African deciduous fruit was price elastic implying that South African producers are price takers on world markets. Increased export supply by local producers will have little impact on export price but will markedly raise export revenues. The high income elasticity of deciduous fruit export demand means that income growth in developed countries can boost export performance.

Short-run deciduous fruit export supply was price inelastic. This sluggish response to changes in the relative price of exports is supported by the significant impact of lagged exports on export supply. It is attributed to a time lag between the decision to plant trees and actual fruit production. Supply shocks play a relatively minor role in explaining export supply.

Variability in the world export price of deciduous fruit has not been fully transmitted to producers due to depreciation of the Rand exchange rate. Producers in South Africa will therefore continue to target foreign markets as long as the real net export realisation price differential exists. Future research into the factors affecting deciduous fruit exports should focus on the export revenue implications of real income growth in importing countries and Rand exchange rate changes.

Note

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