CHAPTER 6

SUMMARY AND RECOMMENDATIONS

This study presents an alternative regime-switching methodology to allow multisector simulation models to switch between various techniques of model closure in order to simulate the most realistic formation of equilibrium prices. The first part of this study provided the theoretical foundation of price formation and model closure. This included an overview of literature to illustrate the uniqueness of the methodology that was developed in this study. While the existing regime-switching models switch between various intercepts and/or parameter estimates of specific single equations, the switch in this study occurs between the various model closure techniques that each consist of a combination of single equations and identities with different intercepts and parameter estimates. Hence, this study focused on equilibrium pricing conditions and the relevant model closure to enable the correct formation of prices under distinct trade regimes in a multi-commodity model, rather than just price transmission and market integration between distinct markets.

The next step was to identify the alternative market regimes in the various grain markets. The fact that trade occurs, even though prices are not trading at parity levels, implies that there might be some level of integration between domestic and world markets under autarky. Analyses show that, contrary to economic theory, there is indeed some level of integration between domestic and world markets when domestic markets are trading under what this study refers to as near-autarky. A detailed discussion followed on the concepts of model closure and price formation under various market regimes. Flow and price-quantity (P-Q) diagrams were used to provide easy guidance towards the understanding of important economic and biological relationships.

The next section of the study presented the empirical results. A clear distinction was made between the previous version of the BFAP sector model and the redesigned regime-switching sector model. The domestic supply and demand components of the existing model remained unchanged. The estimated results of the redesigned price and trade equations include the parameter estimates, p-values, R^2, Durban Watson statistics (DW), and the elasticities. The elasticities were calculated at the mean values of the corresponding variables. The empirical results were followed by a detailed discussion of the technical implementation of the switching mechanism in the model. In short, the redesigned sector model is made up of the demand and supply components from the previous version of the sector model, redesigned price and trade equations for alternative market regimes, and most importantly, a switching mechanism that allows the model to switch between various model closure techniques that are dictated by the equilibrium pricing conditions.

In the last section various approaches were used to test whether the redesigned sector model complies with the hypothesis of this study. The first approach involved the simulation of baseline projections under a combination of different trade regimes in the grain markets. Ten percent shocks in parity prices were imposed on the alternative baseline projections to calculate absolute and percentage deviations (impact multipliers) from the baseline. The second approach illustrated the usefulness of the automated switch between the various model closure techniques by comparing *ex-post* simulation results of the regime-switching model to the results of the pre-existing sector model. Results proved that the previous sector model, which does not consist of a switching mechanism, simulated unrealistic results under switching market regimes. The last approach presented a more hands-on application of the regime-switching model to real-life examples by analysing the impact of a combination of market- and policy-related shocks in the form of scenario analysis.

This study has proven that the redesigned regime-switching model is able to capture a richer variety of market behaviour than standard models as a result of the regime-switching innovation outlined, therefore capturing more accurately the likely effects of shocks on the domestic market. It is therefore consistent with the hypothesis that with the correct model structure and closure, a combination of modelling techniques can be applied to develop a simulation model that is able to generate reliable estimates and projections of endogenous variables under market-switching regimes. The regime-switching model is, by design, more rigorous than the previous sector model in that it emphasises price formation and correct model closure under alternative regimes. Over the past production seasons a number of local agribusinesses have tested and applied this model successfully in the field of scenario planning and analyses. Although the model is particularly appropriate for the South African grain market as specified here, it provides a template for which models for other countries and commodities may be developed.

This study identified a number of important issues that need to be addressed in future studies. The first point that needs to be made is that the focus of this study fell predominantly on the economic significance and the practical application of the redesigned sector model to real-world issues. The idea of undertaking a study of this nature was initiated through close interaction with a number of agribusinesses and industry experts. The fact that the old sector model could not handle some of the most important features of the industry implied that a new approach had to be developed. The automated switching mechanism added to the flexibility of the model and its ability to model a number of short- and long-run policy and market-related shocks simultaneously. Future studies should focus more on finding statistical tests, specifically a consistent statistical test to test the significance of a regime-switching model with three possible regimes. Although Meyer (2003) did not apply any automated regime-switching methodology when he developed a threshold vector error correction model, he also mentioned the shortcoming of formal statistical tests to test for the significance of having multiple regimes in a model.

The lack of adequate data hampered the applications of more advanced statistical techniques like Error Correction Models (ECM) that, for example, test for the stationarity of the data and provide refined tests of price transmission. The challenge is to develop equilibrium models that are able to reproduce a degree of price transmission consistent with the one estimated under the distinct market regimes, but which are able to switch between the various regimes over the projection period. ECM are frequently used to test for short- and long-run equilibrium, without taking into consideration that regime switching has a major impact on the outcome of the results.

Specific improvements to the regime-switching model include the implementation of the regime-switching methodology for other commodities in the model due to cross-commodity correlations. A regime switch in the major commodity markets, for example maize or poultry, can easily force a change in regime in the smaller commodity markets. The issue of price expectations also needs to be readdressed. One can argue that since the deregulation of the markets and the effective operation of the futures markets, farmers do not respond to price expectations anymore because they have far more accurate price information and the opportunity to fix prices for the full season in advance. Therefore, farmers are not purely backward-looking in developing their price expectations. Hence, if farmers had something more closely approaching rational or even quasi-rational expectations, the model oscillations of the cobweb effect would not happen or at least be mitigated.

To conclude, it is important to categorise the different shifts that can take place in an industry. For example, a shift in trade policy regime could influence the rate of price transmission between spatial markets and thus change the correlation between parity and local market prices, but it will not necessarily induce a switch in equilibrium pricing conditions (i.e. a switch in model closure) for example from import parity to near-autarky for a specific commodity. This implies that if there is no switch in equilibrium pricing conditions, estimation techniques, for instance dummy variables, can be applied to improve parameter estimates under switching policy regimes because the choice of the model closure technique need not change. If, however, a switch in market regimes induces a switch in equilibrium pricing conditions, then an alternative method of model closure has to be implemented.

It becomes far more complex if one takes into consideration that there are a number of exogenous factors/market drivers that could potentially bring on a permanent complete structural shift in the agricultural industry. One needs to make a clear distinction between shifts that have occurred in the past and will appear again in the future, and shifts that have not occurred in the past but where there is a chance that they will occur in future and the outcome of these shifts is uncertain. Adverse weather conditions serve as a good example for the first category of shifts. South Africa has experienced a number of droughts and floods in the past, and the chances are very high that it will occur again. Although adverse weather conditions have caused shifts in equilibrium pricing conditions, the shifts were not of a permanent nature. The regime-switching model has demonstrated that it has the ability to model these non-permanent shifts.

The second category of shifts is trickier to handle. For example, in the eighties and early nineties South Africa occasionally produced a wheat surplus, but since deregulation South Africa has become a net importer of wheat. The shift in marketing policies has, thus, resulted in a permanent structural shift in the industry. This implies that a typical econometric model, where parameter estimates were purely based on historic data before the shift in marketing regimes, would not have been able to project the possible impact of this shift. At a danger of stating the obvious, it is far more difficult to predict the impact of a shift that has not occurred before, compared to a shift that has taken place in the past. The most refined statistical techniques and tests will not provide good estimates of these shifts. Projecting the possible impact of land reform policies also poses a major challenge to any existing simulation model. Land reform policies could lead to a structural shift in the South African agricultural sector that has not occurred before. The advantage of the modelling approach that is developed in this study is that when time series analyses are not realistically applicable due to inadequate or poor-quality data, or just because a complete structural shift that has not occurred in the past could take place in the future, this methodology combines modelling techniques, scenario analyses and industry expertise into a simulation modelling framework that is able to capture the real-world issues of commodity markets.