CHAPTER 5

BASELINE PROJECTIONS, IMPACT MULTIPLIERS, AND SCENARIO ANALYSES

5.1 INTRODUCTION

This chapter illustrates the regime-switching model's ability to generate reliable estimates and projections of endogenous variables under real-world conditions. The main purpose of this chapter is to test the hypothesis formulated in chapter 1. Various approaches are used to test the various aspects of the hypothesis. A useful technique to test a regime-switching model is to introduce a number of shocks in the form of scenario analyses that can cause a market to switch between various market regimes. It is important that the model is able to handle these shocks in the forecasting period.

A shift in world prices, which is imposed on the model under the various regimes, illustrates how the correlation between the world and domestic prices changes as the equilibrium pricing conditions change. The impacts are presented in the form of absolute and percentage effects (impact multipliers). In order to calculate the impact multipliers, the first step is to generate benchmarks under a combination of different trade regimes in the grain markets. These benchmarks are also referred to as baselines and are simulated for the forecasting period. The baseline projections under a combination of different trade regimes in the grain markets are presented in the first section of this chapter. This is followed by the presentation of the impact multipliers of a 10 percent increase in parity prices. According to Baulch (1997), border parity prices are more appropriate to use than world prices since parity prices already include the components like the exchange rates, the transportation costs, and the import tariff. Parity prices were also used in the estimation of the various price and trade components in chapter 4.

Apart from testing the correlation between domestic and parity prices under various trade regimes, an important aspect of the hypothesis that needs to be proven is whether the switching mechanism does actually improve the simulation model's performance. In order to show the usefulness of the automated switch between the various model closure techniques, the *ex-post* simulation results of the regime-switching model and the pre-existing sector model are compared. The previous sector model ignores the possibility of regime switching and just a single method of price determination is used. Section 5.4 compares the modelling results of the previous sector model with the new regime-switching sector model.

The elasticity matrices that are presented in section 5.5 provide a concise summary of a number of price and cross-price effects, production and consumption. The last section of the chapter presents a more hands-on application of the regime-switching model to real-life examples. When this simulation model was first presented to industry experts, it was quickly realised that a theoretical approach does not meet the requirements of the industry to understand the evolution of the sector under alternative shocks. This led to the development of scenario analysis and planning techniques, where the forecasts under a combination of scenarios can be compared to the baseline results. Various scenarios can be developed, including short-term and long-term effects.

5.2 THE BASELINE

A baseline is a simulation of the sector model under agreed policy and certain assumptions with respect to macroeconomics, the weather, and technological change. The baseline does not constitute a forecast, but rather presents a benchmark of what could happen under a particular set of assumptions. Inherent uncertainties, including policy changes weather, and other market disruptions, ensure that the future is highly unlikely to match baseline projections. A baseline can thus be looked upon as a "reference scenario" and can form part of the validation procedures. Many different reference scenarios can be developed under various assumptions, but the application and interpretation of a specific baseline (or reference scenario) will determine the significance of the baseline. This point is emphasized by Westhoff *et al* (2004) who mention that "sometimes analysts will argue that baselines are not important, because what matters is the change from the baseline that results when an alternative scenario is implemented, but the particular provisions of many trade agreements mean that baselines matter, and they often matter a lot".

In order to construct basic price and trade impact multipliers that portray the most important relationships between domestic and world prices and trade flow, three baseline projections are generated under a combination of different trade regimes in the grain market. These combinations are based on the number of regimes under which each market can trade.. The first combination presents the baseline projections where all three grain markets are trading under import parity. The second combination presents the baseline projections where white and yellow maize trade under autarky and wheat trades under import parity. In the third combination of regimes, baseline projections are generated where white maize trades under export parity, yellow maize trades under autarky, and wheat trades under import parity. The various combinations of trade regimes are established by basic assumptions on local weather conditions that influence crop conditions in 2007. These assumptions are introduced in the models in the form of once-off shocks in 2007. The baselines are simulated for the period 2006-2012.

Macroeconomic assumptions and world prices are required for the projection period to simulate the baseline results. In this study only one set of the macroeconomic assumptions and world prices is utilised for the various baseline projections. The macroeconomic assumptions (table 5.1) are based on forecasts prepared by a number of institutions like Global Insight, the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri, and the Actuarial Society of South Africa (for projections on population).

Table 5.1: Macroeconomic assumptions and world price forecasts, 2006 – 2012

Variables	Units	2006	2007	2008	2009	2010	2011	2012
Exchange Rate	c/US$	609.21	648.81	687.73	726.94	766.92	805.26	837.47
Population	Millions	47.64	47.68	47.65	47.54	47.39	47.22	47.04
Real per capita GDP	R/capita	16627.3	17192.6	17759.9	18346.0	18896.4	19444.4	19988.8
CPIF	Index ('00)	143.87	149.91	155.16	161.83	168.47	174.53	181.86
FUEL	Index ('00)	157.61	165.80	173.26	182.45	191.75	200.57	211.00
Freight rates	US$/t	33.72	41.97	48.19	54.44	55.73	57.06	58.44
Harbour costs	R/ton	115.62	120.47	124.69	130.05	135.38	140.26	146.15
Yellow maize, US No.2, fob, Gulf	US$/t	104.19	105.16	106.12	107.09	108.05	109.02	109.98
Wheat US No2 HRW fob (ord) Gulf	US$/t	150.39	153.44	155.50	158.21	160.52	162.43	164.61

Source: BFAP baseline, 2005

Only the most relevant macroeconomic assumptions and world price forecasts are included in the previous table. Harbour costs and freight rates are included to forecast the import and export parity prices for the various grains. It is important to mention that the baseline contains all currently agreed policies on an international as well as domestic level. This implies that trade policies, for example the import tariff dispensations for maize and wheat, will remain unchanged for the projected period.

Baseline projections are presented in the form of tables and figures. The tables present the various endogenous variables generated in the model in the form of crop balance sheets, which include production, consumption and trade. The figures illustrate how domestic market prices are projected to fluctuate in the band, established by the import and export parity price boundaries. Projected imports and exports are also portrayed in the figures. One would expect that if markets are trading under import parity, imports will be high and the domestic price will trade at the upper border parity price boundary, referred to as the import parity price. If, however, the market is trading under export parity, one would expect the domestic price to trade at the lower border parity price boundary, referred to as the export parity price. These figures are similar to the figures presented in chapter 2, but present the price band over the long run. Similar to chapter 2, the domestic market price that is simulated in the model is actually the SAFEX price and is also labelled as such in the figures presented in this chapter.

In order to generate the baselines under the alternative combinations of trade regime, assumptions on the level of domestic production are made. For the first baseline projection all three grains trade under import parity. Hence, a short crop has to be simulated in order for the white and yellow maize models to automatically switch to the import parity closure. As was discussed in chapter 4, the wheat model always closes under import parity. Tables 5.2 through to 5.4 present the first baseline projections where the assumption is made that a severe drought in 2007 reduces the white maize yield to 1.57 ton/ha, the yellow maize yield to 1.02 ton/ha, and the wheat yields in the summer and winter rainfall region to 1.39 ton/ha and 0.87 ton/ha respectively. These extremely low yields are not "far-fetched"/unrealistic since they are in line with the yields that were obtained with the severe drought of 1992.

Table 5.2: Baseline 1 - White maize

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
White maize area harvested	973.0	1590.8	1878.0	1596.9	1525.6	1546.3	1536.1
				t/ha			
White maize average yield	3.64	1.57	3.70	3.73	3.76	3.79	3.82
				Thousand tons			
White maize production	3538.1	2500.0	6953.3	5962.5	5743.1	5866.4	5871.7
White maize feed consumption	644.0	493.2	634.9	670.3	680.3	693.9	709.0
White maize human consumption	3696.1	3545.2	3699.6	3731.6	3712.8	3699.2	3682.1
White maize domestic use	4585.1	4363.5	4659.5	4727.0	4718.1	4718.1	4716.2
White maize ending stocks	1035.4	280.0	1181.3	1346.2	1361.7	1431.1	1488.1
White maize exports	431.2	0.0	1392.6	1099.9	1052.4	1106.4	1121.5
White maize imports	157.7	1108.0	0.0	29.3	42.9	27.4	23.0
				R/ton			
White maize domestic price	1025.6	1394.1	1067.0	995.7	1025.0	1031.5	1043.1

Table 5.3: Baseline 1 - Yellow maize

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Yellow maize area harvested	575.0	984.4	1052.4	995.1	968.7	971.6	970.1
				t/ha			
Yellow maize average yield	4.10	1.02	4.00	4.04	4.08	4.13	4.17
				Thousand tons			
Yellow maize production	2355.7	1000.0	4208.5	4022.7	3956.8	4008.5	4041.1
Yellow maize domestic use	3295.5	3345.4	3447.6	3559.0	3606.5	3657.9	3698.5
Yellow maize feed consumption	3921.7	3763.7	3872.3	3985.4	4030.6	4080.4	4118.8
Yellow maize human consumption	242.3	236.3	242.8	244.4	242.1	240.5	238.3
Yellow maize ending stocks	566.9	230.0	711.9	870.8	913.0	949.8	977.2
Yellow maize exports	98.6	0.0	214.2	218.2	219.1	220.3	220.9
Yellow maize imports	940.0	2426.8	359.9	339.7	335.1	329.0	326.0
				R/ton			
Yellow maize domestic price	976.9	1095.6	968.5	926.7	956.6	970.4	995.9

Table 5.4: Baseline 1 - Wheat

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Wheat summer area harvested	530.5	490.0	481.7	511.3	551.5	572.1	591.0
Wheat winter area harvested	323.5	344.3	328.7	329.5	338.2	345.5	351.2
				t/ha			
Wheat average yield: Summer area	2.71	1.39	2.75	2.77	2.78	2.80	2.82
Wheat average yield: Winter area	1.70	0.87	1.71	1.71	1.71	1.71	1.71
				Thousand tons			
Wheat production	1988.1	980.0	1884.7	1977.4	2113.9	2193.9	2267.2
Wheat feed consumption	90.7	98.8	75.2	63.7	60.9	56.9	54.6
Wheat human consumption	2751.8257	2811.191	2741.9	2716.4	2710.361	2700.38	2694.15
Wheat domestic use	2862.2	2929.7	2836.8	2799.8	2790.9	2777.0	2768.5
Wheat ending stocks	611.2	599.0	587.3	572.0	561.0	550.9	544.1
Wheat exports	123.9	7.5	117.2	131.9	147.4	157.6	166.3
Wheat imports	1003.1	1945.0	1057.6	938.8	813.4	730.6	660.6
				R/ton			
Wheat domestic price	1433.2	1564.2	1685.1	1822.8	1940.9	2054.3	2163.7

The figures below help explain the baseline projections simulated under the first combination of trade regimes. In response to the severe drought conditions, white and yellow maize are imported in 2007. The sharp increase in imports and the corresponding rise in the domestic market prices of white and yellow maize (to the upper border parity price boundary) are consistent with economic theory. Figure 5.2 might be confusing in the sense that the yellow maize market is trading at import parity levels for two years (2006 and 2007) in succession. The yellow maize model is already trading at import parity levels in 2006 due to very low plantings in the 2005/06 production season and not because of any shock that was already introduced in 2006. Chapter 2 explains why the yellow maize market tends to trade under import parity more frequently than the white maize market.

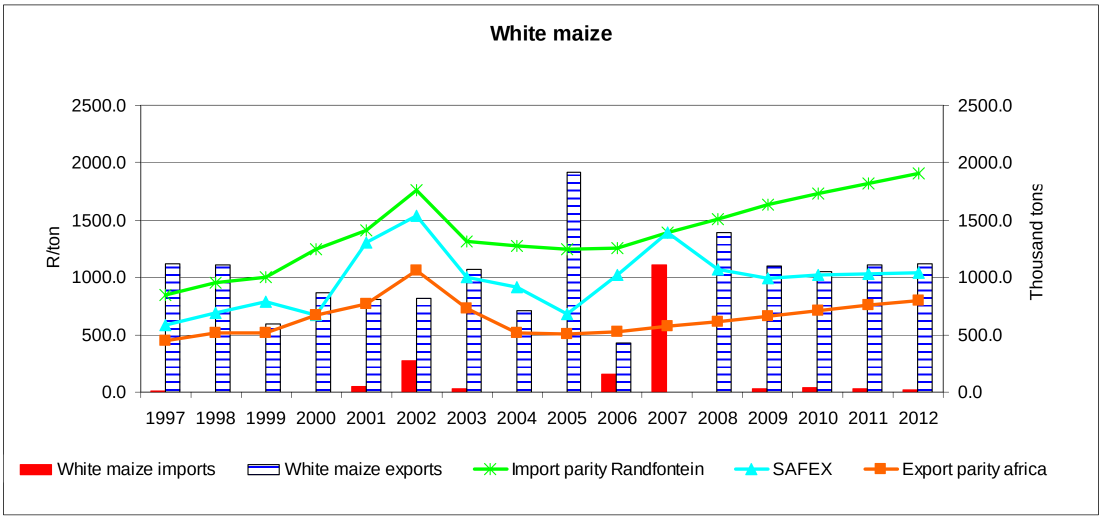

Figure 5.1: Baseline 1 - Price space for white maize, 1997 – 2012

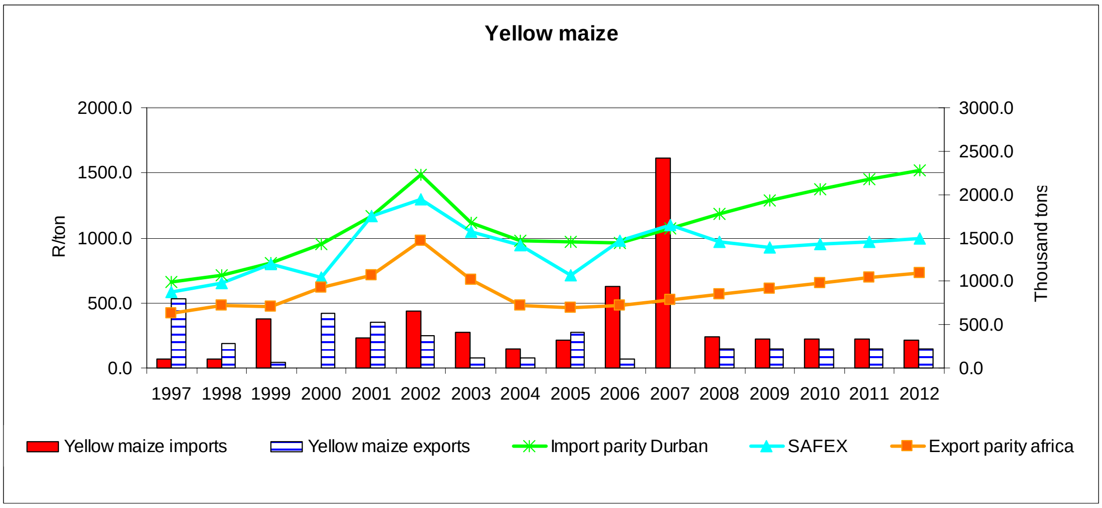

Figure 5.2: Baseline 1 - Price space for yellow maize, 1997 – 2012

Although imports increase sharply in response to a shock in the yields, the wheat domestic price is not affected by the drought conditions because the wheat market has been trading at import parity levels all along. It is interesting to note that figure 5.3 clearly illustrates the structural shift (also mentioned in chapter 2) that took place in the relationship between the domestic price and the import parity price after the sharp decrease in the value of the Rand in 2002. Whereas wheat traded slightly under the Randfontein import parity price before the sharp depreciation of the Rand, the domestic wheat price is now trading right on top of the Randfontein import parity price. Large volumes of wheat are transported to the inland and one can argue that the reference point for the import parity price should be Randfontein.

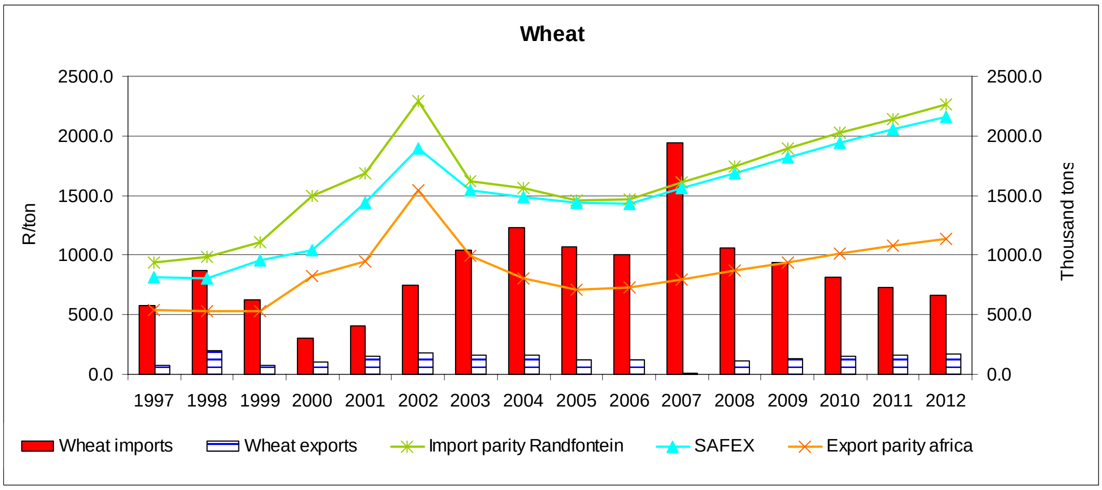

Figure 5.3: Baseline 1 - Price space for wheat, 1997 – 2012

Tables 5.5 through to 5.7 present the second set of baseline projections where white and yellow maize trade under autarky and wheat trades under import parity. Now special assumptions are made and no shocks are imposed to simulate this version of the baseline. Apart from the standard macroeconomic assumptions and world price forecasts, it is assumed that normal weather conditions will prevail into the future. The white and yellow maize markets are trading in near-autarky from 2007 onwards because domestic production meets consumption. The wheat market is trading under import parity. This set of baseline projections is used for the scenario evaluation exercise that is presented in the final section of this chapter.

Table 5.5: Baseline 2 - White maize

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
White maize area harvested	973.0	1613.7	1548.3	1502.5	1549.1	1556.1	1535.8
				t/ha			
White maize average yield	3.64	3.67	3.70	3.73	3.76	3.79	3.82
				Thousand tons			
White maize production	3538.1	5922.1	5732.3	5610.1	5831.6	5903.7	5870.6
White maize feed consumption	644.0	659.0	658.1	656.9	672.4	695.0	709.6
White maize human consumption	3696.1	3745.2	3742.3	3717.4	3708.0	3699.6	3682.7
White maize domestic use	4585.1	4729.2	4725.5	4699.3	4705.4	4719.6	4717.2
White maize ending stocks	1035.4	1237.1	1284.9	1260.2	1344.0	1435.6	1490.8
White maize exports	431.2	1038.3	1013.3	995.0	1077.9	1116.9	1121.3
White maize imports	157.7	47.0	54.2	59.5	35.6	24.4	23.1
				R/ton			
White maize domestic price	1025.6	954.4	969.7	1029.5	1036.9	1030.4	1041.7

Table 5.6: Baseline 2 - Yellow maize

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Yellow maize area harvested	575.0	984.4	977.2	964.6	970.9	968.8	970.3
				t/ha			
Yellow maize average yield	4.10	3.95	4.00	4.04	4.08	4.13	4.17
				Thousand tons			
Yellow maize production	2355.7	3891.9	3907.5	3899.4	3966.0	3997.1	4041.8
Yellow maize domestic use	3295.5	3419.7	3517.0	3566.5	3619.5	3656.5	3698.6
Yellow maize feed consumption	3921.7	3847.8	3945.5	3992.5	4043.8	4078.9	4119.0
Yellow maize human consumption	242.3	246.1	246.5	243.9	242.3	240.4	238.3
Yellow maize ending stocks	566.9	762.2	855.3	885.3	922.7	949.7	977.5
Yellow maize exports	940.0	364.5	347.6	341.1	334.4	329.1	326.0
Yellow maize imports	98.6	213.3	216.6	217.9	219.3	220.3	220.9
				R/ton			
Yellow maize domestic price	976.9	907.7	896.0	935.4	951.6	971.6	995.4

Table 5.7: Baseline 2 - Wheat

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Wheat summer area harvested	530.5	490.0	508.8	532.6	553.9	570.9	590.6
Wheat winter area harvested	323.5	321.4	324.9	332.5	339.7	345.3	351.1
				t/ha			
Wheat average yield: Summer area	2.71	2.73	2.75	2.77	2.78	2.80	2.82
Wheat average yield: Winter area	1.70	1.70	1.71	1.71	1.71	1.71	1.71
				Thousand tons			
Wheat production	1988.1	1885.0	1952.7	2041.5	2123.2	2190.4	2266.1
Wheat feed consumption	90.7	75.4	68.3	65.1	60.8	57.0	54.6
Wheat human consumption	2751.8	2731.2	2724.8	2722.1	2712.3	2700.2	2693.9
Wheat domestic use	2862.2	2826.3	2812.8	2806.8	2792.8	2776.9	2768.2
Wheat ending stocks	611.2	599.8	586.2	572.9	561.7	551.2	544.2
Wheat exports	123.9	118.3	127.5	137.9	148.2	157.3	166.2
Wheat imports	1003.1	1048.3	974.0	890.0	806.6	733.3	661.2
				R/ton			
Wheat domestic price	1433.2	1564.2	1685.1	1822.8	1940.9	2054.3	2163.7

Despite a significant level of trade occurring, baseline projections (figure 5.4 and 5.5) suggest that the domestic prices of white and yellow maize fall consistently within what Barrett (1999) refers to as the "non-tradables band" established by the import and export parity price band. This is typical of the condition of local the market which this study refers to as "near-autarky". Although prices fall in the non-tradables band, trade occurs to neighbouring countries. White and yellow maize prices are projected to decrease in 2007 in response to increased production and then level off as production and consumption stabilise.

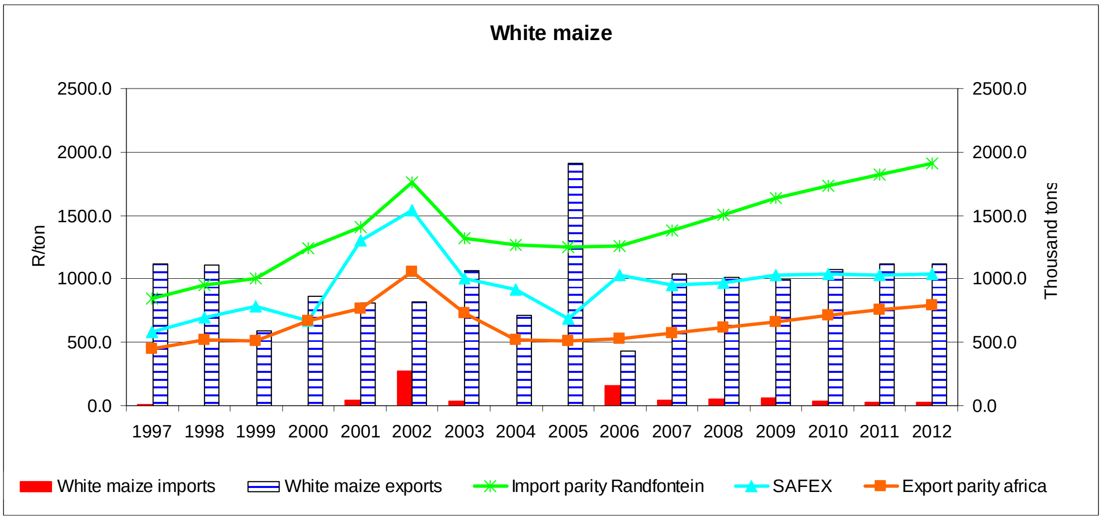

Figure 5.4: Baseline 2 - Price space for white maize, 1997 – 2012

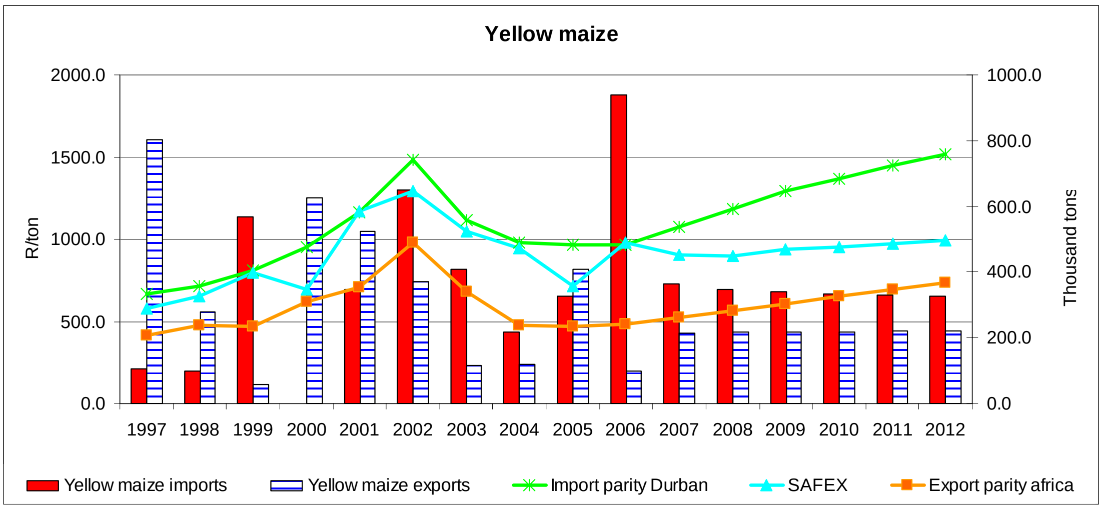

Figure 5.5: Baseline 2 - Price space for yellow maize, 1997 – 2012

The domestic wheat price is projected to increase as import parity prices increase. Although a decline in wheat imports is projected, the wheat market will remain at import parity levels throughout 2012.

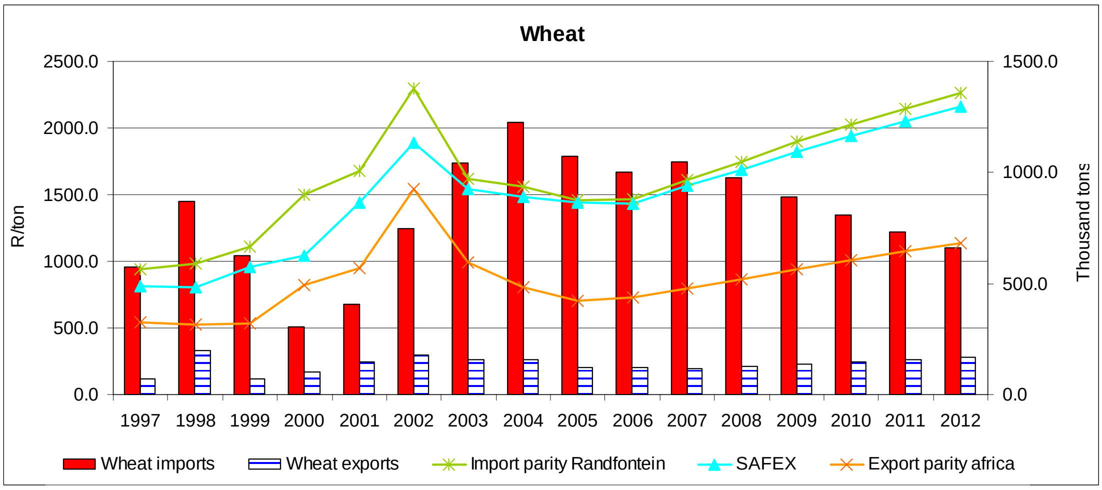

Figure 5.6: Baseline 2 - Price space for wheat, 1997 – 2012

The third set of baseline projections is generated where white maize trades under export parity, yellow maize trades under autarky, and wheat trades under import parity. This combination of trade regimes is established by assuming that favourable weather conditions induce record yields and therefore surpluses that are exported. The white maize model automatically switches to close under the export parity model closure technique, the yellow maize model closes under near-autarky, and the wheat model closes under import parity.

Table 5.8: Baseline 3 – White maize

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
White maize area harvested	973.0	1631.8	1188.2	1450.0	1553.9	1567.0	1535.2
				t/ha			
White maize average yield	3.64	4.83	3.70	3.73	3.76	3.79	3.82
				Thousand tons			
White maize production	3538.1	7800.0	4399.2	5414.1	5849.5	5945.2	5868.3
White maize feed consumption	644.0	749.6	727.0	638.5	669.8	694.4	710.4
White maize human consumption	3696.1	3913.2	3766.5	3711.0	3702.9	3699.9	3683.0
White maize domestic use	4585.1	4987.8	4818.4	4674.5	4697.7	4719.3	4718.3
White maize ending stocks	1035.4	2227.6	1342.6	1216.7	1322.1	1439.5	1492.3
White maize imports	157.7	0.0	164.6	75.2	34.7	20.8	23.3
White maize exports	431.2	1620.1	630.4	940.7	1081.1	1129.2	1120.5
				R/ton			
White maize domestic price	1025.6	585.1	914.7	1044.9	1049.6	1029.6	1040.9

Table 5.9: Baseline 3 – Yellow maize

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Yellow maize area harvested	575.0	984.4	854.8	999.3	962.1	971.5	969.0
				t/ha			
Yellow maize average yield	4.10	4.57	4.00	4.04	4.08	4.13	4.17
				Thousand tons			
Yellow maize production	2355.7	4500.0	3418.1	4039.5	3930.0	4008.3	4036.7
Yellow maize domestic use	3295.5	3665.0	3398.5	3612.5	3615.3	3660.2	3697.3
Yellow maize feed consumption	3921.7	4107.1	3822.9	4039.7	4039.2	4082.8	4117.6
Yellow maize human consumption	242.3	260.1	242.4	245.3	241.9	240.6	238.3
Yellow maize ending stocks	566.9	1050.9	793.1	911.2	918.7	952.4	976.8
Yellow maize exports	940.0	314.4	361.0	337.1	335.7	328.7	326.1
Yellow maize imports	98.6	223.2	214.0	218.7	219.0	220.4	220.9
				R/ton			
Yellow maize domestic price	976.9	638.2	974.8	909.8	960.2	968.7	996.4

Table 5.10: Baseline 3 – Wheat

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Wheat summer area harvested	530.5	490.0	571.2	554.3	557.4	569.8	590.3
Wheat winter area harvested	323.5	303.3	331.9	338.5	340.8	345.4	351.0
				t/ha			
Wheat average yield: Summer area	2.71	3.67	2.75	2.77	2.78	2.80	2.82
Wheat average yield: Winter area	1.70	2.64	1.71	1.71	1.71	1.71	1.71
				Thousand tons			
Wheat production	1988.1	2600.0	2136.3	2111.6	2134.8	2187.5	2265.0
Wheat feed consumption	90.7	48.4	72.7	63.9	61.7	56.8	54.6
Wheat human consumption	2751.8	2664.0	2715.2	2724.7	2714.3	2700.1	2693.8
Wheat domestic use	2862.2	2732.0	2807.5	2808.2	2795.6	2776.5	2768.1
Wheat ending stocks	611.2	599.3	587.6	574.6	562.9	551.7	544.3
Wheat exports	123.9	207.4	148.1	145.4	149.2	157.1	166.1
Wheat imports	1003.1	327.5	807.7	829.0	798.4	734.9	661.9
				R/ton			
Wheat domestic price	1433.2	1564.2	1685.1	1822.8	1940.9	2054.3	2163.7

Baseline results under the third combination of trade regimes project that the domestic white maize price will fall to the lower border parity price boundary (export parity price) in 2007 as exports increase rapidly. Although the yellow maize model closes under near-autarky and the domestic yellow maize price is projected to move closer to export parity levels, the model projects that the domestic yellow maize price will trade at approximately R50/ton above the domestic white maize price. An analysis of price trends over the past decade shows clearly that in the years when large surpluses of maize are being produced, white maize tends to be cheaper than yellow maize. Industry experts currently estimate this margin to be between R40/ton and R50/ton.

Table 5.9 shows an increase in the use of white maize for feed compared to the first and second baseline projections. White maize will only be used for animal feed if it is sufficiently cheaper than yellow maize to compensate for the additional supplements that have to be included in the ration if white maize is fed. This again proves that the model has the ability to produce reliable projections of the evolution of the sector under alternative shocks.

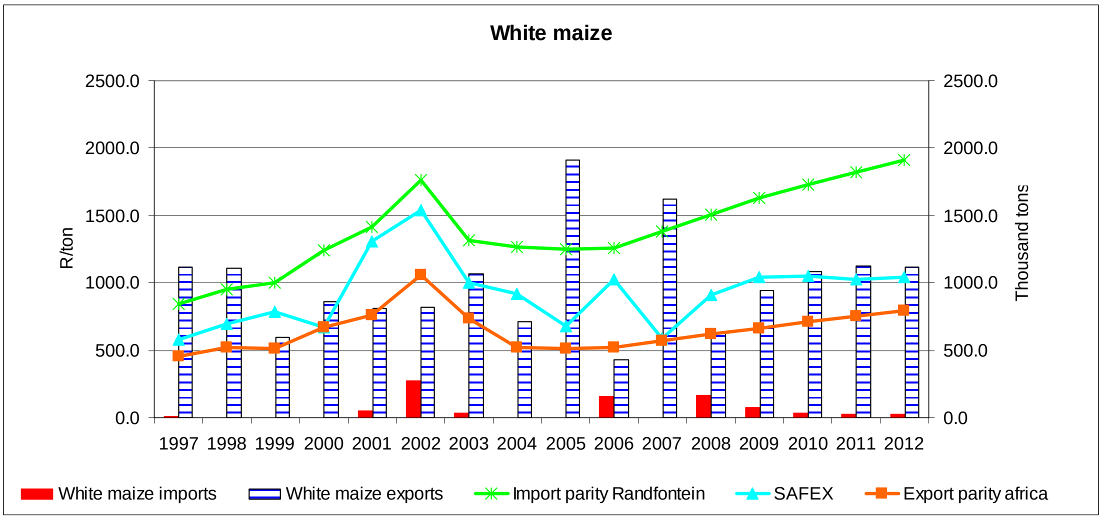

Figure 5.7: Baseline 3 - Price space for white maize, 1997 – 2012

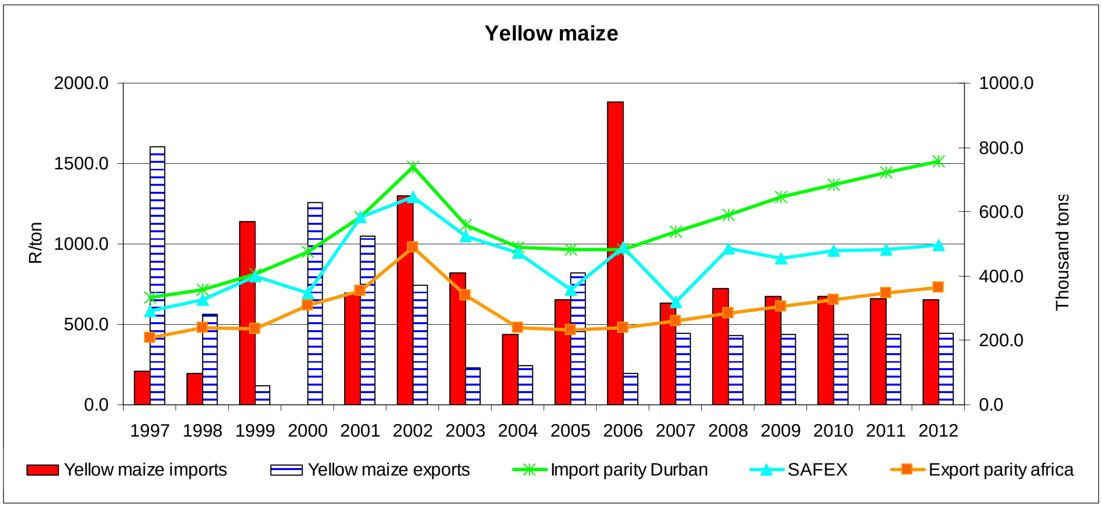

Figure 5.8: Baseline 3 - Price space for yellow maize, 1997 – 2012

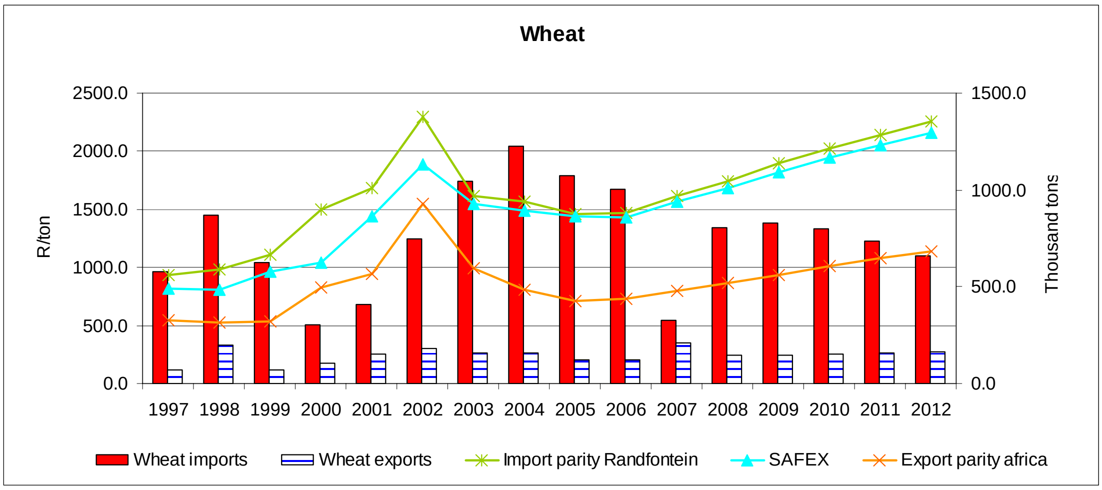

Figure 5.9: Baseline 3 - Price space for wheat, 1997 – 2012

Finally, the recursive effects that take place in the model have to be stressed. Recursive effects are clearly illustrated in the model where the forecast values of the various baseline projections differ over the period 2008 - 2010. This is due to the methodology of price expectations that is applied in the model. For example, the 2008 maize area harvested in baseline 1 is higher than the 2008 maize area harvested in baselines 2 and 3. This is caused by farmers responding to the higher producer prices (at import parity levels) in 2007 and increasing plantings in 2008. What is also worth mentioning is that although the wheat model closes only under import parity and the drought has no direct impact on the level of domestic prices, cross-commodity linkages in the model induce shifts in the area harvested to wheat, and the level of human and feed consumption.

The baseline projections show that by switching between different closure techniques, the new regime-switching model captures the salient features of the grain markets trading under a combination of different trade regimes. This section only illustrates the model's ability to simulate realistic projections of endogenous variables under different regimes. The next step is to determine if the model is able to distinguish between the level of integration between domestic and world markets when a switch in market regimes occurs.

5.3 IMPACT MULTIPLIERS

A shift in parity prices, which is imposed on the model under the various regimes, will be used to illustrate how the integration between world and domestic prices changes as the equilibrium pricing conditions change. The impact of a 10 percent increase in parity prices on domestic prices and trade flow is calculated by comparing the scenario results to the baseline projections under a combination of different trade regimes in the grain market. If the parity price shock for each grain is applied to the three different regime combinations one by one, it implies that six scenarios will be analysed. The shock in the parity prices is introduced in 2007. The actual tables are developed by presenting the absolute and percentage changes from the 2007 baseline values as presented in the baseline section above. Tables 5.11 through to 5.16 present the results of the impact multipliers for each of the scenarios.

Only the impact multipliers for year one and two (2007 and 2008) after the 10 percent shock are included in the tables below to illustrate the current and lagged effects of the shock. The full tables that show how the model settles down after oscillating, are included in Appendix B.

Table 5.11: 10 percent increase in the white maize parity prices – import parity regime

		2007			2008		
White Maize		Baseline	Absolute	%	Baseline	Absolute	%
	Area Harvested	1590.8	0.0	0.0%	1878.0	90.6	4.8%
	Production	2500.0	0.0	0.0%	6953.3	335.4	4.8%
	Ending Stock	280.0	0.0	0.0%	1181.3	152.4	12.9%
	Human Consumption	3545.2	-32.7	-0.9%	3699.6	33.0	0.9%
	Feed Consumption	493.2	-17.5	-3.6%	634.9	4.8	0.8%
	Exports	0.0	0.0		1392.6	145.1	
	Imports	1108.0	-50.2		0.0	0.0	
	Domestic Price	1394.1	128.1	9.2%	1067.0	-75.1	-7.0%

Table 5.12: 10 percent increase in the white maize parity prices – autarky regime

		2007			2008		
White Maize		Baseline	Absolute	%	Baseline	Absolute	%
	Area Harvested	1613.7	0.0	0.0%	1548.3	36.5	2.4%
	Production	5922.1	0.0	0.0%	5732.3	135.1	2.4%
	Ending Stock	1237.1	-25.3	-2.0%	1284.9	43.3	3.4%
	Human Consumption	3745.2	5.9	0.2%	3742.3	7.7	0.2%
	Feed Consumption	659.0	-11.6	-1.8%	658.1	5.0	0.8%
	Exports	1038.3	24.1		1013.3	41.7	
	Imports	47.0	-7.0		54.2	-12.0	
	Domestic Price	954.4	43.3	4.5%	969.7	-17.5	-1.8%

Table 5.13: 10 percent increase in the white maize parity prices – export parity regime

	2007			2008		
White Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	1631.8	0.0	0.0%	1188.2	62.4	5.3%
Production	7800.0	0.0	0.0%	4399.2	231.2	5.3%
Ending Stock	2227.6	-90.6	-4.1%	1342.6	43.0	3.2%
Human Consumption	3913.2	-2.8	-0.1%	3766.5	6.1	0.2%
Feed Consumption	749.6	-24.6	-3.3%	727.0	3.3	0.5%
Exports	1620.1	117.9		630.4	68.4	
Imports	0.0	0.0		164.6	-19.7	
Domestic Price	585.1	62.3	10.6%	914.7	-13.9	-1.5%

Table 5.14: 10 percent increase in the yellow maize parity prices – import parity regime

	2007			2008		
Yellow Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	984.4	0.0	0.0%	1052.4	47.5	4.5%
Production	1000.0	0.0	0.0%	4208.5	189.9	4.5%
Ending Stock	230.0	0.0	0.0%	711.9	87.6	12.3%
Human Consumption	236.3	-6.0	-2.5%	242.8	4.2	1.7%
Feed Consumption	3345.4	-101.7	-3.0%	3447.6	81.4	2.4%
Exports	0.0	0.0		214.2	2.8	
Imports	2426.8	-107.7		359.9	-13.9	
Domestic Price	1095.6	114.7	10.5%	968.5	-81.8	-8.4%

Table 5.15: 10 percent increase in the yellow maize parity prices – autarky regime

	2007			2008		
Yellow Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	984.4	0.0	0.0%	977.2	6.9	0.7%
Production	3891.9	0.0	0.0%	3907.5	27.4	0.7%
Ending Stock	762.2	-10.6	-1.4%	855.3	8.2	1.0%
Human Consumption	246.1	-1.1	-0.5%	246.5	0.5	0.2%
Feed Consumption	3419.7	-2.3	-0.1%	3517.0	6.0	0.2%
Exports	213.3	2.3		216.6	0.3	
Imports	364.5	-11.7		347.6	-1.7	
Domestic Price	907.7	21.5	2.4%	896.0	-10.2	-1.1%

Table 5.16: 10 percent increase in the wheat parity prices – import parity regime

		2007			2008		
Wheat		Baseline	Absolute	%	Baseline	Absolute	%
	Area Harvested:Summer	490.0	0.0	0.0%	481.7	18.9	3.9%
	Area Harvested:Winter	344.3	0.0	0.0%	328.7	10.4	3.2%
	Production	980.0	0.0	0.0%	1884.7	69.7	3.7%
	Ending Stock	599.0	-18.5	-3.1%	587.3	-9.5	-1.6%
	Human Consumption	2811.2	-8.7	-0.3%	2741.9	-13.2	-0.5%
	Feed Consumption	98.8	0.6	0.6%	75.2	-7.2	-9.6%
	Exports	7.5	2.9		117.2	8.9	
	Imports	1945.0	-23.6		1057.6	-72.3	
	Domestic Price	1564.2	140.6	9.0%	1685.1	0.0	0.0%

Tables 5.11 through to 5.16 do not present the ordinary single-equation multipliers, but rather impact multipliers that reflect a full model response to a shock. Only absolute deviations from the baseline are reported for imports and exports in each of the six scenarios. The reason for this is that trade is by definition smaller in the near-autarky case and, therefore, the percentage deviations will exaggerate the impact of a shock in parity prices on net trade.

Results suggest that a shift in equilibrium pricing conditions changes the correlation between domestic and world prices and, therefore, different impact multipliers in response to a 10 percent shift in parity prices are generated under the various trade regimes. There is a higher level of integration between domestic and world grain markets under the import/export parity regimes than under near-autarky. The absolute changes in imports and exports in response to a 10 percent increase in the parity prices of each commodity demonstrate that the absolute changes in trade are larger under import and export parity than in near-autarky. Chapter 4 shows that because some trade still occurs under near-autarky, net trade is modelled as a function of parity prices and the exchange rate when the grain markets are trading under near-autarky. Subsequently, these variables will have an impact on the domestic price.

In the case of the domestic price of white maize, an impact multiplier of 4.5 percent was simulated under near-autarky compared to an impact multiplier of 9.2 percent and 10.6 percent simulated for import and export parity respectively. In the case of the domestic price for yellow maize, an impact multiplier of 2.4 percent was simulated under near-autarky compared to an impact multiplier of 10.5 percent simulated for import parity. The integration between domestic and world markets is also highlighted by the level of trade that is higher under import and export parity than in near-autarky. A shift in domestic prices not only shifts net trade, but also induces a shift in domestic production and consumption levels. An increase in domestic prices generally reduces domestic human and feed consumption and increases the area harvested in 2008.

The wheat model has the most basic structure and is only set up to solve for prices under an import parity market regime. Therefore, only the impact multipliers for the import parity scenario can be presented. In response to a 10 percent increase in the parity price, the domestic wheat price increases by 9 percent. Farmers respond to the higher domestic prices and the area harvested in 2008 increases by 3.9 percent and 3.2 percent in the summer and winter region, respectively.

The price and trade impact multipliers for the alternative regimes are summarised in table 5.17.

Table 5.17: Price and trade impact multipliers under alternative market regimes, 2007

	Import parity			Near - Autarky			Export parity		
	Baseline	Absolute	%	Baseline	Absolute	%	Baseline	Absolute	%
White Maize									
Exports	0.0	0.0		1038.3	24.1		1620.1	117.9	
Imports	1108.0	-50.2		47.0	-7.0		0.0	0.0	
Domestic Price	1394.1	128.1	9.2%	954.4	43.3	4.5%	585.1	62.3	10.6%
Yellow Maize									
Exports	0.0	0.0		213.3	2.3				
Imports	2426.8	-107.7		364.5	-11.7				
Domestic Price	1095.6	114.7	10.5%	907.7	21.5	2.4%			
Wheat									
Exports	7.5	2.9							
Imports	1945.0	-23.6							
Domestic Price	1564.2	140.6	9.0%						

5.4 THE OLD VERSUS THE NEW MODEL

Another aspect of the hypothesis that needs to be tested is whether a model that takes account of a switch in market regimes has an advantage, with respect to the modelling of real-world issues, over a model that just makes use of a single linear method of price determination. In order to prove that the switching mechanism improves the model's ability to track real-world issues, the previous version of the BFAP sector model, referred to as the "old model", is used to simulate one of the scenarios that were presented in the section above. Similar to models that are usually applied in policy evaluation, the old sector model applies just a single linear method of price determination. Therefore, the old model does not consist of any switching mechanisms between different model closure techniques. The white and yellow maize models are closed under autarky, which implies that the estimated price transmission elasticities are likely to be moderate, understating the true elasticity when supplies were either large or small relative to domestic demand, but overstating the true response when domestic supply and demand are in balance. Hence, in order to clearly show the advantage of the regime-switching model, a scenario has to be selected where the white and yellow maize markets are not trading under autarky, but rather under import parity or export parity.

The first baseline results of the regime-switching model (tables 5.2 and 5.3) were generated under the combination of trade regimes where all three grain markets are trading under import parity. This combination was introduced by making the assumption that a severe drought will decrease maize yields sharply and will cause a shortage in the market. When the same scenario is simulated in the old model, the output of the two models can be compared. The results of the old model are presented in tables 5.18 and 5.19. Figures 5.10 and 5.11 graphically illustrate the price space and the impact multipliers are presented in tables 5.20 and 5.21.

Table 5.18: White maize baseline projections – old model

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
White maize area harvested	973.0	1590.8	2128.7	1375.5	1539.3	1552.2	1541.9
				t/ha			
White maize average yield	3.64	1.57	3.70	3.73	3.76	3.79	3.82
				Thousand tons			
White maize production	3538.1	2500.0	7881.4	5136.1	5794.5	5889.0	5894.1
White maize feed consumption	644.0	432.7	589.0	708.1	659.0	696.0	708.4
White maize human consumption	3696.1	3198.2	3790.5	3722.7	3707.4	3697.0	3682.9
White maize domestic use	4585.1	3955.9	4704.4	4755.8	4691.4	4718.0	4716.2
White maize ending stocks	1035.4	280.0	1630.8	1267.8	1336.6	1422.8	1493.0
White maize imports	157.7	744.1	0.0	102.5	37.4	26.1	21.0
White maize exports	431.2	0.0	1826.2	845.8	1071.7	1110.9	1128.6
				R/ton			
White maize domestic price	1025.6	2156.9	860.2	1016.9	1038.2	1037.1	1041.1

Table 5.19: Yellow maize baseline projections – old model

	2006	2007	2008	2009	2010	2011	2012
				Thousand hectares			
Yellow maize area harvested	575.0	984.4	1277.5	837.3	1009.3	958.4	974.0
				t/ha			
Yellow maize average yield	4.10	1.02	4.00	4.04	4.08	4.13	4.17
				Thousand tons			
Yellow maize production	2355.7	1000.0	5108.3	3384.7	4122.8	3954.2	4057.2
Yellow maize domestic use	3295.5	2485.4	3855.8	3422.6	3658.2	3645.8	3702.9
Yellow maize feed consumption	3921.7	2861.2	4299.1	3843.2	4084.1	4067.6	4123.4
Yellow maize human consumption	242.3	193.8	261.3	238.6	243.9	239.9	238.5
Yellow maize ending stocks	566.9	230.0	1112.6	796.2	945.0	942.0	980.4
Yellow maize exports	940.0	1675.6	299.5	357.1	330.0	330.6	325.5
Yellow maize imports	98.6	0.0	226.2	214.7	220.1	220.0	221.0
				R/ton			
Yellow maize domestic price	976.9	1914.4	611.6	1038.3	921.3	982.2	991.6

After the yields in 2007 are reduced due to severe drought, the old model projects that prices will increase sharply to R2156/ton and R1914/ton for white and yellow maize respectively. It is clear that prices increase way beyond import parity prices, as illustrated in figures 5.10 and 5.11. Due to the unrealistically high domestic prices, consumption decreases sharply and imports do not rise to the same extent as was the case with the baseline 1 projections of the regime-switching model. The lagged effects in the baseline projections also suggest that the areas planted in 2008 are overestimated due to the high domestic prices in 2007. Whereas tables 5.2 and 5.3 show that the areas harvested under white and yellow maize will in 2008 increase to 1.8 million and 1 million hectares respectively, tables 5.18 and 5.19 show that the old model projects that the areas harvested under white and yellow maize will increase to 2.1 million and 1.2 million hectares respectively.

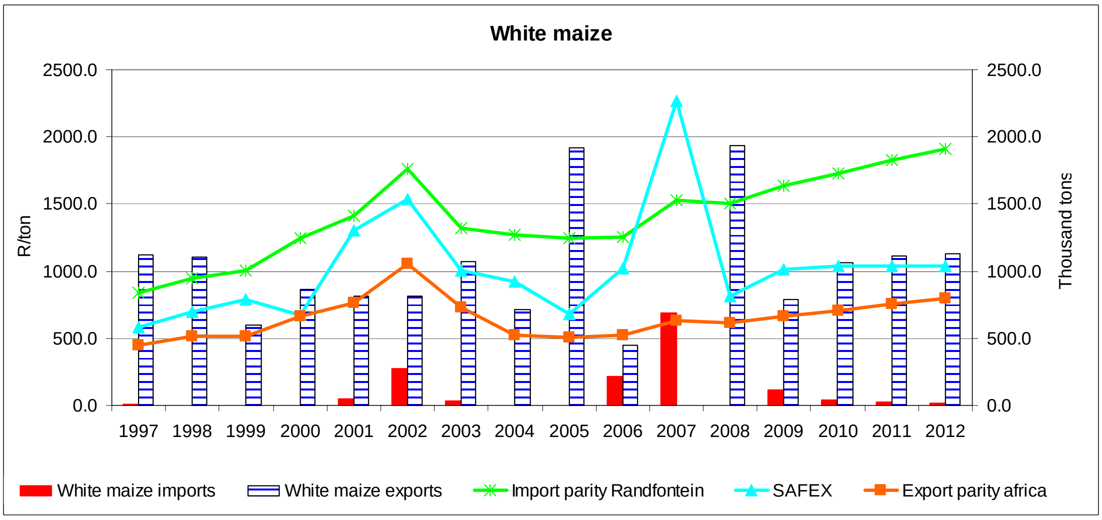

Figure 5.10: Price space for white maize – old model, 1997 – 2012

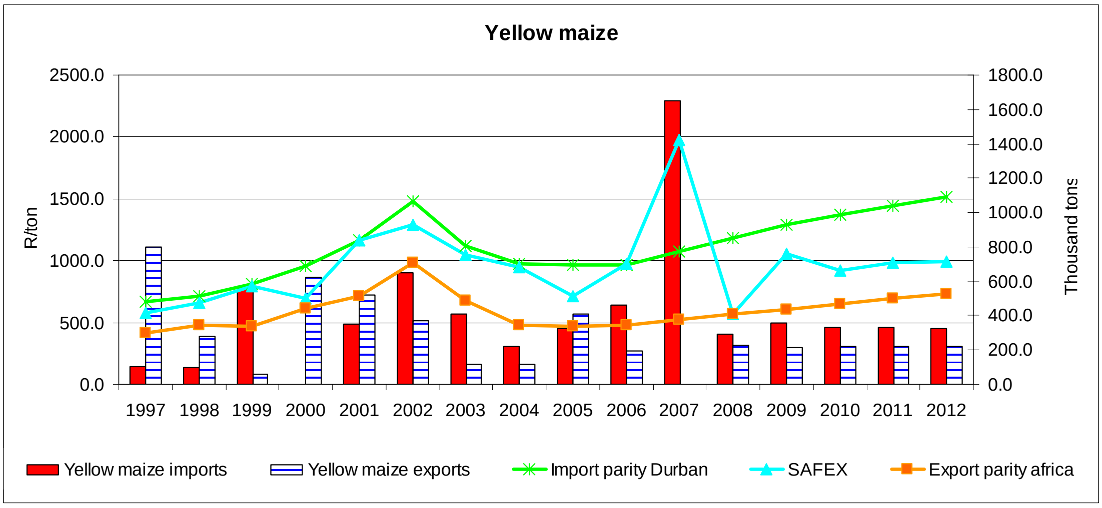

Figure 5.11: Price space for yellow maize – old model, 2007 – 2012

This scenario relates well to the example used in the opening chapter of this study where the possible impact of a drought was used to illustrate the impact of alternative model closure techniques on the formation of prices. Although the old model was set up to solve for prices within the domestic market and therefore takes the local production and consumption levels into account, the model was not bound by the import parity levels. Figures 5.10 and 5.11 show clearly how the white and yellow maize models solve for unrealistically high prices.

Apart from the unrealistically high prices, the impact multipliers (tables 5.20 and 5.21) show that the correlation between domestic and parity prices is low, despite high volumes of imports. A 10 percent increase in the parity prices in 2007 results in a 5.1 percent increase in the white maize price and a 3.1 percent increase in the yellow maize price. As mentioned by Barrett (1999), if a commodity moves from a non-tradable to an importable equilibrium, the correlation between the parity price and the local market prices should jump from zero to significantly positive, to one if the law of one price holds strictly. Table 5.17 shows how the regime-switching model that was developed in this study complies with *a priori* expectations and simulates an increase in the domestic white maize price of 9.2 percent and yellow maize price of 10.5 percent due to a 10 percent increase in the parity price. The results highlight what Barrett and Li (2002) referred to as the “messy character of market relationships" arising from treating price transmissions mostly as a linear phenomenon. This proves that the regime-switching methodology that was developed to allow the new sector model to switch between various techniques of model closure, provides the model with the ability to simulate the most realistic formation of equilibrium prices under switch market regimes and is therefore consistent with the hypothesis of this study.

Table 5.20: White maize impact multipliers – old model, 2007

	2007			2008		
White Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	1618.8	0.0	0.0%	2128.7	72.6	3.4%
Production	2500.0	0.0	0.0%	7881.3	268.8	3.4%
Ending Stock	280.0	0.0	0.0%	1630.8	130.2	8.0%
Human Consumption	3198.2	-24.6	-0.8%	3790.4	21.7	0.6%
Feed Consumption	432.7	-32.7	-7.6%	589.0	10.0	1.7%
Exports	0.0			1826.2	106.7	
Imports	744.1			0.0	0.0	
Domestic Price	2156.8	110.3	5.1%	860.2	-49.3	-5.7%

Table 5.21: Yellow maize impact multipliers – old model, 2007

	2007			2008		
Yellow Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	1115.3	0.0	0.0%	1277.5	21.1	1.7%
Production	1000.0	0.0	0.0%	5108.3	84.4	1.7%
Ending Stock	230.0	0.0	0.0%	1112.6	40.2	3.6%
Human Consumption	193.8	-3.0	-1.6%	261.3	2.0	0.8%
Feed Consumption	2485.4	-23.8	-1.0%	3855.8	34.1	0.9%
Exports	0.0	0.0		226.2	1.3	
Imports	1675.6	-26.9		299.5	-6.6	
Domestic Price	1914.4	58.6	3.1%	611.6	-38.9	-6.4%

For this section an import parity scenario was specifically selected to highlight the difference between the old and new versions of the model. Although the difference between the two models will be smaller if white and yellow maize are trading under near-autarky, there are other improvements to the new model that need to be considered that will also distinguish the new from the old model. Apart from the advantage of the switching mechanism, the new version of the sector model also incorporates parity prices into the trade and price equations, which implies that shocks to the transaction costs can also be simulated in the model. The old model only included world prices and exchange rates in the price and trade components. The advantage of incorporating parity prices is illustrated clearly in section 5.6, where the scenario analysis of real-world issues is undertaken.

5.5 ELASTICITY MATRICES

Elasticity matrices provide a very helpful summary of all the own price and cross-price effects in the model. These effects help to better understand the dynamic interaction between various commodities in the model, especially when market-related scenarios are analysed that cover a number of the commodities in the model.

The following matrices present system elasticities (response) that are generated in the sector model. A 10 percent shock is introduced in the domestic prices in 2006, and the resulting elasticity point estimates are generated by the model. Although this study only focuses on the maize and wheat sectors, the area elasticities for all the grains are presented in table 5.22. Table 5.23 presents the elasticities for the human consumption response of white maize, yellow maize and wheat to a 10 percent increase in domestic prices and table 5.24 presents the elasticities for the feed grain consumption response to a 10 percent increase in the domestic price.

Table 5.22: Area harvested own and cross price elasticity matrix, 2006

	Price						
Area harvested	**W maize**	**Y maize**	**Wheat**	**Sunflower**	**Sorghum**	**Soybean**	**All 6 prices**
White maize	**0.535**	0.040	-0.110	-0.300	-0.003	-0.272	0.234
Yellow maize	-0.049	**0.340**	-0.046	-0.016	-0.003	-0.020	0.234
Summer wheat	-0.258	-0.141	**0.755**	-0.080	-0.013	-0.104	0.234
Winter wheat	-0.089	-0.049	**0.371**	-0.028	-0.005	-0.036	0.234
Sunflower	-0.198	-0.108	-0.185	**0.752**	-0.010	-0.021	0.234
Sorghum	-0.072	-0.039	-0.067	-0.022	**0.429**	-0.029	0.234
Soybean	-0.011	-0.007	-0.011	-0.004	-0.001	**0.245**	0.234
Total area	0.073	0.039	0.068	0.022	0.004	0.029	**0.234**

The calculated area elasticity matrix complies with *a priori* expectations, capturing the own price effect and the substitution between the alternative crops in the form of the cross-price elasticities. It is important to note that the sum of the individual responses to a shock in price is equal to the total response if all prices are shocked simultaneously.

Table 5.23: Human grain consumption own and cross-price elasticity matrix, 2006

	Prices			
Human Consumption	W maize	Y maize	Wheat	All 3 prices
White maize	**-0.137**	0.000	0.083	-0.054
Yellow maize	0.000	**-0.173**	0.000	-0.173
Wheat	0.073	0.000	**-0.137**	-0.064
Total human consumption	-0.045	-0.007	-0.011	**-0.063**

The system elasticities of human consumption stress the findings (chapter 4) that white maize and wheat products can be regarded as staple food and, therefore, price inelastic.

Table 5.24: Feed grain consumption cross-price elasticity matrix, 2006

	Prices			
Feed Consumption	W maize	Y maize	Wheat	All 3 prices
White maize	**-0.95**	0.74	0.05	-0.17
Yellow maize	0.15	**-0.45**	0.03	-0.28
Wheat	0.28	0.79	**-1.22**	-0.17
Total feed consumption	-0.02	-0.23	0.01	**-0.24**

System elasticities of domestic feed consumption comply with *a priori* expectations. The white maize and wheat feed markets are very small compared to the yellow maize feed market, and therefore the own price elasticities for white maize and wheat are high compared to the own price elasticity of yellow maize. Whereas white maize and wheat have a very small cross-effect on yellow maize, a shift in the yellow maize price results in a relatively large shift in the white maize and wheat feed markets.

5.6 SCENARIO ANALYSIS

This section presents the combination of shocks that are introduced in the model in the form of a scenario. Scenarios represent a sequence of events that take place in a logical way in order to present the possible outcome of reality. Various scenarios can be developed by the inclusion of short-term and long-term assumptions and can be presented in the form of short- and long-run impact multipliers. A distinction needs to be made between once-off or sustained shocks to one or a combination of the exogenous variables.

In this section once-off and sustained shocks are performed on important exogenous variables within the system to examine short-run as well as long-run impacts on all endogenous variables. These impacts are presented in the form of absolute and percentage changes (impact multipliers). Although percentages provide a very clear idea of what the total effect of a shock on the system is, they might be misleading (especially in the case of trade) because percentage changes can turn out to be very large simply because the baseline absolute values are very small and the relative changes large.

To ensure that the model is truly applied to real-world issues, the scenario that is presented in this section is not specifically designed for the academic purpose of this study, but was selected from a range of scenarios developed to analyse the possible impact of ethanol production from maize on the South African agricultural industry. Some of the assumptions in the scenario focus more on the shift of economic drivers in the market place (for example exchange rates and world prices) and other assumptions focus on the impact of alternative policies (for example import tariffs) on market equilibrium. The ethanol scenario reads as follows:

Scenario: The impact of ethanol production on the South African agricultural industry. Time period for which scenario is developed: 2006 - 2010

The first ethanol plant is constructed in 2007 with a capacity to process 370 000 tons of maize into 110 000 tons of dried distillers grain (DDG) and 150 million litres of ethanol. Due to the political sensitivity of using white maize, which is regarded as staple food in the African region, it is decided that only yellow maize will be used in the production of ethanol. Despite this, government decides to abolish the import tariffs on white and yellow maize from 2008 onwards so that imported maize can be cheaper. The rand depreciates against the US dollar in response to an improving US economy and the European economies are struggling due to political and economical instability. China's economic growth declines due to high inflation, leading to a recession in the demand for oil and precious metals like gold. The rand depreciates further in response to the declining demand for gold to a level of R9.50 per US dollar in 2010. The decrease in demand for international shipping leads to the stabilisation of freight rates. Farmers' input costs decrease as a result of lower oil prices. Due to the depreciation of the rand, the local industry is more competitive in the export market.

The first step in analysing this scenario is to introduce the various economic and political assumptions in the regime-switching model. The macroeconomic and policy assumptions of the scenario are summarised in table 5.25.

Table 5.25: Assumptions of exogenous variables – ethanol scenario

Variables	Units	2006	2007	2008	2009	2010
Exchange rate	c/US$	650.0	750.0	850.0	900.0	950.0
Freight rates	US$/t	33.7	33.7	33.7	33.7	33.7
Oil price	US $/barrel	45.0	40.0	35.0	30.0	25.0
Maize tariff	R/ton	37.7	36.3	0.0	0.0	0.0
Input cost index	Index ('00)	144.7	139.7	134.7	129.7	124.7

The second set of baseline projections presented in the first section of this chapter will be used as the baseline from where the absolute and percentage deviations for this scenario are calculated. Impact multipliers are calculated for 2007 and 2010 in order to capture the short-term and long-term effects. Tables 5.26 and 5.27 present the impact multipliers in response to the economic and political shocks alone. The impact multipliers in response to all the assumptions of the scenario are presented in tables 5.28 and 5.29. For the purpose of this study, only the impact on the white and yellow maize industries will be presented and not the corresponding impacts on the various livestock industries in the model.

Table 5.26: White maize impact multipliers – economic and political shocks

	2007			2010		
White Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	1613.7	66.2	4.1%	1549.1	35.3	2.3%
Production	5922.1	242.9	4.1%	5831.6	132.8	2.3%
Ending Stock	1237.1	74.1	6.0%	1344.0	111.7	8.3%
Human Consumption	3745.2	23.4	0.6%	3708.0	36.5	1.0%
Feed Consumption	659.0	-11.6	-1.8%	672.4	6.1	0.9%
Total Consumption	4729.2	11.8	0.2%	4705.4	42.6	0.9%
Exports	1038.3	107.2	10.3%	1077.9	72.1	6.7%
Imports	47.0	-30.9	-65.7%	35.6	-20.8	-58.4%
Producer Price	954.4	-2.2	-0.2%	1036.9	-24.7	-2.4%

Table 5.27: Yellow maize impact multipliers – economic and political shocks

Yellow Maize	2007			2010		
	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	984.4	52.7	5.4%	970.9	24.7	2.5%
Production	3891.9	208.4	5.4%	3966.0	100.7	2.5%
Ending Stock	762.2	62.9	8.3%	922.7	70.2	7.6%
Human Consumption	246.1	2.1	0.9%	242.3	2.0	0.8%
Feed Consumption	3419.7	80.5	2.4%	3619.5	78.8	2.2%
Total Consumption	3847.8	82.6	2.1%	4043.8	80.9	2.0%
Exports	213.3	5.3	2.5%	219.3	4.5	2.0%
Imports	364.5	-26.6	-7.3%	334.4	-22.5	-6.7%
Producer Price	907.7	-41.1	-4.5%	951.6	-39.4	-4.1%

Despite lower freight rates, parity prices increase in response to the fast weakening of the rand. The higher parity prices in 2006 induce an increase in domestic prices in 2006 and farmers respond by increasing the areas planted in 2007. Therefore, white and yellow maize production increase in 2007, which causes domestic prices to decrease slightly by 0.2 percent and 4.5 percent in the case of white and yellow maize respectively. White and yellow maize exports increase and imports decrease due to the higher level of production.

The assumption of ethanol production from maize is now also introduced in the model. Apart from yellow maize feed and human consumption, an additional consumption category of 370 000 tons is incorporated in the model in 2007. The livestock industries are influenced by the shift in domestic yellow maize consumption and the entrance of DDG into the feed market as an alternative feed stock.

Table 5.26: White maize impact multipliers – ethanol scenario, 2007 - 2010

White Maize	2007			2010		
	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	1613.7	66.2	4.1%	1549.1	44.8	2.9%
Production	5922.1	242.9	4.1%	5831.6	168.6	2.9%
Ending Stock	1237.1	52.0	4.2%	1344.0	109.0	8.1%
Human Consumption	3745.2	15.0	0.4%	3708.0	33.8	0.9%
Feed Consumption	659.0	57.6	8.7%	672.4	42.9	6.4%
Total Consumption	4729.2	72.6	1.5%	4705.4	76.7	1.6%
Exports	1038.3	77.1	7.4%	1077.9	67.8	6.3%
Imports	47.0	-22.2	-47.2%	35.6	-19.6	-54.9%
Domestic Price	954.4	16.2	1.7%	1036.9	-18.0	-1.7%

Table 5.27: Yellow maize impact multipliers – ethanol scenario, 2007 - 2010

	2007			2010		
Yellow Maize	Baseline	Absolute	%	Baseline	Absolute	%
Area Harvested	984.4	52.7	5.4%	970.9	77.6	8.0%
Production	3891.9	208.4	5.4%	3966.0	316.9	8.0%
Ending Stock	762.2	-21.5	-2.8%	922.7	82.3	8.9%
Human Consumption	246.1	-6.8	-2.8%	242.3	-3.2	-1.3%
Feed Consumption	3419.7	-162.5	-4.8%	3619.5	-62.9	-1.7%
Total Consumption	3847.8	200.8	5.2%	4043.8	303.9	7.5%
Exports	213.3	-0.3	-0.1%	219.3	1.9	0.9%
Imports	364.5	1.5	0.4%	334.4	-9.5	-2.8%
Domestic Price	907.7	130.6	14.4%	951.6	62.6	6.6%

At first glance, the impact multipliers show a larger effect on the yellow maize market than on the white maize market. What may come as a surprise, is that the total consumption of yellow maize does not increase by the full 370 000 tons that are required for the production of ethanol. Instead, feed consumption decreases by 162 000 tons in 2007 and 62 000 tons in 2010. This is due to the substitution effect of yellow maize between the feed and ethanol markets. Some of the loss in total maize feed consumption will be made up by an increase in white maize feed consumption in 2007 and 2010.

Clearly, the increase in domestic consumption has a positive impact on white and yellow maize prices in 2007. However, as farmers respond over time to the increase in domestic prices, the impact of prices reduces and in the case of white maize the domestic price even decreases by 1.7 percent compared to the baseline projections. This is, however, not the case with yellow maize where domestic prices are supported by the increase in domestic consumption of 200 800 tons in 2007 and 303 900 ton in 2010.

5.7 SUMMARY

The main purpose of this chapter was to test the hypothesis formulated in chapter 1. A number of approaches were used to test various aspects of the hypothesis. Firstly, benchmarks, also referred to as baseline projections, were simulated under a combination of different trade regimes. A shift in parity prices was imposed on the regime-switching model under the various baselines to illustrate how the correlation between parity and domestic prices changes as the equilibrium pricing conditions change. Results show that the correlation between the parity and local prices is high when local grain markets are trading under import/export parity and the correlation is relatively low when markets are trading under near-autarky. The observed impact multipliers also suggest that the absolute effect on trade due to a shock in parity prices is much higher under import/export parity, than under near-autarky.

The second approach involved a comparison between the regime-switching model developed in this study, and the pre-existing version of the model where a regime switch is not included. Results showed that the pre-existing model simulates unrealistically high domestic prices and the correlation between parity and domestic prices is too low when there is a shortage in local grain markets. Finally, the analysis of a scenario involving real-world issues was conducted to illustrate the model's ability to simulate the impact of market-related and policy impacts on local grain markets.

This chapter has proven that the regime-switching methodology that was developed to allow the new sector model to switch between various techniques of model closure, enables the model to simulate the most realistic estimates and projections of endogenous variables under market-switching regimes. It is therefore consistent with the hypothesis of this study. The proposed regime-switching model is, by design, more rigorous than the pre-existing model in that it emphasises price formation and correct model closure under alternative regimes.