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Analysing the South African table grape industry within a partial equilibrium framework

By

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Abstract

This paper presents a partial equilibrium model for the South African table grape industry, focussing on the fresh market segments. The model is a dynamic recursive model solving various equations simultaneously, reaching a state of equilibrium once total production equals total demand and equilibrium is established in the export- and domestic market for fresh grapes. Results over the next eight years are presented in the form of a baseline outlook and two "what if" questions. Answering these questions quantifies the sensitivity of the export price to changes in demand and supply. The model is housed and maintained in the Bureau for Food and Agricultural Policy at the Western Cape Department of Agriculture and Universities of Pretoria and Stellenbosch.

Keywords: partial equilibrium; table grape industry; projections

1. Introduction

The table and dried grape industry has experienced remarkable growth over the past ten years, both in volume and in value. The total value of the industry increased from R1.2 billion in 1997/98 to R2.3 billion in the 2006/07 season (DoA, 2008). Over the same period total production increased from 333 000 tons to 522 000 tons. Fresh grapes account for over 80% of the total value of production with a value of R1.99 billion in 2006/07 (DoA, 2008). The largest share of this value is earned in the export market as the local market accounts for approximately only 13% of fresh grapes sold. Unfortunately for South African producers, the average export realisation price did not follow a similar increasing trend as with volume. The export price traded at R6 900/ton in 1997/98, reached its peak in 2000/01 at R8 400/ton and dropped the year after to R5 800/ton. The average export price for 2006/07 is estimated at R7 800/ton. Deflating the prices to constant 2000 prices shows that the average export price declined from R8 100 in 1997/98 to R4 900 in 2006/07. Transforming the average Rand prices into Euro prices, the currency of South

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Africa's main trading partner, the price declined by almost 30% in real terms over the past ten years.

The declining trend in the price of South African grapes over the past ten years reflects a number of issues or forces, including increased supply of South African grapes, increased competition from other Southern Hemisphere countries, increased concentration of buying power in the export markets, the largely fragmented South African industry following deregulation in 1997 and increased uncertainty in the global market place.

On the positive side, returns in the export market increased for the past two consecutive seasons. But to what extent are these price increases supply driven and to what extent demand driven? Did export prices reach the trough of the downward cycle and will global food inflation and rising input costs support the price of fresh grapes consumed by the wealthy Northern Hemisphere consumers? Or are the price increases of the past two seasons temporary fluctuations in an even longer term downward price cycle?

There are no easy answers to these questions as economies, policies, weather and market structures change continuously and at an increasing pace. It is for this reason that the Bureau for Food and Agricultural Policy is committed to the development and maintenance of a serious of models analysing different future scenarios and assisting industry in informed decision-making. The purpose of this article is to describe a simulating model projecting future demand, supply and prices for the South African table grape industry. This dynamic recursive partial equilibrium model was developed with the purpose of analysing "what if' questions, assisting the industry forming a picture of the likely impact market and other changes might have on future price movements by answering "what if" questions.

The remainder of the paper is structured as follows: Sections 2 and 3 provide some background on the table grape industry over the past two decades and the data sources. The structure of the model is discussed in Section 4 and this is followed by a discussion of the so-called baseline simulation. Section 6 provides two examples of model applications in answering "what if" questions and Section 7 contains some concluding remarks.

2. Overview of the South African table grape industry

The production of table and dried grapes almost doubled over the past ten years as total tonnage increased from 345 895 tons in 1997 to 522 144 tons in 2007 (see Figure 1). The increase in volume was mainly concentrated in the

export market as total volume exported increased from 109 900 tons to 227 265 tons.

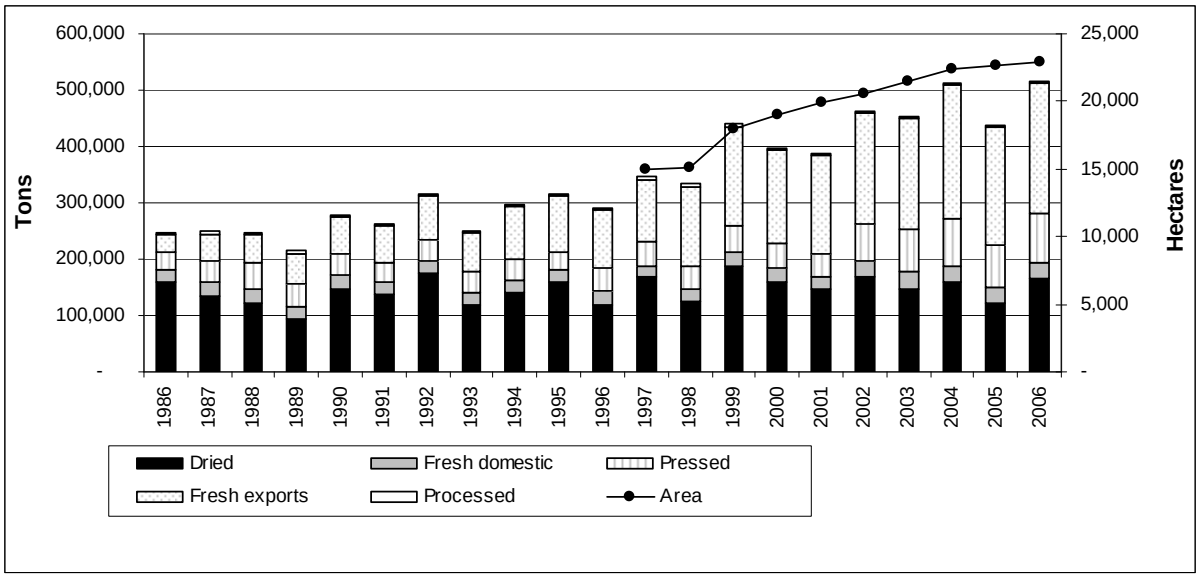

Figure 1: Total production and area planted of table and dried grapes in South Africa

Source: DFPT, DoA and SAWIS

The declining trend in the real Rand price for South African grape exports is not only prevalent for the last decade, but actually for the past two decades as shown in Figure 2. In constant 2000 prices, the average export price for grapes was R11 000/ton in 1986, declined to R6 800/ton in 1996 and to R4 100/ton another ten years later. The main export destination of South African grapes remains the European Union, with 84% of exports destined for the EU-15 countries. The EU is followed by Hong Kong, United Arab Emirates and Saudi Arabia. South Africa is the second largest grape exporter in the Southern Hemisphere, lagging behind Chile that exported 812 000 tons in 2006.

The domestic market price for fresh grapes traded fairly stable over the past two decades ranging between R2 700 and R3 700 per ton. The domestic price was the lowest in 2000, but since then followed an increasing trend despite increasing volumes.

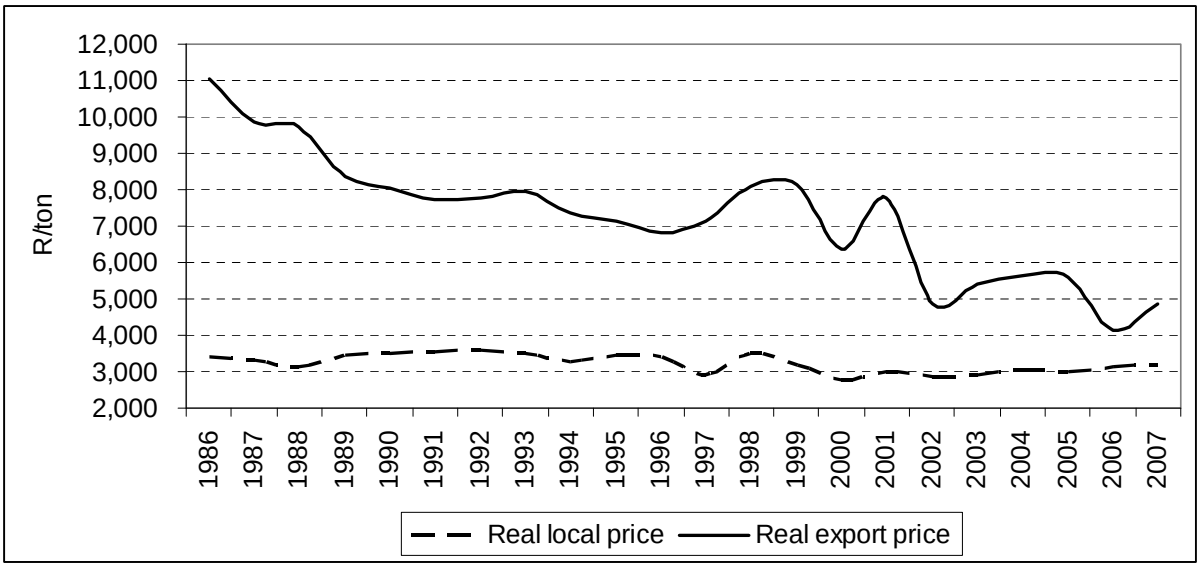

Figure 2: Average real prices of fresh grapes exported and sold in the local market (constant 2000 prices)

Source: DFPT and DoA

3. Data sources

Data on grape production, exports, volume sold in the domestic market and grapes allocated for processing and drying were obtained from the Deciduous Fruit Producers' Trust (DFPT, 2008), the South African Table Grape Industry (SATI, 2008) and the National Department of Agriculture (DoA, 2008). Data on exports per country and intakes per region were obtained from the Perishable Products Export Control Board and the South African Table Grape Industry. Exports of fresh grapes from other Southern Hemisphere countries were obtained from the Food and Agricultural Organisation (FAO, 2008) and Decofruit (Quiroz, 2006). The frequency of the data is annual and most data are available from 1986.

4. The model

This model is a dynamic recursive partial equilibrium model. The components of demand and supply were identified and equilibrium is established ensuring demand equals supply. The technique used is similar to that of Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri, Columbia, USA. In the South African context, the FAPRI approach was first adapted to long-term commodities with the development of the wine grapes sector model and since then has been used in the apple and table grape industries. These models are maintained and housed at the Bureau for Food and Agricultural Policy (BFAP) at the Western Cape Department of Agriculture and the Universities of Pretoria and Stellenbosch. The BFAP

models proved to be useful in combining it with scenario planning and answering "what if" questions to facilitate better-informed decision-making.

Figure 3 represents the components of supply and demand in the table and dried grape industry in South Africa and also shows all the links in the model. Production is allocated to fresh grape exports, fresh grapes supplied to the domestic market, grapes pressed and grapes delivered for processing and drying. The model closes or solves by finding the equilibrium prices in the domestic and export markets where demand equals supply. The graphical presentation assists in understanding the economic relationships among all the variables influencing above mentioned components. It also shows the complexity and interdependency of the various relationships.

It should be remembered that any model is a simplification of reality and there are numerous factors not taken into account by the model.

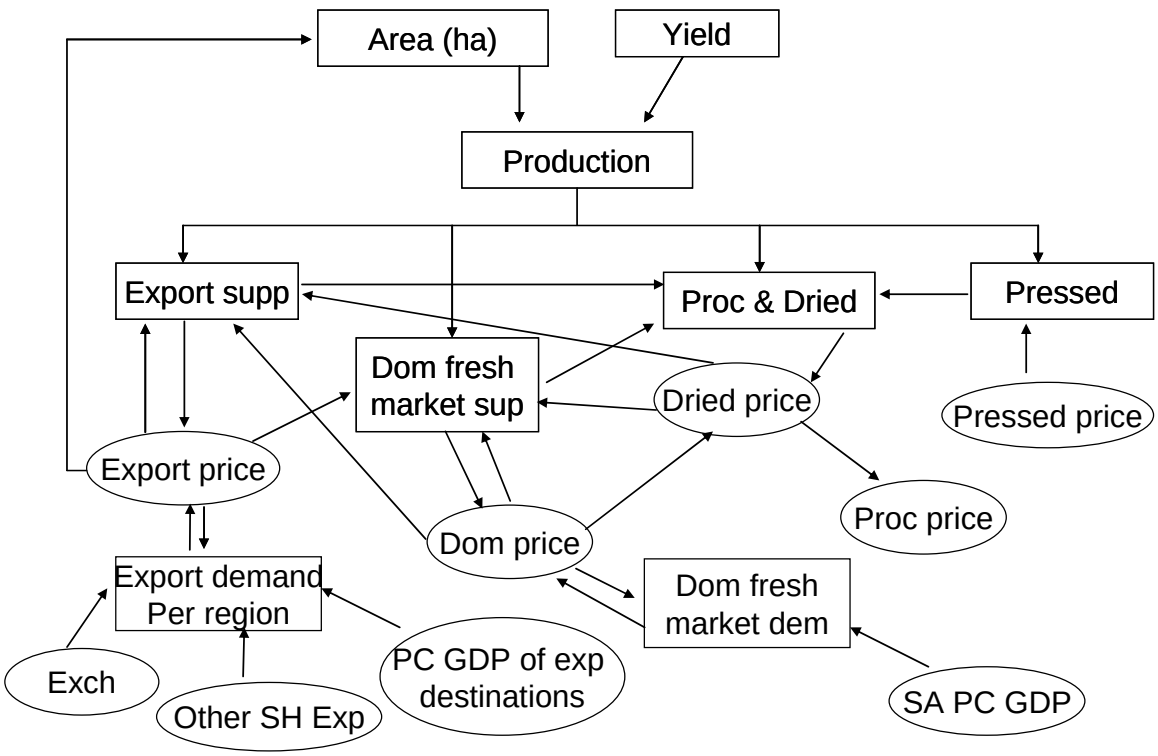

Figure 3: Sketch of links in sector model for table grape industry

Equation specifications

This section describes the behavioural equations, identities and the closure used in the model. The model is divided into three sections: the supply and allocation block, demand block and price linkage block.

A single-equation approach was followed, but the equations form part of a system of equations that solves simultaneously. The equations were estimated using the estimation procedure of Ordinary Least Squares, but considering that the primary objective of the model is to replicate the industry, synthetic parameters were imposed in some cases to ensure reasonable model behaviour. (See the Appendix for details on parameter estimates and calculated elasticities.) All equations are estimated over a period from 1985/86 (i.e. 1 October 1985 to 30 September 1986, referred to as 1986 in model) to 2005/06, with the exception of the total area and export demand equations. Time series data for the dependent variables in these models are only available since 1997 and 1999 respectively; hence synthetic parameters were imposed in constructing these equations. The data interval is annual and *t* is used to indicate the year. All variables in the model and the estimated parameters are listed in the Appendix.

Supply and allocation block

In theory, the supply side of a model for perennial crops should consist of the following components: new plantings, removals and yield, but data is a common problem with this approach, therefore is only total area estimated. There are three approaches to modelling total supply of a long-term crop: a backward looking approach taking into account historical prices, a forward looking approach discounting expected future returns (an investment type of function) or a combination of the two (Nerlove, 1979: 875). A backward looking approach is applied in this model by using a weighted average return per hectare between the export and dried prices. Perennial crops have a lag period between planting and reaching full production (it takes 3 to 5 years for a vineyard to reach full production), but allowing prices to influence production only in five years time is not a true reflection of reality and it makes the production function too static in its response to market changes.

$$TGTASA_t = f\{TGTASA_{t-1}, TGWAVERPH, DUMMY99\} \qquad \text{(Eq. 1)}$$

$$TGWAVERPHA_t = 0.7 \times (0.8 \times TGREXPPSA_{t-3} + 0.2 \times TGRDRIEDPSA_{t-3}) \times YIELD_{t-3} + 0.3 \times (0.8 \times TGREXPPSA_{t-2} + 0.2 \times TGRDRIEDPSA_{t-2}) \times YIELD_{t-2} \qquad \text{(Eq. 2)}$$

TGTASA	: Total area under table and dried grapes
TGWAVERPH	: Weighted average return per hectare
DUMMY99	: 1999 = 1, other = 0
TGREXPPSA	: Table grape real export price
TGRDRIEDPSA	: Table grape real dried price
YIELD	: Average yield per hectare

Allocation of domestic production

Total production is allocated to fresh exports, fresh domestic market, pressing and drying and processing. Numerous factors influence the allocation decision including cultivar, variety, quality and relative prices. Due to data limitations and difficulty in quantifying quality the allocation decisions is modelled primarily as a function of prices.

$$TGFMSSA = f\left\{\begin{array}{l} TGFMSSA_{t-1}, TGPRDSA_t, \dfrac{TGRFMPSA_t}{\frac{1}{2}(TGRDRIEDPSA_{t-1} + TGRDRIEDPSA_t)}, SHIFT97, \\ IF\left(TGREXPPSA_{t-2} < TGRFMPSA_{t-2} \cap TGREXPPSA_{t-1} < TGRFMPSA_{t-1}\right) \\ THEN\left(TGRFMPSA_t - TGREXPPSA_t\right) \end{array}\right\} \quad \text{(Eq. 3)}$$

$$TGEXPSSA = f\left\{\begin{array}{l} TGEXPSSA_{t-1}, TGPRDSA_t, \dfrac{0.3 \times TGREXPPSA_{t-1} + 0.7 \times TGREXPPSA_t}{TGRDRIEDPSA_{t-1}}, \\ IF\left(TGREXPPSA_{t-2} < TGRFMPSA_{t-2} \cap TGREXPPSA_{t-1} < TGRFMPSA_{t-1}\right) \\ THEN\left(\dfrac{0.2 \times TGRFMPSA_{t-1} + 0.8 \times TGRFMPSA_t}{0.2 \times TGREXPPSA_{t-1} + 0.8 \times TGREXPPSA_t}\right) \end{array}\right\} \quad \text{(Eq. 4)}$$

$$TGPRESSA_t = f\left\{TGPRESSA_{t-1}, TGPRDSA_T, TGRPRESPSA_t\right\} \quad \text{(Eq. 5)}$$

$$TGDRIEDSA = TGPRDSA_t - TGEXPSSA_t - TGFMSSA_t - TGPRESSA_t \quad \text{(Eq. 6)}$$

TGFMSSA	: Supply of fresh grapes allocated to domestic market
TGEXPSSA	: Supply of fresh grapes for export
TGPRDSA	: Total domestic production of table grapes
TGRFMPSA	: Real table grape fresh market price in SA
TGPRESSA	: Supply of (table and dried) grapes for pressing
TGDRIEDSA	: Supply of grapes for drying
TGRPRESPSA	: Real price for pressed grapes

TGRDRIEDPSA : Real price for dried grapes
TGREXPPSA : Real table grape export price in SA Rand
SHIFT97 : Up to 1996 = 0, from 1997 onwards = 1

The volume of table grapes marketed fresh in South Africa (TGFMSSA) depends on last year's volume sold in domestic market, total production and the ratio of expected return in the domestic and the expected and last year's return for dried grapes. Export supply is a function of last year's supply, total production and the ratio between the previous year's export price and the expected export price and the dried price of the previous season. An if-statement is included in both the supply equations. Should the average price in the domestic market exceed the average export price for two consecutive seasons, agents are expected to change their behaviour and shift larger volumes to the domestic market. Hence, allocation to the domestic market will be a function of the price difference between the expected domestic and expected export price, while export supply will depend on the price ratio of expected and last year's domestic and export prices. The if-statements are only activated after two years of lower returns in the export market, because agents are reluctant to withdraw from international marketing as the export business of perishable fruit exporters rely heavily on building and maintaining relationships. Not supplying the required volumes of fruit to the importer/supermarket may result in loosing the programme the following year.

Table and dried grapes for pressing is a function of last year's volume for pressing, total production and the expected price for pressed grapes. The volume of grapes allocated for processing and drying is the calculated balance.

Demand block

$$TGPCFCSA_t = f\{RPCGDPSA_t, TGRFMPSA_t\} \quad \text{(Eq. 7)}$$

$$TGFMDSA_t = TGPCFCSA_t \times POPSA_t \quad \text{(Eq. 8)}$$

$$TGPCEXP_{i,t} = f\{RPCGDP_{i,t}, TGRCIFPSA_{i,t}, OTSHEXP_t\} \quad \text{(Eq. 9)}$$

$$TGEXPDSA_t = \sum_I TGPCEXP_{i,t} \times POP_{i,t} \quad \text{(Eq. 10)}$$

TGPCFCSA : Per capita consumption of fresh grapes in SA from Nov to Apr
RPCGDPSA : Real per capita gross domestic product in SA

TGRFMPSA	: Real table grape fresh market price in SA
TGFMDSA	: Total demand for table grapes in SA from Nov to Apr
POPSA	: Total population in SA
$TGPCEXP_i$	: Per capita exports of SA table grapes to country i
$TGRCIFPSA_i$	: Average real price of SA table grapes in foreign currency of country i
OTSHEXP	: Total SH exports of fresh grapes, excluding SA
TGEXPDSA	: Total export demand for SA table grapes
POP_i	: Total population of country i

Per capita consumption in South Africa is modelled as a function of real gross domestic product (GDP) per capita and the real price of table grapes. Total demand for table grapes in South Africa from November to April is calculated as the product of per capita fresh consumption and total population.

Per capita exports of table grapes to a particular country is estimated as a function of real per capita GDP in that country, the estimated average real CIF price of South African grapes and total grape exports of other Southern Hemisphere countries. Due to short times series it is not possible to determine coefficients for the export demand functions using econometric techniques. The coefficients were imposed based on elasticities estimated in other econometric studies.[2] The income elasticities of the countries differ depending on the level of per capita income as less developed economies are expected to have larger income elasticities for fruit than richer developed countries. The sensitivity for other Southern Hemisphere countries also differs among the countries, depending on the geographical location of the country and the history of imports of the country.

Price linkage block

$$TGRDRIEDPSA_t = f\left\{\begin{matrix} TGRDRIEDPSA_{t-1}, TGRFMPSA_{t-1}, TGDRIEDSA_t, RAISINWRLDPRD_t, \\ SHIFT98_00 \end{matrix}\right\} \quad \text{(Eq. 11)}$$

$$TGRCIFPSA_{i,t} = \frac{TGEXPPSA_t \times EXCH_{i,t}}{CPI_{i,t}} \quad \text{(Eq. 12)}$$

$$TGRFMPSA_t = f\{TGFMDSA_t, TGFMSSA_t\} \quad \text{(Eq. 13)}$$

$$TGREXPPSA_t = f\{TGEXPDSA_t, TGEXPSSA_t\} \quad \text{(Eq. 14)}$$

[2] *See Lechene (2000), Marquez and McNeilly (1998) and Durham and Eales (2006).*

TGRCIFPSA	: Average real price for SA grapes in foreign currency of country i
TGEXPPSA	: Table grape export price in SA Rand
$EXCH_i$	: Rand exchange rate pertaining to country i
CPI_i	: CPI index for country i
TGRDRIEDPSA	: Real price for dried grapes in SA
TGRFMPSA	: Real table grape fresh market price in SA
TGDRIEDSA	: Supply of grapes for drying and processing
RAISINWRLDPRD	: World production of raisins
SHIFT98_00	: 1998, 1999, 2000 = 1, other =0
TGFMDSA	: Demand for fresh grapes in SA from Nov to Apr
TGFMSSA	: Supply of fresh grapes in SA from SA crop
TGREXPPSA	: Real table grape export price in SA Rand
TGEXPDSA	: Export demand for SA grapes
TGEXPSSA	: Supply of fresh grapes for export

The price of dried grapes is a function of the lagged price, the average fresh domestic price of the previous season, the supply of grapes for drying and processing, the world production of raisins and a shift variable for the years following deregulation.

The model is closed by finding the equilibrium prices in export and domestic market where supply equals demand in these market segments.

5. The baseline outlook

Using these models, a so-called baseline outlook is simulated under a particular set of assumptions. The baseline does not constitute a forecast, but serves as a starting point or benchmark against which other scenarios or "what if" questions can be measured or evaluated.

Agricultural industries in South Africa are largely driven by macro-economic indicators over which the agricultural domain has little or no control. For the table grape industry these include, among others, the exchange rate, population and economic growth (which are important drivers in the demand for food) and total export volumes from other Southern Hemisphere countries. The baseline assumptions for a selected set of macro-economic indicators are shown in Table 1. Data up to 2007 are actual data and from 2008 onwards projections. The exchange rate is projected to average around R11.59/Euro during 2008 and to depreciate over time to R15.19 in 2016. Population and economic growth in the export destinations vary, but for the EU-15 countries real gross domestic product (GDP), which serves as a measure of disposable

income, is projected to increase by between 1.7 and 2.1 percent per annum. Total population in the EU-15 countries is projected to increase by 3.4 million people over the next nine years. In South Africa, real GDP growth is projected to decrease in 2008 and 2009 to 3% per year, but from 2010 onwards it is projected to grow at an increasing rate up to 2015. Total population is projected to increase by 1.8 million people by 2016. Total exports of fresh grapes from other Southern Hemisphere countries are assumed to reach 1 million tons in 2010 and almost 1.07 million tons in 2016. That is based on an assumed 1% increase per annum.

Table 1: Macro-economic indicators

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total population of SA (Million)*										
7.300	47.448	47.627	47.791	47.958	48.130	48.312	48.514	48.736	48.985	49.251
SA economic growth (% change in real per capita GDP)*										
3.64	5.03	3.00	3.00	4.00	5.00	5.65	5.82	6.09	6.21	6.02
Total population of EU-15 countries (Million)*										
386.52	387.18	387.79	388.34	388.83	389.27	389.65	389.98	390.23	390.48	390.66
EU-15 economic growth (% change in real per capita GDP)*										
2.83	2.66	1.75	1.92	2.00	2.06	2.03	1.97	1.93	1.93	1.94
Exchange rate - SA Rand/Euro*										
8.52	9.74	11.59	11.99	12.22	12.48	12.77	13.25	13.93	14.57	15.19
Southern Hemisphere exports excl. SA (1000 tons)										
1,002	992	986	996	1,006	1,016	1,026	1,037	1,047	1,057	1,068

*Source: *BFAP (2008) and Global Insight*

Based on these assumptions and the historical relationships and interdependency among a variety of variables total area under dried and table grapes in South Africa is projected to increase by 1600 hectares over the next seven years. Assuming average weather conditions, the additional hectares is projected to add over 13,000 tons or 2.9 million equivalent cartons of grapes exported. Figure 4 shows that the average euro price for SA grapes recovered to some extent in 2006/07 (referred to as 2007 in the figure). South African grape supply is measured on the right axis and other Southern Hemisphere supply and price are measured on the left axis. The price is set to increase further in the 2007/08 season due to lower supply from South Africa and other Southern Hemisphere countries. From the 2008/09 season onwards prices are projected to come under pressure as volume from South Africa and other Southern Hemisphere increases and new export markets are not opened.

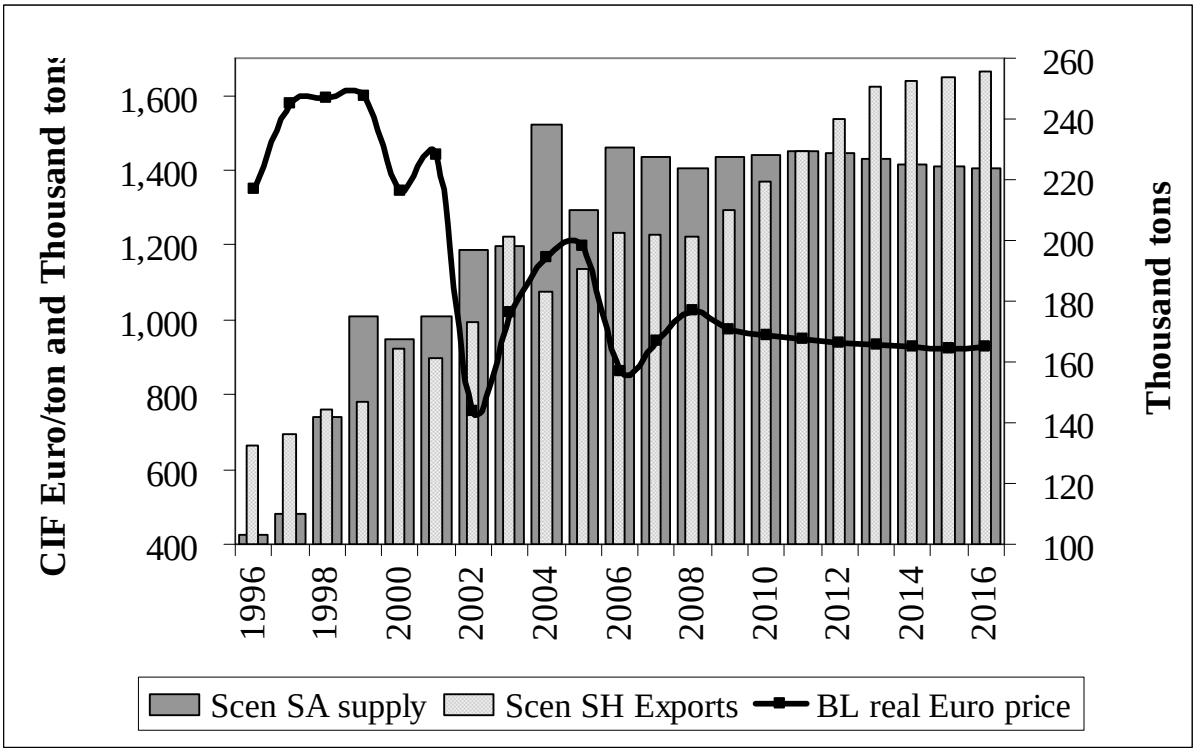

Figure 4: The export market for South African grapes

The projected depreciation in the exchange rate serves as buffer against the declining Euro price, resulting in increasing Rand prices shown in Table 2. However, the depreciation in the Rand is not sufficient to ensure real increases over the baseline period. The average export price is projected to decline in real terms from 2009 to 2012, before it starts to recover from 2013 onwards.

Table 2: Nominal prices of fresh grapes (Rand/ton)

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Export price (free on board) – Rand/ton										
6,072	7,787	10,019	10,054	10,396	10,692	11,051	11,612	12,368	13,152	14,003
Domestic price – Rand/ton										
4,605	5,116	5,679	5,972	6,346	6,757	7,239	7,787	8,433	9,172	9,988

Table 3: Percentage changes in real prices of fresh grapes

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Export price										
-26.2	17.9	17.9	-5.1	-2.0	-2.0	-1.4	0.5	1.9	1.8	2.0
Domestic price										
3.4	2.1	1.7	-0.5	0.7	1.4	2.2	2.9	3.6	4.1	4.3

Although the local market for fresh grapes is small compared to the export segment, this market might become increasingly important should prices in the export market remain under pressure. The domestic market for fresh fruit

showed excellent growth over the past seven years. The real price of table grapes increased on average by 2% per annum, while volume traded also increased by 2% per annum. The slow down in the economy and the high inflationary pressure is projected to put downward pressure on the local price over the next two years, but from 2010 onwards real prices are projected to increase at an increasing rate over the remainder of the baseline period as macro-economic conditions in the economy improve.

6. Answering "What if…" questions

As mentioned before, the future is characterised by risk and uncertainty. Key uncertainties for the South African table grape industry include movements in the exchange rate, economic growth and disposable income in South Africa, the EU and other export destinations, weather conditions, future export volumes from other SH countries, access to new markets, non-trade barriers, oil prices and the impact thereof on shipping costs, etc. All of these factors influence either demand or supply and prices. The model discussed can serve the purpose of analysing different possible future scenario's by answering "what if" questions. The results of two "what if" questions are discussed in this section.

Export supply of fresh grapes from other Southern Hemisphere countries increased on average by 7% per annum from 1999 to 2006. Export volumes from Chile and SA, the largest and second largest exporters of fresh grapes in the Southern Hemisphere, increased respectively by 6% and 4% per annum over this period. Over the same time, the average price received for South African grape exports declined on average by 9% per annum in real terms. Based on the decline in price and profit margins over the past five years, the assumption in the baseline is that exports from other Southern Hemisphere countries will slow down to 1% per annum. But, what if export volumes from South Africa's competitor countries continue to increase by 7% per annum for the next five years?

The model results show that under this scenario there would be an additional 88 million cartons in the market by 2016. This extra volume will put prices under tremendous pressure as shown in Figure 5. The estimated Euro price for South African grapes will reach an all time low in 2013, where after it is projected to recover slowly as South African supply declines and volume from the rest of the Southern Hemisphere stabilises. The decline in supply of South African grapes is due to production being shifted from the export market to the domestic market and drying segment, and also due to less plantings and consequently lower production.

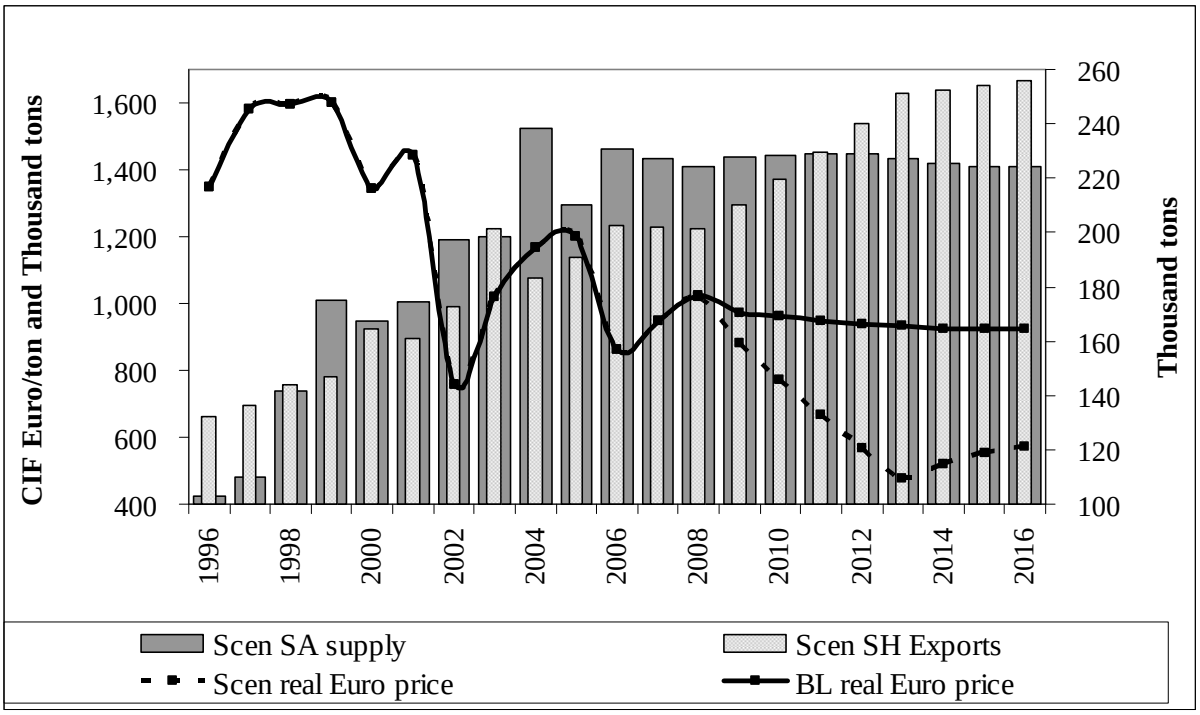

Figure 5: Average CIF Euro price for SA grapes under scenario of higher SH export supply (constant 2000 prices)

In rand terms, the average real export price is projected to decline sharply to R2600 (constant 2000 prices) in 2013 (vs. R5200 in the baseline), which is R800 below the domestic price (see Figure 6). After two consecutive years of lower returns in the export market compared to the domestic market, volumes are projected to shift from the export to the local market, resulting in the domestic market price to plummet to R3000/ton. The lower export volumes (and stabilising Southern Hemisphere supplies) support the export price and both prices drift upwards over the remainder of the baseline period. By 2016 volume sold fresh in the local market is almost 6% higher than the baseline level, despite a decline of 5% in total production relative to the baseline. Total exports are 8% lower than the baseline level.

Another possible scenario is the impact of opening up new markets on the average export price. It is often argued that South Africa is not creating trade and opening new markets. Seventeen years ago 85% of our trade went to European countries and in 2007 84% of table grape exports were destined for Europe. However, few people realise that table grape exports increased by 163,000 tons over this period, which is an increase of more than 250%. In 2007, SA exported almost 8.3 million cartons to non-EU countries, which are 2.8 million cartons more than in 2001.

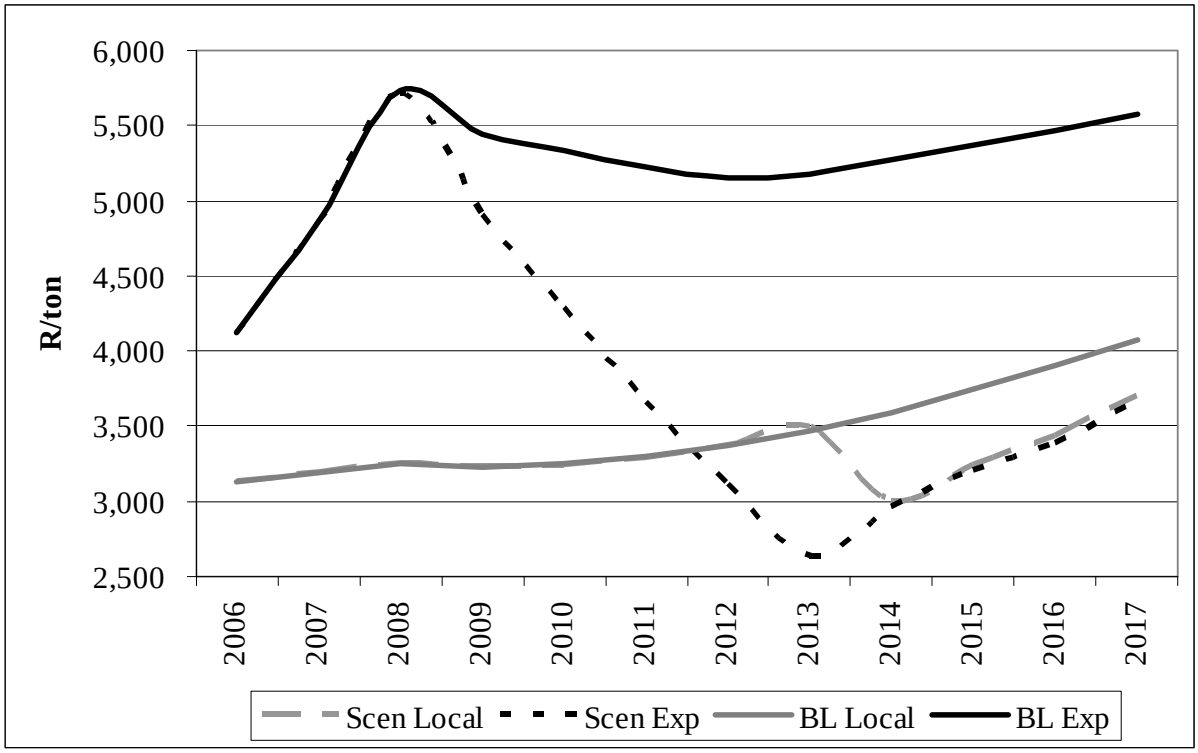

Figure 6: Average real Rand prices for SA grapes under scenario of higher Southern Hemisphere export supply (constant 2000 prices)

Consider the impact of increasing export demand by another 2.8 million cartons over the next six years. We shall probably not see an increase of 2.8 million cartons, because it is unlikely that supply can match this quantity. The model results show that additional demand increasing linearly to reach 2.8 million cartons in 2014 will lead to an average export price of R17,600/ton in 2016. This translates to a real price of R6,900/ton, a price level similar to that of the early 2000's. However, by 2016 production will be 2.3% higher compared to the baseline level, resulting in relatively higher supply in the domestic market and therefore relatively lower prices (see Figure 7).

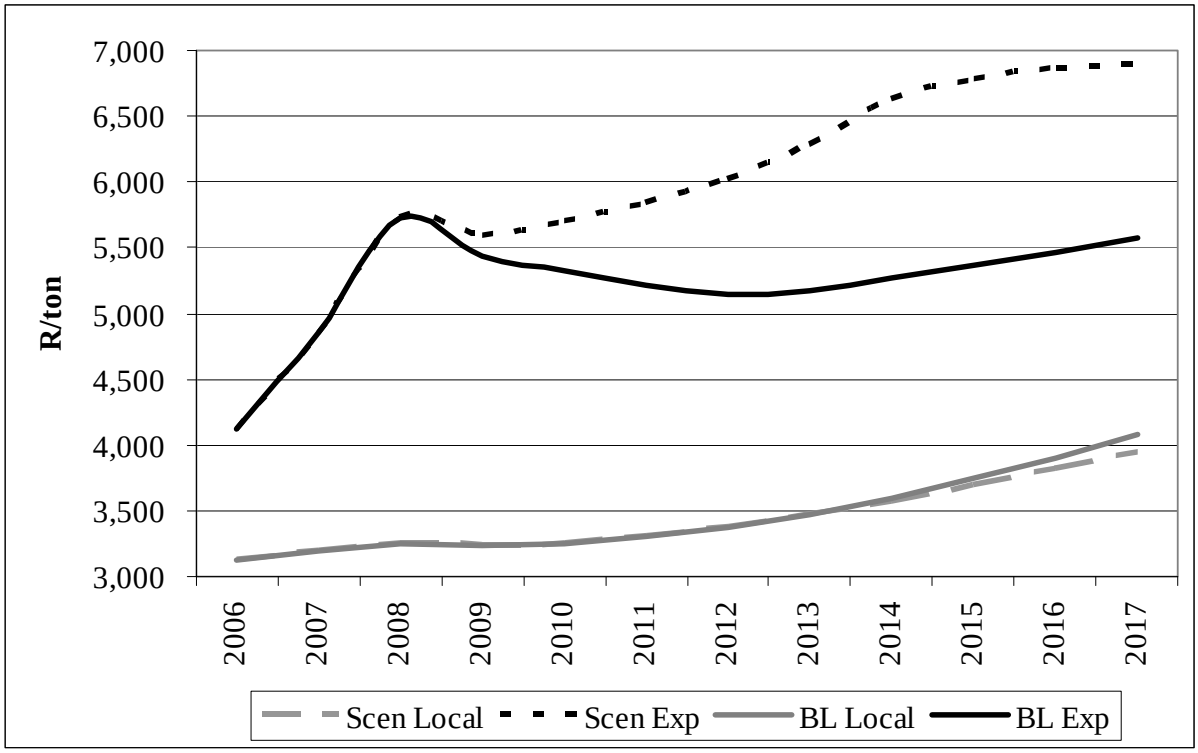

Figure 7: Average real Rand prices for SA grapes under scenario of increased demand (constant 2000 prices)

7. Concluding remarks

The table grape industry has a long history of declining real prices, but in the wake of rising input costs and global food inflation the past two seasons of increased returns in the export market incites hope for a reversal of the downward price cycle. The partial equilibrium model presented in this paper is a tool to provide different possible future outlooks for the table grape industry, depending on the global macro-economic outlook. The model is not developed for the purpose of forecasting, but rather for the purpose of informing government, industry, producers and business on the dynamics of the industry and should be regarded as one of the tools in the planning process. The model is also a method for teaching role-players more about the dynamics of the industry.

The results presented in this paper clearly illustrate the importance of demand and supply in the determination of prices. In the baseline outlook, where the exchange rate depreciates, global economic growth slows down, supply from other Southern Hemisphere countries increase at 1% per year and no new markets are penetrated, the real export realisation price is projected to stabilise between R5000/ton and R5500/ton (constant 2000 prices) over the next eight years. However, should supply from other southern hemisphere continue to increase at the historical rate of 7% per annum, the South African industry

faces a pale future of continuing declining prices. On the other, if the industry can repeat the history and manage to increase demand for South African grapes by opening new markets the export price might set on an upward trend for the first time in 20 years.

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Appendix

List of variables in the model

Abbreviation	Unit	Explanation	Source
TGTASA	Hectares	Total hectares of table and dried grapes in SA	Deciduous Fruit Producers Trust (DFPT)
TGPRDSA	Tons	Table and dried grape production in SA	DFPT/Department of Agriculture (DoA)
TGEXPSSA	Tons	Table grape fresh export supply from SA	DFPT/DoA
TGDRIEDSA	Tons	Table and dried grapes used for processing and drying in SA	DFPT/DoA
TGFMSSA	Tons	Table and dried grapes sold as fresh in domestic market	DFPT/DoA
TGPRESSA	Tons	Table and dried grapes delivered for pressing in SA	SAWIS
TGEXPDSA	Tons	Total export demand for SA table grapes	PPECB
TGFMDSA	Tons	Total domestic demand for fresh table grapes in SA from Nov to Apr	DFPT/DoA
$TGPCEXPSA_i$	Kg/person/season	Per capita export demand for grapes from SA per country	Calculated
TGPCFCSA	Kg/person/season	Per capita consumption of fresh grapes in SA from Nov to Apr	Calculated
TGEXPPSA	Rand/ton	Table grape export price (free on board price)	DFPT/DoA
TGFMPSA	Rand/ton	Table grape fresh market price in SA	DFPT/DoA
TGDRIEDPSA	Rand/ton	Price of grapes delivered for drying	DFPT/DoA
TGPRESPSA	Rand/ton	Price of grapes delivered for pressing	SAWIS
TGREXPPSA	Rand/ton (Constant 2000)	Table grape real export price	Calculated
TGRFMPSA	Rand/ton (Constant 2000)	Table grape real fresh market price	Calculated
TGRDRIEDPSA	Rand/ton	Real price of grapes delivered for drying	Calculated
TGRPRESPSA	Rand/ton	Real price of grapes delivered for pressing	Calculated
TGWAVERPH	Rand/ton	Weighted average return per hectare	Calculated
$TGRCIFPSA_i$	Foreign currency/ton	Table grape real price in foreign currency of export destination	Calculated
$EXCH_i$	Rand/foreign currency	Rand exchange rate per country	Global Insight

RPCGDPSA	Rand (Constant 2000)	Per capita real GDP of SA	Global Insight
$RPCGDP_i$	Rand (Constant 2000)	Per capita real GDP per country	Global Insight
POPSA	Million people	Total population of SA	Actuarial Society of SA
POP_i	Million people	Total population of export destination country	Global Insight
OTSHEXP	Tons	Total fresh grape exports from other Southern Hemisphere countries	FAO
RAISINWRLDPRD	Tons	World production of raisins	FAO
DUMMY99		1999 = 1, rest = 0	
SHIFT97		Shift variable (1997 onwards = 1)	
SHIFT98_00		Shift variable (1998 to 2000 = 1, rest is = 0)	

Estimated equations

Table and dried grape area harvested

	C	TGTASA(-1)	WAVERPH	DUMMY04
Coefficient	1,151.77	0.91	0.01	2,611.30
Elasticity		0.91	0.06	

Table and dried grapes pressed

	C	TGPRESSA (-1)	TGPRDSA	TGRPRESPSA	SHIFT97
Coefficient	-5,449.06	0.03	0.13	28.16	-13,894.84
Elasticity		0.03	0.92	0.26	

Table grapes fresh domestic supply

	C	TGFMSSA (-1)	TGPRDSA	TGRFMPSA/ AVE(TGREXPPSA, TGREXPPSA(-1))	TGRFMPSA - TGREXPPSA	SHIFT97
Coefficient	7,858.06	0.03	0.03	1,367.99	80.00	-1,746.59
Elasticity			0.57	0.16	1.25	

Table grape export supply

	C	TGEXPSSA (-1)	TGPRDSA	AVE(TGREXPPSA, TGREXPPSA(-1))/ TGRDRIEDPSA(-1)	AVE(TGRFMPSA, TGRFMPSA(-1))/ AVE(TGREXPPSA, TGREXPPSA(-1))
Coefficient	-33,322.04	0.01	0.40	3,204.58	-1121.96
Elasticity			0.93	0.10	-0.003

Per capita consumption of fresh table grapes in SA

	C	TGRFMPSA	RPCGDPSA
Coefficient	0.660000	-0.000085	0.000010
Elasticity		-0.45	0.27

EU-15 per capita export demand

	C	RPCGDPEU15	TGRCIFEU15	OTSHEXP
Coefficient	0.7080359	0.0000102	-0.0001477	-0.0000002
Elasticity		0.50	-0.40	-0.43

Hong Kong per capita export demand

	C	RPCGDPHK	TGRCIFHK	OTSHEXP
Coefficient	2.07424	0.0000112	-0.0000271	-0.0000008
Elasticity		0.40	-0.40	-0.86

United Arab Emirates capita export demand

	C	RPCGDPUAE	TGRCIFUAE	OTSHEXP
Coefficient	1.0362919	0.0000111	-0.0000226	-0.0000003
Elasticity		0.50	-0.20	-0.43

Saudi Arabia capita export demand

	C	RPCGDPSAUA	TGRCIFSAUA	OTSHEXP
Coefficient	0.1276466	0.0000049	-0.0000031	-0.00000004
Elasticity		0.65	-0.20	-0.43

United States of America capita export demand

	C	RPCGDPUSA	TGRCIFUSA	OTSHEXP
Coefficient	0.06873848	0.00000021	-0.00000553	-0.00000004
Elasticity		0.50	-0.40	-1.72

Canada capita export demand

	C	RPCGDPCA	TGRCIFCA	OTSHEXP
Coefficient	0.3939359	0.0000023	-0.0000255	-0.0000002
Elasticity		0.50	-0.40	-1.29

Russia capita export demand

	C	RPCGDPRU	TGRCIFRU	OTSHEXP
Coefficient	0.02220391	0.00000280	-0.00000013	-0.00000001
Elasticity		0.65	-0.40	-0.86

Malaysia capita export demand

	C	RPCGDPMA	TGRCIFMA	OTSHEXP
Coefficient	0.04731114	0.00001000	-0.00000565	-0.00000003
Elasticity		0.65	-0.40	-0.43

Thailand capita export demand

	C	RPCGDPTH	TGRCIFTH	OTSHEXP
Coefficient	0.01815081	0.00000320	-0.00000009	-0.00000001
Elasticity		0.65	-0.40	-0.43

Other export demand

	C	TGEXPQOT(-1)	TGEXPPSA	OTSHEXP
Coefficient	11,168.894	0.537	-0.330	-0.004
Elasticity		0.54	-0.30	-0.43

Price for dried grapes

	C	TGRDRIEDPSA (-1)	TGRFMPSA (-1)	TGDRIEDSA	RAISIN WRLPRD	SHIFT98_00
Coefficient	1,896.938	0.057	0.167	-0.005	-0.001	250.895
Elasticity			0.49	-0.77	-0.0004	