ECONOMIC EFFECTS OF MARKET AND TRADE LIBERALIZATION ON AGRICULTURE IN THE WESTERN CAPE PROVINCE OF SOUTH AFRICA

J. van Zyl[1], R.F. Townsend[2] and N. Vink[3]

This paper attempts to estimate the effects of some of the changes in the marketing system on the Western Cape Province of South Africa, utilizing a regional linear programming model of the agricultural sector of the region. The model includes supply, demand and production risk, and simulates the present agricultural production structure well. Market and trade liberalisation have major impacts on the structure of Western Cape agriculture, particularly the grain and livestock sub-sectors, with only marginal and mostly insignificant effects on horticultural products.

EKONOMIESE EFFEKTE VAN MARK- EN HANDELSLIBERALISERING OP DIE LANDBOU IN DIE WES-KAAP PROVINSIE

In hierdie artikel word gepoog om die uitwerking wat sommige veranderings in die bemarkingsisteem op die Wes-Kaap met behulp van 'n regionale lineêre programmeringsmodel van die landbousektor van die stree te bepaal. Die model sluit aanbod, vraag en produksierisiko in en is 'n goeie simulasie van die huidige produksiestruktuur. Mark- en handelsliberalisering het 'n groot impak op die struktuur van die Wes-Kaapse landbou, veral op die graan- en lewendehawesubsektore, met slegs marginale en meestal onbenullige effekte op tuinbouprodukte.

1. INTRODUCTION

South African agriculture has a long history of ever increasing governmental intervention, reaching a zenith in approximately 1980 with a horde of laws, ordinances, statutes and regulations affecting all aspects of agriculture, including prices of and/or access to and/or use of natural resources, finance, capital, labour, local markets, foreign markets, foreign exchange, etc. Political and economic power had become highly concentrated (Kassier & Groenewald, 1992). The policy environment of racial discrimination and price distortions, however, could not be sustained. The period since 1980 is characterised by a reversal of past policies, resulting in removal of the racial

1 *Vice-chancellor and Principal, University of Pretoria.*
2 *Department of Agricultural Economics, Extension and Rural Development,University of Pretoria.*
3 *Department of Agricultural Economics, University of Stellenbosch.*

barriers between black and white agriculture, and increased liberalisation and democratisation of the agricultural sector.

Agricultural marketing reform is a major source of change in South and Southern African Agriculture, as market interventions constituted one of the major instruments of government control (Kirsten & Van Zyl, 1996). The economic effects of these changing policies differ from region to region. This paper attempts to estimate the effects of some of the changes in the marketing system on the Western Cape Province of South Africa, utilising a regional linear programming model of the agricultural sector of the region.

The paper is organised as follows: the next section provides a brief description of the model constructed for the analysis, *i.e.* modelling of supply, demand and risk in the Western Cape agricultural sector. Section three consists of the data requirements, followed by testing of the model for its accuracy and predicting abilities. The model is subsequently used to simulate a number of different policy scenarios. Some recommendations conclude the paper.

2. THE MODEL

Sectoral and regional mathematical programming models in agriculture have been discussed in some detail by a number of authors, including Hazell and Norton (1986). This section concentrates on utilising these procedures in order to model the Western Cape agricultural sector. The characteristics of the Western Cape agricultural sector and in particular the production side thereof were taken mainly from the *'1988 South African Agricultural Census Report'* (CSS, 1993), which provides the most recent comprehensive data on the subject. These characteristics served as the basis for the model described here.

The construction of the model was done in three distinct phases: First the basic model with costs and fixed prices only was assembled. Next, risk was included by using the mean absolute deviation method (MOTAD). Finally, variable product and input prices were modelled by using stepped demand functions, respectively. Each of these three stages is described in detail in earlier publications (Van Zyl, 1995; Vink, *et al*., 1997) and is not repeated here. The base year for the modelling exercise is 1988, the most recent period for which a comprehensive data set is available.

Following from the above, the model consists of three distinct sections, namely the supply side depicting farm production and raw material imports which is characterised by the **supply equations** and the **risk section**, and the

demand for the raw products, depicted by the set of **demand equations**. Transport activities link the supply and demand sections of the model together: each of the ten resource regions or two import 'harbours' can supply any of the three consumption points (the Western Cape region as a whole, and the two export 'harbours', Cape Town and Beaufort West). Supply and demand for each region are treated as if it is coming from a point or one specific locality, rather than from all over a region. This is done to make the treatment of transport costs between and within resource regions easier. Consumption and production points were subsequently developed to facilitate this. This is in line with the assumption that production practices, yields, risk and prices are the same within regions. The model thus has the following sections:

Supply: Production activities for 20 different commodities in each of the 10 resource regions; and import activities of some of the most important commodities (livestock products and winter grains) through any of the two entry points (Cape Town and Beaufort West);

Linking activities: Transport of commodities from any of the 12 supply points (two entry points and 10 regional supply points) to the 3 demand areas, i.e. the consumption point for the Western cape as a whole, and the two exit points (Cape Town and Beaufort West);

Demand: Stepped demand schedules for each of the 20 commodities for its major uses (animal/human consumption within the Western Cape, the rest of South Africa or exports), each consisting of ten steps; and

Risk: Incorporation of production risk (six years of risk data).

The model was structured in such a way as to allow for the easy measurement of producer, consumer and total welfare. The objective function of the model maximises total welfare. The number of activities, risk years and steps in the demand schedules are considered to be enough to allow for the desired degree of sensitivity when simulating policy changes.

3. DATA REQUIREMENTS AND INPUTS

The data requirements are quite formidable as the data are not available in exactly the required format, and several sources had to be used for the collection. The data used for this analysis come largely from the 1988 Census Report describing agriculture in the Western Cape, the Combud publications

of the Department of Agricultural Development, unpublished reports of the Department of Transport and Spoornet, data obtained from the CSS and a number of agricultural marketing boards. As the most recent comprehensive data set was available for the 1988 production year, and given that the 1988 year was considered to be fairly 'normal', this year was chosen for setting up the model. All price and quantity data refer to this year.

For the construction of the model, data requirements are as follows:

(i) production, area/number and yield data for the 20 selected commodities in each of the 10 resource regions;

(ii) production costs for each of the commodities in each of the 10 resource areas;[4]

(iii) c.i.f. prices for each of the commodity imports;

(iv) net export prices of commodities which are exported;

(v) base prices and quantities of commodity consumption (for each of its major uses) in the Western Cape and the rest of South Africa in order to determine the step-wise demand schedules for each region;

(vi) transport costs from every supply point to the consumption (demand) points; and

(vii) risk data consisting of prices and yields of each commodity in each of the regions for the 6 year period 1982-1988.

4. MODEL VALIDATION

The testing of the model was performed by imposing all of the relevant policies which were current in 1988, specifically the marketing and pricing regime for each product, credit policy and other on farm policies, in order to see how well it simulates the current (1988) situation. The better the current situation is represented by the model, the more reliable the model. The values generated by the model corresponds fairly well with the actual values for the

[4] *Ideally, several enterprise budgets are needed for each commodity to model different points on the production function which can capture some of the farmers' reaction to changes in prices. This was not possible in this application as it would have required too many additional assumptions.*

Western Cape as a whole (this is not necessarily true for each of the 13 sub-regions)[5]. If a deviation of 15 percent is deemed acceptable for the model as a general rule of thumb (as suggested by Hazell & Norton, 1986), all the generated production quantities for the Western Cape as a whole are within this limit. A percentage absolute deviation of 6.94 percent across all commodities for the Western Cape (as a whole) is obtained, which is adequate (and even good) for this type of model (see Table 1). The model can thus be accepted as being relatively accurate and can be used for simulating the effects of policy changes with some degree of confidence.

5. RESULTS

The results obtained with the different policy simulations are often a function of the set of assumptions that underpins the analysis. Therefore, explicitly stating some of the most important assumptions which impact on the subsequent results is necessary. Also, the direction of change is often much more important than the actual magnitude of the results obtained. For this reason less emphasis should be placed on the actual results than on the direction of change, while the assumptions which underpin the analysis (many of which are often only implicit) should be considered together with the analysis of the results.

Two policy scenarios were modelled to illustrate the effects of marketing policy changes on production, price and welfare of the major groups involved in the analysis: (i) a free market system with no statutory price fixing or other controls with respect to domestic marketing arrangements of the commodities, and no imports of the commodities (or substitutes) are allowed; and (ii) free market system with respect to the domestic marketing arrangements of the selected commodities, as well as abolishment of controls on imports.

Both these scenarios refer to a situation where the fixed-price single-channel marketing systems for winter grains and the floor price schemes for red meat, eggs and diary products (which were in place in 1988) are abolished and market clearing prices are established through the interaction of supply and demand in a freer market economy (the pool price schemes for exports of

[5] *In some of the sub-regions where very small amounts of a specific commodity are produced, the model predicts a relatively large deviation (increase or decrease) of up to 75 percent of the actual production, but in absolute terms these variations are small and insignificant. Where a specific commodity is important in a region, the model predicts both the relative and absolute production levels fairly accurately.*

citrus, deciduous fruit, wool and mohair are maintained) (see, for example, Meyer and Van Zyl, 1992, for a similar exercise). This situation allows for the establishment of different prices for each commodity in the Western Cape region and the rest of South Africa (e.g. with respect to wheat) for each of its uses, depending on the supply, demand and transport situation.[6]

The selected key variables, which are monitored to determine the effects of policy changes, include areas under production, employment, prices and welfare values. The values of these variables for the base scenario is used as a basis for comparison in each case. The base values were derived by imposing all the relevant current (1988) policies, and then maximising total welfare (with specific restrictions in place to model the current situations more realistically). Important is that all other variables, for example transport costs, exchange rates, international prices and interest rates, stay the same for each scenario.[7]

5.1 Domestic market liberalisation

Table 1 shows that when domestic markets become freer and no imports are allowed, the production of commodities with marketing systems heavily regulated by statutory controls will be influenced most. In particular, production of wheat and other winter grains, and numbers of cattle and sheep are affected most.

Liberalization of grain markets, specifically wheat, is the key to explaining the changes in production. Abolishment of the single channel fixed price scheme for wheat causes the prices of wheat to decrease by nearly 6 percent. This causes a decline in wheat production of more than 25 percent. The land freed up in this way is partly used for the increased production of other crops, specifically barley and oats. However, by far the largest portion is used for increasing livestock production, in particular in the production of dairy products and wool. Most of the other production changes are insignificant.

---

[6] *An important consideration (and limitation of the analysis) is that it is assumed that market liberalisation will not affect agricultural input prices (credit and labour excluded). It can be argued that it should also be taken into account (the structure of the model allows for easy incorporation). However, for this specific application, it was assumed that the monopolistic structure of competition between agricultural input suppliers will not allow for significant benefits in this respect (see, for example, Van Zyl and Groenewald, 1988).*

[7] *This is restrictive, but allows for evaluation of the effects of the specific scenario in relative isolation.*

The freer market scenario negatively impacts on the producer prices of wheat, as well as the other two winter grains, while the price changes in other crops which were not influenced by statutory marketing arrangements (or to a lesser extent), are largely insignificant. The latter is not true for prices of controlled livestock products -- prices of dairy products, beef, mutton and pork decline significantly.[8]

These tendencies cause the producer surplus to increase relative to that of the base scenario. On the other hand, consumers benefit from the lower prices with the result that the consumer surplus is nearly 6 percent higher than in the case of the base scenario. The net effect is that the total surplus is also higher than in the base scenario.

This scenario clearly demonstrates how domestic marketing policies of specifically winter grains, dairy products and red meat have distorted production patterns in the Western Cape and how this has resulted in a social cost to the region and the country. The magnitude of this social cost is the opportunity cost of following other strategies, in other words the decrease in total welfare resulting from sub-optimal policy environments. Employment in agriculture is 7.5 percent higher than in the base scenario.

5.2 Trade liberalisation

When the marketing systems of the controlled commodities discussed above are liberalised, and import controls are abolished (with the assumption of a zero tariff level), the results are similar to these described above, but they are much more accentuated.

Production changes are again driven by changes in the wheat scenario. Because of the sharp decline in wheat prices (of nearly 33 percent) to import parity levels, most of the wheat requirements of the region are imported, with the result that wheat production declines a staggering 85 percent. This large chunk of land freed up in the process, goes partly towards the expansion of oats and barley production, but is again largely used for increased livestock production. In particular, the production of export products like wool and mohair (and mutton as a by-product) gets a major boost -- these products do

[8] *As expected, there is a direct correlation between marketing control and production changes. Those commodities with the most intervention and control in their marketing regimes, and thus also deviation from market-clearing equilibria, show the largest changes.*

not have the same limitations of a finite and often limited domestic (both within the region and elsewhere in South Africa) market and demand and have relatively large price elasticities of demand.

The above process goes hand in hand with decreases in prices of all commodities, although changes for all export oriented commodities (both fruit and livestock products) are insignificant. Particularly negatively affected are prices of diary products and red meat, with declines of more than 10 percent. However, livestock production mainly on planted pastures still seems to be a better option than wheat production due to the relatively greater drop in wheat prices to import parity levels.

These processes cause producer welfare to decrease significantly by more than 20 percent relative to the base scenario. On the other hand, consumer welfare increases by more than 12 percent. In spite of the lower producer surplus, the increase in consumer welfare is the major factor in an increase of nearly 9 percent in total welfare relative to the base scenario. This scenario clearly demonstrates how the marketing policies and specifically the trade policy of not allowing free trade cause a welfare transfer from consumers to producers, and resulted in a social cost to the economy as a whole (see section above). The marketing and trade policies followed clearly benefited producers and imposed a cost on consumers and the society as a whole.

The employment level in Western Cape agriculture is 7.1 percent more than in the base scenario, it is marginally lower than when imports are not allowed. Importation of agricultural commodities thus results in the loss of some employment opportunities, albeit nearly insignificant in magnitude.

5.3 Summary

The results in Table 1 show that market and trade liberalisation has major impacts on the structure of Western Cape agriculture. These impacts are, however, targeted on the grain and livestock sub-sectors, with only marginal and mostly insignificant and negligible effects on horticultural products, both vegetables and fruit. This is directly related to the degree of statutory control and intervention associated with the marketing process of these commodities: where intervention is severe, as in the case of grain and livestock (which are also related to each other because they are dependant on each other), the changes are relatively large and significant; where marketing is relatively free, as in the case of vegetables and fruit, changes are relatively small and insignificant.

Table 1: Comparison of modelled changes in the marketing system with base values

Measure	Item	Actual values 1988	% deviation of modelled base values from actual values (%)	% deviation of simulation results from base values (%)	
				Without imports	With imports

	Production of crops (ton):	**(ha)**	**(%)**	**(%)**	**(%)**
	Field crops:				
	- wheat	519808	-3.1	-25.5	-84.6
	- barley	133935	7.3	5.5	12.6
	- oats	136443	4.2	5.8	15.8
	Vegetables:				
	- potatoes	11196	7.9	1.5	2.5
	- onions	2967	-1.5	2.3	2.9
	- other	17306	-4.4	1.8	3.6
	Fruit:				
	- oranges	5157	-2.3	0.4	0.6
Production	- apples	14167	5.6	0.3	0.4
	- pears	8334	8.2	0.3	0.5
	- peaches	8969	7.3	0.3	0.4
	- table grapes	9112	11.2	0.5	0.5
	- wine grapes	84864	-3.1	2.9	3.1
	Number of livestock:	**(number)**	**(%)**	**(%)**	**(%)**
	Dairy cattle	227719	7.9	24.5	28.4
	Beef cattle	120682	-13.4	7.4	11.6
	Wool sheep	2865970	10.1	28.3	45.2
	Non-wool sheep	579848	-12.7	8.2	12.9
	Angoras	410319	-14.2	3.6	7.6
	Pigs	188744	7.7	1.1	2.4
	Chickens	14952938	-2.5	0.7	1.2

Prices	Field crops:	**(%)**	**(%)**
	- wheat	-5.8	-32.4
	- barley	-2.5	-3.4
	- oats	-4.1	-5.3
	Vegetables:		
	- potatoes	-0.5	-0.9
	- onions	-2.1	-4.4
	- other	-0.3	-0.8
	Fruit:		
	- oranges	-0.2	-0.2
	- apples	-0.1	-0.2
	- pears	-0.1	-0.1
	- peaches	-0.1	-0.1
	- table grapes	-0.3	-0.4
	- wine grapes	-2.1	-2.9
	Livestock:		
	- dairy products	-12.9	-14.5
	- beef	-11.2	-15.1
	- wool	-0.4	-2.7
	- mutton	-10.9	-14.9
	- mohair	-0.1	-0.2
	- pork	-9.1	-15.6
	- broilers	-0.3	-4.3
	- broilers	-0.3	-2.9
	- eggs		
Welfare	Producers	6.8	-21.5
	Consumers	5.9	12.2
	Total	6.0	8.8
Farm Jobs	Farm employment (jobs)	7.5	7.1

6. CONCLUSIONS

The conclusions which are drawn from this analysis, subject to the numerous assumptions made, are that market reforms leading to increased market liberalisation, and in particular the lifting of controls on wheat imports, will have major impacts on the grain and livestock sub-sectors, while not influencing fruit and vegetable production much. The major points with some policy reference which arise from this are that:

(i) the grain and livestock sectors are influenced by the simulated policy changes, while the horticultural industry, which seems to be pretty efficient and competitive, is not affected to any significant extent; and

(ii) full market liberalisation with no import tariffs will impact extremely negatively on grain farm profitability.

These conclusions are directly related to the many assumptions employed and shortcomings of the modelling approach followed. All of these limit the use of the model as it is, but does not invalidate the results given these specific assumptions.[9] However, some of these assumptions which have major implications on the specific outcomes are clearly unrealistic, for example the assumption of a zero tariff level on the imports of wheat. Nonetheless, it gives a feel for the magnitude, and more important the direction, of changes that can be expected in different scenarios. In this respect, this study often raises more questions than answers, but serves as a base for further analysis.

REFERENCES

CSS, (1993). *1988 South African agricultural census report.* Report No. 11-02-02, Pretoria : Central Statistical Services.

HAZELL, P.B.R. & NORTON, R.D. (986) *Mathematical programming for economic analysis in agriculture*. New York : Macmillan Publishing Company.

[9] *Virtually all of these limitations/assumptions can be addressed by incorporating more scenarios and enlarging the model. However, to do this requires even more assumptions (often based only on subjective intuition) which require seperate studies on their own just to validate or justify. There is little point in doing it here as this is not the objective of this analysis. Some of these scenarios, however, have been addressed in follow-up work (see Vink, et al., 1997).*

KASSIER, W.E. & GROENEWALD, J.A. (1992). Agriculture : an overview. *In*: R. Schrire (ed). *Wealth or Poverty? Critical choices for South Africa*. Cape Town : Oxford University Press.

KIRSTEN, J.F. AND VAN ZYL, J. (1996). The contemporary agricultural policy environment : Undoing the legacy of the past. In: Van Zyl, J, Kirsten, J F & Binswanger, H P (eds) *Agricultural Land Reform in South Africa: Policies, Markets and Mechanisms*. Oxford University Press, Cape Town.

MEYER, N.G. & VAN ZYL, J. (1992). Comparative advantages in development Region G : An application of a sectoral linear programming model. *Agrekon,* 31(4).

VAN ZYL, J. (995). *Modelling the Western Cape agricultural sector.* Unpublished Report, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria: 53 pp.

VAN ZYL, J. & GROENEWALD, J.A. (1988). Effects of protection on South African commercial agriculture. *Journal of Agricultural Economics*, 39(3):387-401.

VINK, N., VAN ZYL, J., VAN SEVENTER, D. & ECKERT, J.B. (1997). The macroeconomics of rural livelihood creation in the Western Cape Province: Macro effects. In: Lipton, M, De Klerk, M & Lipton, M (eds) *Land, Labour and Livelihoods in Rural South Africa - Volume 1: Western Cape*. Durban : Indicator Press : 51-70.