Modelling the impact of the 'Fast Track' land reform policy on Zimbabwe's maize sector

By

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November 2010

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DECLARATION

I declare that the thesis hereby submitted in partial fulfilment of the requirements for the degree Master of Science (Agricultural Economics) at the University of Pretoria has not been submitted by me for any other degree at any other institution.

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ABSTRACT

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The study attempted to analyse the impacts of the 'fast track' land reform on maize production in Zimbabwe. This purpose was tackled by constructing a partial equilibrium model that depicted what could have happened if no further policy shifts had taken place after 2001. Setting up a partial equilibrium model required a sound understanding of the functioning of the Zimbabwe's maize market.

The institutional structure of the Zimbabwean maize market was explored to inform the model development process that would allow for the development of the baseline model. Developing the model started off with the estimation of single equations which were collapsed into a simultaneous system of equations through the use of a combination of ordinary least squares and generalised least squares techniques. The development of the simulation model required that assumptions be made for exogenous variables, and crafted assumptions were based on the 2000 macro-economic and institutional environment as well as agricultural policies.

The re-simulated baseline model that was constructed in this study was used to make projections based on the various trends of exogenous variables in 2000. This means that the model generated an artificial data set based on what the maize market would have looked like under a set of the pre-2000 existent policy conditions. As such, all the shifts in the political and economic environment that took place after 2000 were not introduced in the model. The 'fast track' land reform policy was thus assessed based on the performance of the baseline model using a range of "what if" assumptions. Therefore, the re-simulated baseline solutions

discussed result not only from policy shifts that occurred before 2000, but also from the convergence of hypothetical political and economic stability within the period in question.

The results of the re-simulated baseline indicated that the commercial area harvested was negatively affected by the expropriation of commercial farms. The arguments in literature that the 'fast track' land reform policy shift contributed the loss in area planted owing to the stalling of farming operations due to political unrest, economic instability and input shortages were supported by the model results which showed that total area harvested would have been higher under pre-2000 conditions.

From the re-simulated baseline results, the difference between actual and would be outcomes revealed that the total maize production was 13.27% less than what could have been produced in 2001, the year that the 'fast track' land reform policy was formally implemented. In view of the 2002/03 drought, output was 57.44% less and 33.53% less than what could have actually been produced for the 2002 and 2003 seasons respectively. In the 2005 drought season, the total maize production was 41.8% less than what could have been produced without the 'fast track' land reform. This may imply that droughts would have been less severe if the 'fast track' land reform was not implemented. In 2007, the baseline showed that the nation could have produced almost 48.03% more than what was actually produced. Therefore, according to the model results, the assertion that the 'fast track' land reform contributed, to a fair extent, to the underperformance of the maize sector still holds.

The model developed in this dissertation contributes to an understanding of not only the general structure of the maize market, but also of the impact of the 'fast track' land reform policy on the Zimbabwean maize market based on how the market itself could have performed under the absence of these land reforms. The baseline model revealed that the maize sector performed below potential within the period of the 'fast track' land reform. The maize market model could thus be used as a tool that may assist policymakers to design future strategies that will help enhance maize sector performance.

Key words: 'fast track' land reform, maize, Zimbabwe, baseline model.

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LIST OF ACRONYMS AND ABBREVIATIONS

AGRITEX	Department of Agricultural Technical Extension
AIAS	African Institute for Agrarian Studies
AREX	Department of Agricultural Research and Extension
AMA	Agricultural Marketing Authority
CFU	Commercial Farmers Union
COMESA	Common Market for Eastern and Southern Africa
ESAP	Economic Structural Adjustment Programme
FAO	Food and Agricultural Organisation
FEWSNET	Famine Early Warning System Network
GDP	Gross Domestic Product
GIEWS	Global Information and Early Warning System
GMB	Grain Marketing Board
GMO	Genetically Modified Organism
GoZ	Government of Zimbabwe
MLRR	Ministry of Lands and Rural Resettlement
MAMID	Ministry of Agriculture, Mechanisation and Irrigation Development
MoU	Memorandum of Understanding
PQS	Plant Quarantine Services
SADC	Southern Africa Development Community
SAFEX	South Africa Future's Exchange
SPS	Sanitary and Phyto-sanitary
STERP	Social Transformation and Economic Recovery Program
UNICEF	United Nation's International Children's Emergency Fund
WFP	World Food Programme
ZCGPA	Zimbabwe Commercial Grain Producers Association
ZCFU	Zimbabwe Commercial Farmers Union
ZFU	Zimbabwe Farmers Union
ZGMA	Zimbabwe Grain Millers Association
ZIMACE	Zimbabwe Agricultural Commodity Exchange
ZIMRA	Zimbabwe Revenue Authority
ZIMVAC	Zimbabwe Vulnerability Assessment Committee
ZRA	Zimbabwe Retailers Association

CHAPTER 1

INTRODUCTION

1.1   BACKGROUND

Over the past four decades, both domestic and trade policy interventions within Zimbabwe's agricultural sector have occurred within the context of vast political and socioeconomic change. Key developments in Zimbabwe's agricultural markets which define its dramatic transformation over the last forty years have been marked by three main shifts. Firstly, maize production has shifted in terms of sectoral contributions, with the communal sector's contribution to total output growing to an average of 60% as the commercial farmers diversified into export production (Jayne *et al.,* 1994; Jenrich, 2008; Andersson, 2007). Secondly, the marketing of grain was transformed from a controlled system to a relatively free market dispensation during the 1990s. This was followed by a re-introduction of price controls and marketing restrictions from 2001 to 2008 and, more recently, a shift back to free markets operating under a multi-currency system. Thirdly, with more profound implications, was a 'fast track' land reform policy that led to the expropriation of approximately 4 000 commercial farms from 2001 to present (Richardson, 2006; Moyo, 2006; Moyo and Yeros, 2009). While this snapshot reflects that the agricultural policy environment and the structure of production and marketing have changed tremendously, an important question is what are the implications and impacts of such changes on Zimbabwe's agricultural sector.

As such, the broader changing economic and political landscape within which agricultural production and marketing takes place warrants a greater need to understand how the policy environment impinges on the supply and demand of grain. Looking at the food crisis in context, there is now a greater need to continuously assess implications of the policy decisions concerning pricing, distribution, production and grain market structure. This process would facilitate the understanding and timely application of strategic information on grain market supply and demand which could enable the adoption of effective decisions and marketing strategies. In addition, it is crucial to develop a more efficient grain market if the country's food security status is to be improved, and this can be achieved, in part, by a

prognosis of baseline projections and market outlooks that can assist government in taking remedial action to correct current market inadequacies.

It is against this background that commodity modelling plays a critical role as it equips decision makers with the requisite essential commodity market knowledge. Commodity modelling as a distinct area of economic research has since the mid 1970s raised the awareness of economists and policy makers to predict and better understand commodity price movements and market supply and demand (Meyer, 2005). Within this context, commodity modelling examines the dynamics of commodity markets through various techniques and simplifies the complex nature of the underlying supply and demand relationships for the understanding of the decision makers.

The utility of commodity models occurs at various levels including forecasting, market analysis and policy analysis. In Zimbabwe, literature on econometric commodity models has largely been confined to single equation estimates that sought to estimate supply response for policy analysis. However, the approach used in this study is unique and has not been applied to Zimbabwe's agricultural sector, and may thus provide the much needed foundation for informed policy making in the maize sector.

1.2   RESEARCH PROBLEM

Over the past decade, Zimbabwe has been facing acute and persistent maize shortages. Between 5.2 million and 7.2 million people in Zimbabwe have been in either chronic or transient food insecurity, or both, since 2001 (Zimbabwe Emergency Food Security Assessment Report, 2002; Human Rights Watch Group, 2003; Famine Early Warning Systems Network (FEWSNET), 2008). This has led to substantial emergency grain imports and food aid that have amounted to a cumulative expenditure of US$ 2.8 billion since 2001 (Cross, 2009).

The persistence, scale and scope of Zimbabwe's food crisis reflect that the changes that have occurred in the maize sector over time have not been well understood by policy makers. It is against recurrent maize shortages that the sector be carefully assessed in order to understand the impact of particular policy shifts in the maize market. A landmark shift in

policy that has inevitably affected the maize sector is the 'fast track' land reform policy. A prevailing rationale suggests that the unprecedented maize shortfalls have, to a fair extent, been triggered by the 'fast track' land reform policy implemented in 2001 (Richardson, 2007a; Richardson, 2007b). However, analysing the effect of the 'fast track' land reform on the maize market is complex, not least because of a combination of other policy factors that have also been on-going, but also due to the fact that Zimbabwe experienced droughts in 2002 and 2005 (Andersson, 2007). Another fairly complex dimension to the problem is that the 'fast track' land reform disregarded the private property rights of commercial farmland, which contributed to decline in investor confidence, commercial exports and aggregate production (Richardson, 2007a). The issue of property rights, however, remains contested in literature and its effects have been empirically argued to be inconclusive (Moyo et al., 2009). Therefore, attributing maize shortages to the 'fast track' land reform policy, given the susceptibility of the market to droughts and the perceived negative effects of property rights, remains debatable.

However, this particular study will not focus much on the contentious issue of property rights, but will rather unpack the broader effects of 'fast track' land reforms on the maize market. The complex nature of the interface between 'fast track' land reforms and maize production implies that the production impact of Zimbabwe's 'fast track' land reform policy should be carefully placed within the scope of agricultural market performance. In this study, a partial equilibrium model is constructed in an attempt to give an elaborate link between the 'fast track' land reform policy and maize supply and demand within a specific context and market setting. This empirical approach to land reform analysis may allow the reader to reason that the model's baseline or 'would be' outcomes against actual 'fast track' land reform outcomes could be the impact of the 'fast track' land reform.

1.3   RESEARCH QUESTIONS

The thrust of partial equilibrium modelling as a basis for analysing the impact of Zimbabwe's 'fast track' land reform policy on maize markets forms the theme and focus of the study. It is against this backdrop that the study seeks to answer three specific questions:

- How much maize output would Zimbabwe have achieved assuming no further policy shifts occurred after 2000?

- Based on the maize production outlook, what then would be the proximate impact of the 'fast track' land reform policy on maize production?

- Given the unprecedented fall of the Zimbabwean dollar that occurred up to 2008, what would have been the impact on the maize sector of a year on year depreciation in exchange rate of 12% if Zimbabwe had maintained the 'pre-2000' land reform approach under a stable economic environment?

1.4   RESEARCH OBJECTIVES

The main aim of the study was to model the impact of the 'fast track' land reform policy on the maize market. The study attempted to address this issue from the viewpoint that the 'fast track' land reform policy impacted on the maize sector within the context of complex dynamic policy and non-policy factors that impinge on agricultural markets. The maize model was therefore built on a set of assumptions which will be discussed in-depth in Chapter seven. The study had three overriding specific objectives, namely:

- To provide an outlook of Zimbabwe's total maize production assuming no further policy shifts occurred after 2000.

- To elicit, based on the maize production outlook, the proximate impact of the 'fast track' land reform policy decision on maize production.

- To determine the impact on the maize sector, of a 12% depreciation in the exchange rate if Zimbabwe had maintained the 'pre-2000' land reform approach under a stable economic environment.

The outlined specific objectives were achieved by employing economic theory and econometric modelling techniques applied to Zimbabwe's maize market. The econometric model system developed a picture of what could have happened if no further policy shifts had taken place after 2000. The baseline model outcomes were then compared to the actual outcomes under 'fast track' land reform policy. From this perspective, the developed model provides a basis through which the effects of the 'fast track' land reform policy on the maize market can be analysed.

1.5 OUTLINE OF STUDY

This section gives the background of the study and what it set out to achieve. The thesis systematically unpacks the structure of Zimbabwe's maize market in an effort to build a partial equilibrium model for maize. The study is thus chaptered as follows: Chapter Two reviews the background and role of agriculture in Zimbabwe's economy in general and the market structure of the maize sector in particular. The basic purpose of this chapter is to inform the modelling exercise through an exploration of the maize marketing and pricing structural policies, therefore using evidence as a basis for constructing the partial equilibrium model. Chapter Three provides a literature review on commodity modelling, firstly from a global point of view and secondly from a Zimbabwean viewpoint. The importance of this chapter is to provide a review of how commodity modelling has been done elsewhere in the world and in Zimbabwe, and therefore to inform the study of the utility of available tools and how they may be applied to Zimbabwe's maize sector. Chapter Four discusses the theoretical framework of the study through a brief overview of the theoretical foundation underlying the study. The economic theory discussed in this chapter sets out the micro-foundations that are used in the construction of the model's equations. This leads to a discussion of the structure of the maize model in Chapter Five. The key equations forming the building blocks of the model are outlined based on the theory discussed in the preceding chapter. Chapter Six presents the empirical results of the model's equations and discusses what they imply from an economic point of view. Chapter Seven presents the baseline outcomes based on solutions derived from the simultaneous system of equations. An analysis of the 'fast track' land reform policy scenario and the impact of the depreciation of the Zimbabwean dollar are outlined. Chapter Eight then concludes the study and gives recommendations.

CHAPTER 2

ZIMBABWE'S AGRICULTURAL AND MAIZE SECTOR: AN OVERVIEW

2.1   INTRODUCTION

Developing a partial equilibrium model requires a thorough understanding of the market behaviour (including the decision-making processes of producers and consumers) inside the framework of the wider environment within which maize sector economic agents operate. This chapter therefore provides a descriptive overview of the functioning of Zimbabwe's maize marketing and pricing policy. The essence of the literature here is to provide a basic and sound appreciation of the functioning of the maize market over time so as to provide the foundation for a solid understanding of the maize model development exercise. The functional aspects of the maize market will provide the conceptual acumen for modelling farmers' price expectations and responses, allowing for the development of a simulation model that can appropriately mimic the Zimbabwean maize market.

While the focus of this study's analysis is on modelling the maize market, the reader should also keep in mind the broader political, institutional and historical forces that provide the context for market responses[3] to agricultural policy reform issues and how they influenced the food self-sufficiency outcome in Zimbabwe. Therefore, this chapter also identifies the historic market conditions that existed leading up to the current food crisis. Understanding the historical market conditions is important because the 'fast track' land reform policy links up with maize production structure and supply vis-à-vis maize area planted under commercial and communal sectors over time. Therefore, understanding the past functioning of the maize market and its related production structure is critical to attaining an

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[3] Rohrbach (1987) argues that the complexity of socio-economic and political issues involved in any particular country's producer response to institutional and structural policy changes makes the process of estimating the value of grain forecasts extremely difficult.

understanding of the effects of the 'fast track' land reform policy shift on the supply-demand function in the market.

The chapter is therefore organised into four sections. The first section provides a brief background of the agricultural sector. The second section reviews the evolution of the maize sector as well as its marketing structure. The third section provides an overview of the government policies and the chapter ends with a discussion of the current situation in the Zimbabwean maize sector and a summary of the chapter.

2.2   BACKGROUND AND CONTEXT

The initial step towards eliminating colonially induced economic and social disparities was done through a benchmark policy dubbed the "Growth with Equity" initiative, a policy implemented in 1980 when Zimbabwe gained independence (Muir-Leresche, 1998). Part and parcel of this initiative was to redistribute land to landless communal farmers through a Lancaster House settlement that committed the British government to provide funding for a 'market based' land reform programme (Rukuni, 2006; Utete, 2003). Although considerable policy efforts have been made towards both social equity and economic growth ever since, limited progress has been made in achieving productivity and output growth (Kapuya *et al.*, forthcoming).

A notable point in the history of agricultural policy has been the 'fast track' land programme implemented by the Government of Zimbabwe (GoZ) from 2000 which was set to achieve equitable distribution and growth in agricultural production. Although benefiting thousands of indigenous farmers allocated land under the A1[4] and A2[5] resettlement models, the 'fast track' land reform programme has not transformed the agricultural sector to achieve the expected increases in the level of agricultural production of the traditionally large-scale commercial farming (LSCF) sector dominated enterprises like tobacco and wheat. Moreover, Zimbabwe has even struggled to produce sufficient maize output even though the maize sector is traditionally a communal farmer dominated sector. Communal farmers in the

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[4] The A1 model has plots with 5-6 arable hectares and in excess of 6 hectares for grazing.

[5] The A2 model has farms ranging from 2 to 50 hectares in the peri-urban areas, 15 to 250 hectares in Agro-ecological regions I – III and 350 to 2000 hectares in Agro-ecological regions IV and V. For your reference, go to Annex C

1990's produced an average of two thirds of maize output (Jenrich 2008; Rukuni, 2006). While it would stand to reason that more maize would be produced if communal farmers expanded their land under the redistribution exercise of the 'fast track' land reform programme, most of the years since 2000 have been characterised by acute maize shortages to the extent of attracting international emergency food aid amounting to a cumulative US$ 2.8 billion (Cross, 2008).

Industry experts attribute maize production shortfalls in preceding seasons as well as the 2009/10 production season to a myriad of farm-level challenges emanating from policy and non-policy factors. These include a lack of adequate funding, agricultural input shortages and limited commercial farming skills. Yet, given enough support through strategic and timely interventions under stable institutional, economic and political conditions such as those that existed before 2000, Zimbabwe's agricultural sector may realise substantial increases in productivity. This is argued since research has established that output per hectare increases with reduced farm size in all natural regions of Zimbabwe (Elich, 2005).

However, Richardson (2004) and Richardson (2006) argued that the land redistribution of 2001 did not achieve the expected increases in production, pointing out the 'tragedy of the commons' associated with the land reform policy's failure to uphold private property rights as a key factor. Moreover, the indiscriminate seizure of commercial farmland broke the structural link between the communal and commercial farming sectors, which had symbiotically benefited communal farmers in terms of subsidised fertilizers, inputs, low-interest loans and foreign exchange generation for the agricultural sector (Richardson, 2007a). It is against this background that the 'fast track' land policy is argued as the cause of maize production shortfalls.

In light of this widely-shared opprobrium, an obvious and yet urgent question is the extent of the 'fast track' land reform policy's impact on the maize sector. Although Richardson (2007a) explores what would have happened if the 'fast track' land reform had not been implemented, Andersson (2007) purports that this argument was incoherent and flawed because it was not based on a sound understanding of maize production trends. Nonetheless, it is Richardson's (2007a) line of reasoning that forms the thrust of the argument that this study seeks to further unpack and comprehend. Even though considerable debate has erupted over the appropriation of the 'fast track' land programme as a cause of agricultural

production shortfalls, the study will not focus on this debate but will rather build its argument on how much Zimbabwe could have produced had the GoZ not implemented the 'fast track' land reform programme. Because the study attempts to empirically determine how much maize would have been produced after 2000 if the GoZ continued with its pre-2000 land reform and the then set of agricultural policies, the focus of this chapter will thus be primarily on reviewing grain market and pricing policies over time. This process will allow for a sound grasp of policies, institutions, economic and market conditions that existed prior to and after the 'fast track' land programme period. This knowledge is used to inform the development of a model that may give an outlook within the period the 'fast track' land programme was implemented.

For the sake of recourse, it is important to establish the importance of the agricultural sector to Zimbabwe's economy. In the next section, the importance of the agricultural sector is reviewed in line with its strategic value in the economy.

2.3   OVERVIEW OF ZIMBABWE'S AGRICULTURAL SECTOR

By virtue of being a developing country, Zimbabwe's agrarian economy is sustained by an agricultural sector which is uniquely important for several reasons, namely its provision of food, employment[6], value added to GDP and foreign exchange[7] (Rukuni, 1994; 2006). Agriculture's contribution through these economic functions has meant that agricultural sector performance mirrors the performance of the entire economy (MAMID, 2009).

The Zimbabwean agricultural sector is supported by well-diversified production systems whose structures consist of two main subsectors which include the livestock sector and the crop production sector.

The livestock sector consists of beef, dairy, poultry, piggery and game ranching, while the crop production sector is typified by the production of over 20 types of food and cash crops.

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[6] In 2000, the sector employed 30% of the economy's overall formal labour force and supported 70% of the population's livelihoods through direct and indirect means (Bautista & Thomas, 2000).

[7] In value terms, the agricultural sector forms the largest single source of export earnings, contributing 40% to 45% of total exports in most years since the late 1980s (Mudimu, 2003).

The crop production sector in Zimbabwe can be partitioned broadly into three categories. The first category is food grain crops, which include maize, wheat, edible dry beans and small grains (barley, sorghum and millets). The second category encompasses oilseed and crops such as soybean, groundnuts and sunflower; while the third category includes key export crops – tobacco and cotton. The third category comprises high-value estate or plantation crops (sugarcane, tea, coffee and citrus), horticulture (floriculture and vegetables) and other non-traditional export crops (like paprika).

The contribution of agriculture, in terms of food and exports, has been the pillar of Zimbabwe's economic stability, with years of drought coinciding with years of negative economic growth. An example can be drawn from the 1992 and 1995 droughts in which the agricultural sector's real growth rate declined by 23.3% and 7.6% respectively (Mudimu, 2003). It is during these two seasons throughout the decade that the economy responded by shedding GDP by –5.4% and –1.0% respectively (ibid). This implies that growth in the agricultural sector dictates the performance of the wider national economy. As Muchapondwa (2009) contends, Zimbabwe's economic performance has depended greatly on agricultural export earnings and the production of surplus beyond domestic requirements. As such, after 1980, Zimbabwe's agricultural sector grew steadily, although slowly, accounting for an approximate average of 18% of Gross Domestic product (GDP) and over 40% of national exports annually (Kapuya *et al*., forthcoming). Matshe (2003) attributes about 50% of GDP growth as directly or indirectly dependant on primary agriculture.

Figure 2.1 below shows the trends in year-on-year GDP growth from 1980 to 2008. The graph shows that, historically, year-on-year GDP declined during years of drought, as shown by the negative growth rates in 1983, 1987, 1992 and 1995. This implies that a positive correlation exists between agricultural performance and GDP growth. However, since 1998, Zimbabwe has undergone 12 years of year-on-year GDP decline[8]. Ironically, 1998 is not only the year the country experienced a cyclone, but it was also the same year that sporadic land invasions started (Rukuni & Eicher, 2006). Now, an important

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[8] Zimbabwe's GDP by 2008 had contracted to half of that of 1998 (Robertson, 2009)

observation is that throughout the 'fast track' land reform period, year-on-year GDP growth has been consistently negative (see Figure 2.1).
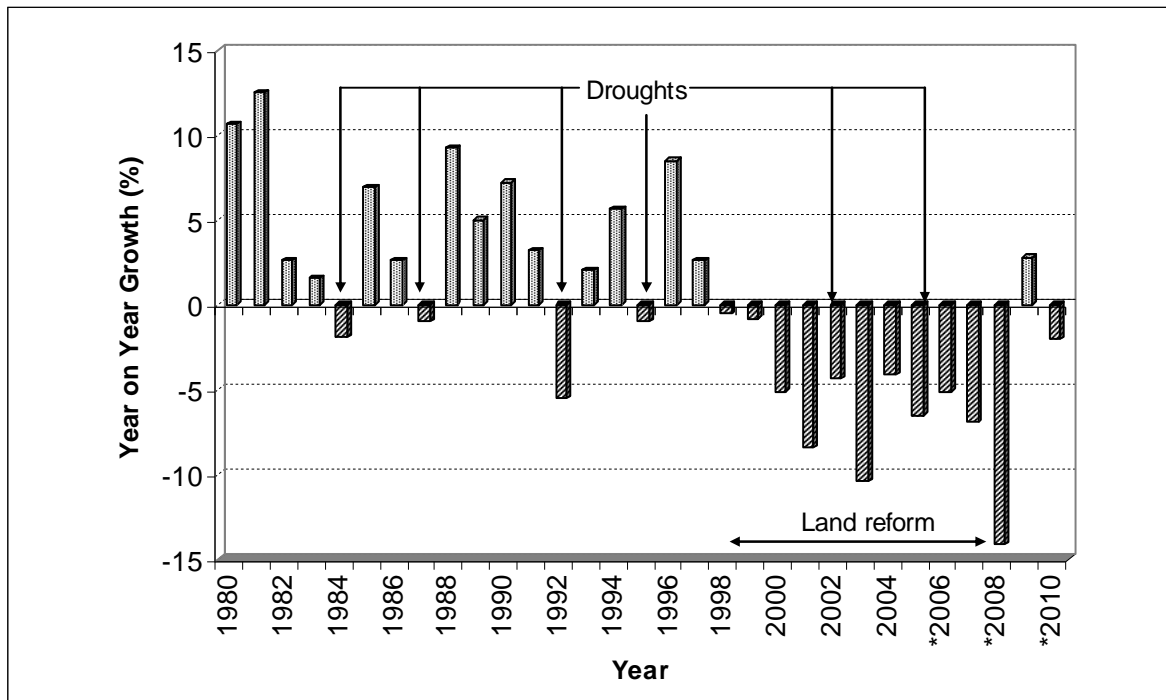
Figure 2.1:   **Trends in Year-on-Year GDP Growth (1980-2010)**

Source: Adapted from Robertson (2009)

* Estimates based on Robertson's (2009) forecasts

Despite the economic decline, agriculture has still remained one of the most important sectors of Zimbabwe's economy (Robertson, 2009). Despite the negative GDP growth, agriculture's contribution to the total GDP has been at least 16% since 2000 (AIAS, 2004). Statistics show that the sector's contribution to GDP peaked at 28.8% in 2001, although its contribution to the growth rate has been negative in most years since 2000 (see Appendix E).

Although there is a lot of evidence to support the notion that agricultural performance and GDP are correlated, the question of the wider economic impacts of 'fast track' land reform on the Zimbabwean macro-economy is quite complex, as is the question of what caused the rapid decline in the economy over the past 10 years. It is important to note that other important factors have had an influence on the economic decline witnessed after 1998. Davies (2004) explores the interaction of a range of factors, including rent seeking in the

black market for commodities and foreign currency, the collapse of institutions of democracy in the interests of an authoritarian ruling party, growing shortages of fuel, electricity and production inputs; and currency-based predations of the 'rentier' class. Richardson (2007a) contends that rainfall (droughts), land reforms, political conditions, labour productivity, capital formation and foreign aid are important factors that determine economic performance in Zimbabwe. While these factors have direct and indirect links to agriculture, Richardson (2006) uses the Zimbabwe case to argue that de Soto (2000) is correct in the analysis of private property rights as the center-piece of the 'hidden architecture' of capitalism and the basis of prosperity in market economies.

As such, that property rights may have had intricate and far-reaching negative ripple effects on investor confidence, land equity, and entrepreneurial knowledge and incentives explains not the causes, but the factors that hastened and sustained economic decline. It is for this reason that Zimbabwe's 'fast track' land reform is identified as a key factor that has contributed to the economic decline. Otherwise, strong neutral considerations support the broad agreement, across a spectrum of ideological perceptions, that 'fast track' land reforms caused the economic crisis since it had an extremely negative effect on the perceptions of both international donors and investors in the early 2000s, with damaging impacts on Foreign Direct Investment (FDI), as well as international funding from the International Monetary Fund (IMF) and World Bank, which eventually exacerbated Zimbabwe's economic decline.

Delving into the cascade of effects of the expropriation of commercial farms under the 'fast track' land reform, the subsequent poor agricultural market performance suggest that the paradox of Zimbabwe's food crisis needs to be unpacked further. Drawing from and building on Richardson's (2007b) argument, the question is: would the drop in agricultural production have been less severe if 'fast track' land reforms had not taken place? This question needs to be treated very carefully because the effects of the loss of property rights under the land reform occurred within the context of a complex and dynamic maize market that also experienced two droughts in the space of three years. Naturally, maize markets would take time to recover from such phenomenal natural disasters. In the next section, an attempt is made to systematically unpack Zimbabwe's maize market to understand the functioning of the market before and after the 'fast track' land reform.

2.4 AN OVERVIEW OF ZIMBABWE'S MAIZE SECTOR

Underpinning Zimbabwe's maize market has been a stern historical policy bias that taxed the sector (Masters, 1991; Masters, 2007). The political fascination of maize in the broader agricultural policy context stems from a number of critical sensitive components pertaining to its aggregate contribution to national welfare. As a basic and essential attribute, maize is the most important grain crop in Zimbabwe, being both a major livestock feed grain and a staple food. FAO (2008) reported that maize and maize products accounted for 43% of the total dietary energy supply (DES) between 2003 and 2005 while FAO (2004) and Jayne *et al.* (2006) estimated maize's contribution to the caloric intake requirement at an average of between 50% and 70% respectively. Despite critical maize shortages, the average per capita food consumption of maize and maize products was 120 kg/yr between 2004 and 2008.

More than half of the maize produced is consumed by humans, with about 10% being utilised by the animal feed industry, while the remainder gets used for seed and other industrial purposes (FAO, 2004). Apart from serving as the country's staple food, maize's share of total agricultural revenue averaged 5.7% (Richardson, 2007a).

The importance of maize as outlined here has been underlined by a great significance in production and marketing organisation. Under this section, the maize sector is reviewed by discussing three important issues which include:

- The maize market calendar
- Maize area harvested, yield and production
- The maize balance sheets

2.4.1 Zimbabwe's Maize Marketing Calendar

Maize planting takes place during the period of 'land preparation and planting' which runs from the beginning of September to the end of December. It is also during this period that Zimbabwe's main rainy season commences, stretching from the period around the end of October or mid-November to around February or March. As shown in Table 2.1 below, the

first maize harvest (green maize) is done between the months of February and May, while the conventional harvest period of dry maize falls between the months of May and August.

Table 2.1:   The Maize Cropping Calendar

Period		Activity
Start	**End**	
31 April/1 May	31 August	Main Harvesting
31 April	31 October	Deliveries to the Market
1 September	31 December	Land Preparation and Planting
31 October/Mid November	31 March	Main Rainy Season
1 February	1 May	Green Maize Harvesting

Source: ZIMVAC (Various Issues)

The GMB trading year is marked by the beginning of the dry maize harvest period and first deliveries on the 31st April. Thus, farmers normally start delivering their maize to the market around April/May, and deliveries usually continue up to October. Takavarasha (1994) points out that 90% of locally produced maize deliveries have in the past been received during the five-month period between June and October.

2.4.2   Maize Area Harvested, Yield and Production

If normal weather prevails, a national total of at least 1.2 million hectares of maize should be planted to meet the domestic human consumption requirements of 1.825 million tonnes, on average. Generally, the trend over time has been towards an increasing total maize area planted. Total maize area harvested has remained above 1.317 million hectares since 2001 and has been above a 1990s average of 1.301 million (MAMID, Various Issues).

Figure 2.2 below shows that the area harvested peaked in 2005 and 2007 to above 1.7 million hectares. This may be attributed to the effects of the 'fast track' land reform which is believed to have expanded communal and smallholder area.
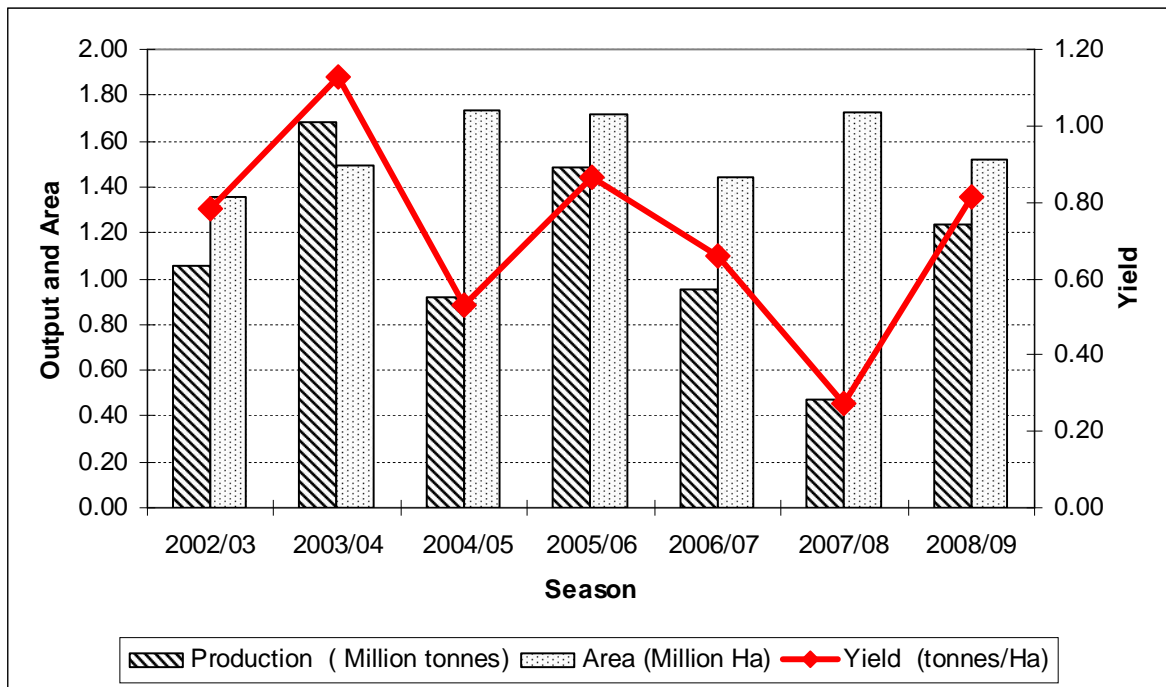
Figure 2.2: **Total Maize Area Harvested, Production and Yield**

Source: AIAS (Various Issues)

The observed gains in maize area harvested have however not been matched with a corresponding increase in yield. Yield has fallen below the 1990s average of 1.25 tons/ha; with the worst yield being 0.4 tons/ha and 0.33 tons/ha recorded in 2002 and 2008, respectively. The effects of declining yield are also reflected in the lower levels of output. Since 2001, Zimbabwe has not produced maize that is sufficient to meet domestic requirements.

As shown in Table 2.2 below, the total national maize output has dropped to 575 000 tonnes in 2007, the lowest since the 1992 drought. Although maize output increased marginally in 2008, production was still less than half of national requirements. Forecasts by the Commercial Farmers' Union (CFU) for the 2009/10 farming season suggest that output will fall to below 400 000 tonnes (ZCGPA, 2010). This estimate is only 22% of national requirements despite the government's target under the Social Transformation and Economic Recovery Programme's (STERP's) forecast of meeting 80% of national maize requirements. Nonetheless, Esterhuizen, (2010) argues that the country is highly likely to produce at most 600 000 tonnes and this will be due to prevailing challenges of input-supply bottlenecks and a lack of funding currently facing farmers.

Table 2.2: Output and Yield Relative to 1990s Annual Average

Year	Output (tonnes)	% Change from the 1990s Output Average	Yield (tonnes/ha)	% Change from the 1990s Yield Average
1990s Average	1,668,600	-	1.25	-
2000/1	1,476,200	-11.50	1.1	-12.00
2001/2	1,526,300	-8.50	0.4	-68.00
2002/3	929,600	-44.30	0.9	-28.00
2003/4	1,058,800	-36.50	0.8	-36.00
2004/5	1,686,200	1.10	0.5	-60.00
2005/6	915,400	-45.10	0.6	-52.00
2006/7	952,600	-42.90	0.5	-60.00
2007/8	575,000	-65.50	0.33	-73.60
2008/09	1,242,600	-25.50	0.81	-35.20

Source: AIAS (Various Sources)

In spite of the maize shortfalls, several programs have been implemented, through NGO, government-funded, intergovernmental and regional initiatives from 2000 to date, to improve maize output. Such programs mainly involved provision of subsidised inputs at concessionary interest rates, and these include:

- The Government Input Scheme (GIS) (2000);

- The Productive Sector Facility (PSF), introduced in 2004; and

- The Agricultural Sector Productivity Enhancement Facility (ASPEF), introduced in 2005 through the Reserve Bank of Zimbabwe's (RBZ) quasi-fiscal policies;

- The Southern African Development Community's (SADC) provision of seed and fertilizer through the SADC Agricultural Inputs Support Initiative (2008) that primarily supports smallholder farmers in communal, old resettlement, and smallholder commercial areas.

- The Humanitarian Inputs Support Scheme (2009) coordinated by the Food and Agriculture Organization (FAO) and funded by 16 donors. The programme was implemented by 35 non-governmental organisations (NGOs), UN-Agencies and other humanitarian organisations.

Despite all these efforts, maize production has not increased beyond national requirements. Uncovered maize deficits have led to the increasing importance of international food aid as a source of grain to meet domestic maize requirements. The United Nations' system, which includes the Food and Agricultural Organisation (FAO), Organisation of Children's Health (OCHA), United Nations Programme on HIV/AIDS (UNAIDS), United Nations International Children's Emergency Fund (UNICEF), United Nations Population Fund (UNFPA), United Nations Development Partnership (UNDP), World Food Program (WFP) and the World Health Organisation (WHO), in collaboration with other non-Governmental Organizations (NGOs) and the Southern Africa Development Community (SADC), have been obtaining and implementing food aid programmes in Zimbabwe to augment the supply of grain and grain products. In 2008, according to the WFP, approximately 327 338 tonnes of maize and maize meal had been delivered through programme aid and on an emergency basis. The table below shows a compilation of the food aid estimates from 2004 to 2008 by the World Food Programme (WFP).

Table 2.3:   Food Aid into Zimbabwe (2004-2008)

Year	Emergency food aid (tonnes)	Project food aid (tonnes)	Total (tonnes)
2004	248 794.70	258.5	249 053
2005	71 552.80	1 522.00	73 075
2006	134 487.40	0	134 487
2007	145 523.50	10 129.50	155 653
2008	322 338.00	5 000.00	327 338

Source: WFP Database (2009)

Over the past three years, maize imports and food aid have accounted for approximately one-third and two-thirds of total supply in the 2006/07 and 2008/09 marketing years; respectively. The combined contribution of food aid and imports increased in the 2007/08 season to an estimated 758 000 tonnes against a local production estimate of 575 000 tonnes. This shows that the maize sector has become increasingly reliant on imports and food aid due to insufficient domestic production.

2.4.3 Zimbabwe's Maize Balance Sheet

A major concern over the past decade has been the need to incorporate food balance sheets in food policy decisions and to therefore inform maize market policy. Recurrent deficits have been a reflection of a general lack of insight into the importance of maize balance

sheets for planning decisions. Jacobs and Summers (2002) and Rukuni and Eicher (2006) point out that food balance sheets are essentially constructed to determine over- and under-supply in a given consumption period. Knowledge of the extent of deficit (or surplus) in turn allows for government to anticipate challenges (and opportunities) that would allow for the design of adaptive measures to combat deficit (or to dispose of surplus). However, balance sheets need to be constructed using good data which has not been readily available. Estimates on supply and demand variables have varied across institutions, with GoZ, FAO/GIEWS and ZIMVAC estimates offering markedly different balance sheet datasets.

Nonetheless, average annual domestic utilisation of maize between 2001/02 and 2008/09 is estimated at 1.98 million tonnes (AIAS and FAO, Various Issues). Estimates from FAO (2008) reports show the total domestic maize utilisation to be 1.825 million tonnes, while government estimates peg it at 2.4 million tonnes after including other discretionary stock uses such as supply stabilisation (precautionary) stock. In Table 2.4 below, a maize balance sheet trend is displayed to show the stock supply and demand balance of Zimbabwe's maize sector from 2003/04 to 2008/09.

Table 2.4:   Trends in Zimbabwe's Maize Balance Sheets (2003/04-2007/08)

Variable	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
Supply						
Production	1 686 000	915 000	1 485 000	953 000	471 000	1 240 000
Opening Stock	88 000	120 000	70 000	0	154 000	32 000
Imports						
• Gvt Imports	340 170	184 901	685 983	250 659	340 170	450 000
• Food Aid	249 053	73 075	134 487	155 653	327 338	299 000
• Informal[9]	-	13 108	1 875	1 617	2 593	23 000
Total Supply	**2 363 223**	**1 292 976**	**2 377 345**	**1 360 929**	**1 141 101**	**2 044 000**
Demand						
Human use	1 529 639	1 549 294	1 648 417	1 747 337	1,632,013	1 825 000
Feed use*	150 000	125 000	137 500	437 975[10]	150 000	150 000
Seed use*	110 000	101 000	56 000	-	48 000	48 000
Losses*	79 000	-	-	-	40 000	57 000
Closing stocks	120 000	70 000	0	154 000	32 000	50 000
Total demand	**1 988 639**	**1 845 294**	**1 841 917**	**2,339,312**	**1 902 013**	**2 130 000**
Surplus/Deficit	**374 584**	**-552 318**	**535 428**	**-860 000**	**-606 912**	**-86 000**

Source: AIAS (Various Issues), *FAO (Various Issues), USAID-FEWSNET (2007; 2009) and MAMID (Various Issues)

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[9] Cross-border informal maize imports from South Africa, Zambia and Mozambique

[10] Aggregate of feed, seed and losses

The 2008/09 maize balance sheet reveals that Zimbabwe's maize market had a negative balance of approximately 86 000 tonnes which represents the uncovered deficit in that particular consumption period. Apart from the 2003/04 and 2005/06 seasons, other years in the previous five year period had been worse, particularly in the 2004/05 and 2006/07 seasons which had uncovered deficits of just over 552 000 tonnes and 860 000 tonnes, respectively (see Table 2.4).

Quite evidently, domestic production has been far short of requirements and has been augmented by imports from government, food aid and cross-border informal trading. A key observation is also that maize deficits have effectively underlined Zimbabwe's position as a net importer of maize. When compared to the 1980s and 1990s, decades in which Zimbabwe was a major net exporter in the region, then one may conclude that there has been a clear shift in the net trading position of the country's maize sector.

It is important to note that while every effort has been made to carefully assess the maize data from various sources, as presented in the balance sheet trends in this section, such data has been quite messy and difficult to validate. This is particularly true with regard to ending stock figures, imports, food aid, and even maize demand. Various sources have offered diverse stock balances, and the attempt here sought to present a near representative maize balance trend. Although the data might not be an accurate reflection of the actual supply and demand, it nevertheless provides an insightful and general idea of the maize supply and demand situation in Zimbabwe over the past five years.

2.5 ZIMBABWE'S AGRICULTURAL POLICY AND GOVERNMENT INTERVENTION

Because food is essential to a nation's health and vital to any concept of well-being, grain markets have been a particular focal point of agricultural policy. This compelling fact can be traced back to the Great Depression in the 1930s, the defining effects of which led to the implementation of the policy foundation of Zimbabwe's agricultural sector. In this section, the historic policy frameworks that governed the maize market and how these affected the maize sector over time are reviewed.

From a broader and much more general perspective, the history of maize market policy in Zimbabwe's agricultural sector has largely been interventionist. The rationale for this approach is premised on four key objectives, namely:

- To achieve income re-distribution,
- To attain food security,
- To achieve economic growth, and/or
- To improve allocation of resources (Timmer, 1986).

In achieving these objectives, the Zimbabwean government's agricultural policy interventions took two main forms which included:

- A pricing regime under a state-controlled market in which uniform prices were set throughout the season (pan seasonal) and throughout the year (pan territorial) from 1930 to 1996, and from 2000 to 2008.
- Direct involvement in maize purchasing, sale, buffer stock management and discretionary trade policy instruments such as export restrictions/bans since the formation of the GMB in 1930.

The key objectives and the forms of interventions outlined above are assessed in this section of the chapter by reviewing the overall policy environment of Zimbabwe's grain sector. Therefore, the section is going to be partitioned into three main subsections which will explore three important aspects which include:

- The evolution of Zimbabwe's maize marketing and pricing policies,
- Zimbabwe's grain trade policy, and
- The market structure of Zimbabwe's maize sector

These are discussed in greater detail below.

2.5.1   Evolution of Zimbabwe's Maize Marketing and Price Policy

The grain sector, as a food production and distribution sector, has received and continues to receive particular attention in terms of both policy and regulation. What started off as a Maize Board in 1931, and was then the foremost policy meant to support white farmers in the negative effects of the Great Depression, set the platform for decades of controlled marketing of maize as well as other agricultural commodities. The creation of the Maize Board paved the way for the enactment of a set of key support institutions and policy instruments that were initiated primarily to offer a comprehensive support system to white commercial farmers. Among the most significant and essential pieces of legislation were the Maize Control Act (1931 and 1934), the Land Apportionment Act 1930, the Land Tenure Act (1969), the Farmers Debt Adjustment Act (1935) and the Seed Act (1965). Research and Extension support institutions were initiated by the setting up of the Department of Research and Specialist Services (DR&SS) in 1948 and the Department of Conservation and Extension (CONEX), respectively. The critical grain marketing functions of the Maize Board were then financed and coordinated by the Agricultural Marketing Authority (AMA) which was established in 1967.

While all of these institutions provided a framework for maize production and marketing, it was nonetheless the Maize Control Act of 1931 that formed the foundation and essence of agricultural policy. The Act has had several amendments over time. The first amendment came in 1934 through the introduction of a segregatory marketing and pricing structure in which black farmers were taxed to subsidise white commercial farmer exports (Rukuni, 1994; Rukuni, 2006). The second landmark came through the reconstitution of the Maize Control Act in 1950 to become the Grain Marketing Act. It was through this Act that the Maize Board became what is now presently known as the Grain Marketing Board (GMB). As the name inferred, the GMB was not only meant to assume control of maize but all other major grain crops. Therefore, Sorghum was thus controlled in 1950, groundnuts in 1952, soybeans in 1969, wheat in 1970 and sunflower seeds in 1984.

Market controls under the GMB implied an administered grain marketing and pricing system in which the Board itself also assumed the sole right to storage, distribution and transport functions of grain throughout the country. While segregatory pricing structures between black and white farmers persisted during the colonial era, it was only in 1980, the

year Zimbabwe gained independence that grain markets under a black government shifted to a non-racially based price system.

During and after the colonial era, set prices were announced either before planting or before harvest (Sukume and Guveya, 2009). Historical trends suggest that post- and pre-planting announcements were discretionary. Takavarasha (1992) argued that pre-planting[11] prices were used under exceptional circumstances, for instance, in seasons following a drought in order to send stronger signals to producers so as to boost production. Generally, producer prices were announced around beginning of April, four to five months after planting. From 1981, the Ministry of Agriculture adopted a consistent post-planting price regime. Previous year's prices were taken to represent the minimum producer price for the upcoming season (Takavarasha, 1994). Thus, farmers based their production decisions on current year's maize price while negotiating for higher prices. The on-going negotiations and producer price outlooks informed the pre-planting policy statements that highlighted government's expectations of future production trends.

In 1987[12] the GoZ modified the maize pricing structure to what is known as a 'two-tier system' in which communal farmers obtained favourable terms and prices (Richardson, 2007a). The key strategic objective of the two tier price system was to promote diversification of commercial farmers to export production whilst maintaining high maize production from the communal farm sector. However, this pricing regime came at the cost of supporting smallholder production through implicit subsidies for transport costs of smallholders, particularly those in remote areas (Jayne and Rukuni, 1993; Muir-Leresche and Muchopa, 2006). The negative impact of these subsidies has been well documented, and the costs of such GMB operations, combined with loss-making maize

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[11] Rohrbach (1989) pointed out a maize pre-planting price regime occurred between 1976 and 1985. From 1979 and 1981, he noted real prices increases of 60%, a corresponding large-scale commercial maize area increase of 50% and a maize sale increase of 250% respectively. In 1982, government temporarily suspended the pre-planting price regime, and a 35% decline in supply followed (ibid).

[12] In the same year, government introduced the Export Retention Scheme and the Export Revolving Fund in which foreign exchange allocations favoured exporters; these were export incentive measures that were meant to stimulate export oriented production. This policy was argued to have increased the propensity of the commercial sector to shift to high value export crops which, in addition to the lure of the depreciation of the Zimbabwean dollar, further increased economic gains as a result of the weakening exchange rates.

export surpluses contributed to fiscal deficits[13] that prompted the need to adopt new sustainable free market measures. Table 2.5 below summarises the pricing approaches before the maize markets were liberalized.

Table 2.5: Summary of Pre-liberalisation Pricing Approaches

Policy	Policy Features	Policy Goals
Pre-planting prices	Producer prices were announced before planting.	Boosted producer incentives as it reduced risk and uncertainty. Also enabled farmers to make decisions based on relative prices
Pre- and post-harvest prices	Producer prices were set and announced around April.	Enabled the GoZ to gauge potential harvests and stocking levels before announcing prices.
Pan-territorial pricing	Payment of uniform prices through the country.	Benefited farmers in remote surplus regions at the expense of those close to markets but in deficit. Discouraged production of high value-low volume crops (Export crops). This implied implicit transport subsidies to remote farmers
Pan-Seasonal pricing	Producer and consumer prices are set annually.	No incentive for off-season production. Encouraged centralised as opposed to on-farm storage.
Two-tier pricing	Communal farmers paid more than Commercial farmers	Encouraged production of high value-low volume crops (Export crops) by commercial farmers.

Source: Adapted from Muir-Leresche and Takavarasha, (1988); Sukume and Guveya (2009)

Against pressure to scale down the GMB operations, the maize market was partially liberalised in 1992, a policy shift that was part of a stepwise approach towards the development of a free market-oriented maize sector. In what became popularly known as the Economic Structural Adjustment Programme (ESAP), a market reform initiative that relegated the Board to residual trading of maize, gradual private-sector participation in the market was cautiously adopted. The GMB, however, still manipulated prices through purchase and sale operations, playing a supply stabilisation function and also maintaining full control over import and export maize trading. This implied that, instead of purchasing the entire marketed surplus as was the objective during the initial control period, the GMB attempted to manipulate maize market prices ostensibly for food security and price stabilisation purposes.

Meaningful private sector participation came through the establishment of the Zimbabwe Agricultural Commodity Exchange (ZIMACE) in 1994 which effectively became a competing entity to the GMB (ZIMACE, 1999). Maize producers during this period had

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[13] Tschirley *et al*. (1999) refer to Jenkins (1997) to point out that fiscal deficits of Zimbabwe's Grain Marketing Board in the early 1990s were 5% of GDP.

several market options. Farmers would either opt for on-farm storage or choose between alternative markets by delivering their produce either to the GMB or directly to processors and other grain traders. Progressive market liberalisation for the maize sector was completed in 1996, implying that the market was free of intervention across the value chain, with the GMB still the buyer of last resort. Concerns over sharp increases in prices during this era attracted scepticism from policy makers who pointed out that free markets failed to stabilise maize and maize meal prices. These concerns came after GMB had raised its maize selling price to millers to adjust to prevailing market prices, following which millers raised roller meal prices by 21% (Masanganise, 2002; Sukume and Guveya, 2009). This triggered food riots across the country in January 1998, and thus government re-introduced controls on maize meal prices in May the same year.

Although this has been signalled as a failure of ESAP, it appears that policy makers have been oblivious to the fact that the performance of the maize market in the 1990s reflects not the impacts of 'liberalised maize markets' but rather a mixed policy environment of legalised private grain trade within the framework of an interventionist GMB operation in the maize market. The Food Security Group (forthcoming) argue that such an environment would not be conducive to nurturing private participation primarily because of its pertinent focus on single functional aspects (such as warehouse receipt systems, storage and other private trading functions) when the real problem is essentially an inherent systemic market challenge. Therefore, the re-introduction of price controls reflected the failure of the GoZ to fully understand systemic grain market challenges.

While ESAP had arguably mixed results, it motivated a reverse-policy shift in 2001 in which the GMB monopoly was reconstituted. This was done through two main statutory instruments, namely:

- The Grain Marketing Notice Statutory Instrument No. 235A of 16 July 2001 which specified maize (and wheat) as controlled products, and
- The gazetting of Statutory Instrument 387 in December 2001 which compelled farmers to deliver maize stock to the Grain Marketing Board (GMB) within 14 days after harvest.

These legislative instruments effectively re-established complete state maize price and movement controls and summarily ended private grain trade (and therefore ZIMACE). To complement this set of policy measures, GoZ 'suspended' the standard grading[14] system of grain that was set according to GMB prescriptions, implying that maize was to be bought at uniform prices regardless of quality.

A devastating drought in 2002 meant that contingency measures had to be taken to avert a catastrophic food security situation within the confines of the rigid policy framework. Large maize millers were therefore given leeway to privately buy or import maize through permits or import licenses from the Ministry of Agriculture, Mechanisation and Irrigation Development (MAMID) under specific conditions that compelled the processor to subscribe to a particular price and a quota under a Memorandum of Understanding (MoU) with the MAMID. Subsequent seasons of poor maize production against an increasingly precarious food security situation paved the way for the issuing of import licenses to other private players to allow private imports in a bid to ease food shortages.

In the retail sector, a barrage of price controls saw the disappearance of maize and maize meal from the supermarket shelves against a thriving black market that capitalised on market shortages. A price monitoring commission, the National Incomes and Pricing Commission (NIPC), was therefore set up in 2007 to enforce price controls in retail outlets irrespective of hyperinflationary pressures that made price controls infeasible. The implementation of market controls in the maize sector, according to Mano (2003), was a poorly informed policy which, contrary to intentions, worsened maize shortages on formal markets.

In what represented a landmark shift in market and economic policy, the GoZ officially suspended the use of the Zimbabwean dollar in February 2009 and introduced a multi-currency system as a measure meant to stabilise an otherwise collapsed economy and ensure viability in food production. The multi-currency system marked the end of ineffective and otherwise harmful GMB price controls, paving the way for a free, unregulated market. The transition of grain markets into a free market environment has nonetheless necessitated vast adjustments as domestic maize producers are now exposed to competition from more

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[14] The GMB grading system for white and yellow maize is classified as A, B, C, D and U, respectively.

efficient regional and international producers, while domestic traders now have the option to purchase domestic and/or imported maize. The GMB is now a purchaser of last resort under constant prices (GoZ, 2009). The general trends in maize and agricultural policy discussed here are summarised in Table 2.6 below.

Table 2.6: Summary of Maize Sector Policy Reforms and Key Policy Instruments in Zimbabwe

Period	Domestic Policy Instruments & Programs	Policy Objectives and Results
1930-1969	Maize Control Act (1931 & 1934)	Established the maize board designed to support white commercial farmers through segregated marketing and pricing structure.
	Grain Marketing Act (1950)	Established Grain Marketing Board (GMB) which assumed the storage, distribution and transportation function within the grain subsector
	Farmers' Debt Adjustment Act (1935)	This set of policies were designed to offer a comprehensive support system for white commercial farmers
	Land Apportionment Act (1930)	
	Seed Act (1965)	
	Land Tenure Act (1969)	
	Department of Research & Specialist Services (DR&SS) (1947)	Extension services provided for commercial grain farmers
	Agricultural Marketing Authority (AMA) (1967)	Coordination of Maize Board activities and financing
1980 – 1986	Growth and Equity Initiative	Grain marketing policies of the previous regime were maintained while implementing a pan-territorial and pan-seasonal pricing regime for all farmers, regardless of race
1987-1991	Export Retention Scheme and Export Revolving Fund	Offered export incentives in order to stimulate export oriented production
1987	Two-Tier Pricing System	Instituted a two-tier system that gave communal grain farmers favourable terms & prices
1991-1997	Economic Structural Adjustment Programme	Due to fiscal deficit pressure grain markets were liberalised by reducing the role of GMB to price and supply stabiliser through purchases and sale operations; however, they remained in the market as the sole import/export of maize grain
1994	Zimbabwe Commodity Exchange (ZIMACE)	Established in 1994 as a competing entity to the GMB
1998 -2000	GMB Price Control	Re-imposition of roller meal price controls due to the perceived failure of the private sector under conditions of rising grain prices. Diversification of GMB's activities into maize meal processing
2001 – Present	'Fast-track' Land Reform Programme	Implementation of the A1and A2and resettlement models
July 2001-2008	The Grain Marketing Notice Statutory Instrument No. 235A	Re-imposed controlled marketing by expanding the role of GMB within the market and restricting private agro-processing access to grain through required Memorandums of Understandings with the board and permits from the Ministry of Agriculture
March 2009-Present	Grain Market Reform	Removal of grain movement restrictions
Removal of import duties
Reduction of GMB's role to buyer-of-last-resort

Sources: Jayne and Rukuni 1993; Rukuni, 1994, 2006; Muir-Leresche and Muchopa, 2006; Jayne *et al.*, 1999; GIEWS, 2009

2.5.2 Zimbabwe's Grain Trade Policy

Under the auspices of the domestic market policies discussed in the previous sub-section, the 2000 to 2009 epoch has not only seen a decline in maize production, but also a subsequent increase in the reliance on food aid and commercial imports from the region. It is against this backdrop, and against the fact that the previous GMB maize import/export monopoly has been dissolved following the adoption of free markets, that Zimbabwe's grain trade policy is reviewed with respect to two important policy dimensions: tariff and non-tariff barriers.

2.5.2.1   *Tariff Barriers*

Like most countries in the developing world, Zimbabwe's grain imports and food aid are subject to various tariff restrictions. These tariff restrictions are bordered by Zimbabwe's allegiance to two main regional trading blocs, namely: the Southern African Development Community (SADC) and the Common Market for Eastern and Southern Africa (COMESA). With SADC now officially a Free Trade Area (FTA) since August 2008, under a tariff phase-down policy from 2000 to 2008 under the SADC Trade Protocol, COMESA on the other hand, implemented a FTA in 2000 scheduled to achieve a common external tariff by December 2008. As at December 2009, the maize sector was subject to the following tariff regime:

Table 2.7:   Zimbabwe's Applicable Tariffs for Maize (%)

Product	Customs Duty				VAT
	General	COMESA	RSA	SADC	
Maize Seed	10	0	0	0	0
Maize (Excl. Seed)	0	0	0	0	0
Maize (Corn) Flour	25	0	0	10	0
Groats & Maize meal	20	2	0	10	0
Other worked maize	20	5	0	0	15
Maize (Corn) Starch	10	4	10	0	15
Crude Maize (corn) oil	10	0	0	0	15
Cooking Oil of Maize	40	5	0	15	0
Other maize oil[15]	10	5	0	0	15
Other prepared cereals	40	5		10	15
Brans & Other Residues	10	0	0	0	15

Source: Zimbabwe Revenue Authority (www.zimra.co.zw), (2009)

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[15] Excluding Crude & Fractions

That Zimbabwe's tariff regime for maize and maize products lies within the domain of the COMESA and SADC trade protocols to allow for preferential treatment of member states in maize trade poses an obvious challenge. That is, Zimbabwe's membership to both these regional blocs complicates the protective tariff structure as the nation has to harmonise the proposed COMESA and SADC common external tariffs. For most processed maize commodities, COMESA and SADC tariffs are different. Mudzonga and Chigwada (2009) have, however, argued that Zimbabwe's compliance rate to both blocs has been very low.

2.5.2.2 Non-Tariff Barriers (NTBs)

Zimbabwe has a longstanding policy against the importation of Genetically Modified (GM) maize on the grounds of health, safety and contamination concerns. However, the risk potential for both consumption and the local environment is yet to be fully established (Musarara, 2009). Grain imports coming into the country are subject to strict sanitary and phyto-sanitary (SPS) requirements, which have acted as a barrier to free cross-border grain trade. Literature on these SPS conditions has, however, not been explicitly documented.

Initially, SPS requirements prohibited the importation of GM[16] raw maize grain. Under the Statutory Instrument 20/2000 Biosafety Regulations, the Research Council established the Biosafety Board to approve the safety of imports of GM maize and maize products. While initially rejecting GM food aid, desperate food shortages compelled the GoZ to later accept GM maize provided all GM grain was milled immediately upon arrival (WTO, 2002; Bridges Trade BioRes, 2002). However, GM maize was imported at the prevailing duty costs plus costs of ensuring that the maize is safe, and prevention of contamination.

Kapuya *et al.*, (forthcoming) outline a number of conditions that exist for maize imports and these include a thorough pre-shipment inspection from the Plant Quarantine Services (PQS) to establish if the imported grain is:

- Free from storage insects, including pests such as larger grain borer, *(Prostephanus trancatus),* Angoumuis moth *(Sitotroga ceralella),* Kharpra beetle *(Trogoderma*

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[16] Current policy prohibits importation of GM grain as Zimbabwe is a signatory of the Biosafety Protocol of 2003.

granarium), lesser grain borer *(Rhizopertha dorminica)*, Grain weevils *(Sitophilus sp.)*, red flour beetle *(Tribolium castaneum),* and saw-toothed grain beetle *(Oryzaephilus surinamensis)*

- Free from live insects and fungal growth

- Free from diseases,

- The grain has been fumigated with Phosphine at 2 g per tonne for a minimum period of 120 hours.

- The consignment is accompanied by a fumigation certificate.

- Free from plant debris

- Packed in new containers/packages

- Free from mould growth, especially aspergillus flavour

Maize meant for propagation requires that inspections be carried out while the maize plants are still in the field. This implies that the inspector has to go to the exporting country to inspect the processes as well as to verify the crops at the farm, all at the cost of the importer. Enforcement of SPS legislation and policy has remained the prerogative of the Department of Plant Inspection, Plant Quarantine Services and the National Bio-Technology Authority of Zimbabwe.

2.5.3 Zimbabwe's Maize Market Structure: Unpacking the Maize-to-Maize Meal Value Chain

The trade, marketing and pricing policies reviewed in the preceding sub-sections have influenced the structure of the maize market over time. In this section, the focus is on how the maize market was affected by the discussed regulations and policies. This part of the chapter draws from Kapuya *et al.*, (forthcoming) who offer a comprehensive review of the grain sector value chain in Zimbabwe. Structurally, the maize market consists of several players along the maize-to-maize meal value chain which include maize producers, storage industry players, millers and retailers. Each of these players is reviewed in this subsection.

2.5.3.1   Producers

The maize production subsector forms the foundation of the maize industry. Over time, the composition of Zimbabwe's farm sector has been modified through a process of land distribution and redistribution since the Land Apportionment Act of 1930. The processes and forms of land reform in Zimbabwe have been well documented and reveal three important landmark policies. The first is the Land Apportionment Act (1930) that defined and entrenched colonial disparities in land distribution along racial lines. The second was the market based land redistribution that was funded by the British government from 1980 up to 1997. The third was the 'fast track' land reform policy which reframed the age-long agrarian structure of Zimbabwe's farm sector (Moyo *et al.*, 2009). From a broader perspective, the farm sector comprises of two major if not distinct categories, namely the large scale commercial farming (LSCF) sector and a relatively complex set of heterogeneous smallholder farmers, a structure defined in the literature as 'dual' (Moyo and Yeros, 2009).

The 'fast track' land reform which in retrospect represents a major policy shift of Zimbabwe's agricultural land reform policy, has seen the implementation of land reforms that have fundamentally modified the organisational structure of both the production and marketing institutions. Thus the 'fast track' land reform programme of 2000 redefined the old structure by allocating former large scale commercial farms to indigenous farmers under the A1[17] and A2[18] resettlement models. The A1 model is analogous to communal sector farms while the A2 model is comparable to the small scale to large scale commercial sector. The traditional communal sector comprises 16.4 million hectares, the A1 resettlement model has taken up 4 231 080 hectares and the A2 has been allocated some 2 198 814 hectares (Moyo, 2004). The Mashonaland provinces (Central, East, and West), which are the main grain producing regions, accommodated 46% of A1 land beneficiaries and 74% of all A2 beneficiaries (ibid). However, due to on-going land occupations, the A1 and A2 model resettlement figures are highly likely to have increased.

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[17] The A1 model has plots with 5-6 hectares arable land and in excess of 6 hectares for grazing.

[18] The A2 model has farms ranging from 15 to 50 hectares in the peri-urban areas, 15 to 250 hectares in Agro-ecological region 1 and 350 to 2000 hectares in Agro-ecological region V. See Appendix D and E

The share of maize production among the communal and commercial sectors has changed in line with shifts in land allocation under instituted land reforms since 1980. As shown in Table 2.8 below, the average national production between 1980/81 and 1989/90 was 1 931 082 tonnes, with the communal sector contributing an average 54.79% against a commercial sector contribution of 47.37% of the total average output. The 1990/91 to 1999/00 average output was marginally lower, declining to 1 668 186 tonnes, with a slight increase in the communal sector contribution, rising to 58.44% against a commercial sector average of 41.56%. The steady decline in output matched the steady decline in commercial sector contribution to total maize output, and this may be due to losses in the average national yield as the commercial sector area declined under land reforms. Nonetheless, the post-2000 phase saw average output fall to 1 175 547 tonnes and this fall in output is mirrored by a dramatic fall in commercial contribution to an average 15.76% of the average total production. This could be due to the restructuring of the farm sector through the 'fast track' land reform which reduced land area for the commercial sector to only 6.73% of the total average area under maize.

Table 2.8:   Average % Contribution of Communal and Commercial Sectors

Period	Communal Sector (% of total)		Commercial Sector (% of total)		Average Total	
	Area	Output	Area	Output	Area (million Ha)	Output (million mt)
1980/81-1989/90	81.88	54.79	18.20	47.37	1.24	1.93
1990/91-1999/00	86.25	58.44	13.75	41.56	1.32	1.67
2000/01-2006/07	93.37	84.24	6.73	15.76	1.47	1.18

Source: AIAS (Various Issues)

While Zimbabwe's farm sector has been restructured by land policy reforms, its previous competitiveness has been threatened by inconsistent and poor production (Kapuya *et al.*, forthcoming). Rukuni and Eicher (2006) cite a number of factors that have contributed to the poor levels of production after 2001 and these include:

- Poor infrastructure and level of technology
- Poorly funded research and development
- Very low extension worker to farmer ratio
- Limited line of credit and high interest rates

- Poor enforcement of private property rights and insecurity of tenure (and therefore low levels of investment)

Apart from these systemic challenges, the communal sector, which produced a substantial portion of total maize output after 2000, has remained particularly vulnerable to droughts as the sector remained heavily depended on rain-fed farming (Rukuni & Eicher, 2006). In fact, the entire smallholder sector has only accounted for only less than 5% of national irrigation resources (Moyo and Sukume, 2006; Makhado *et al.*, 2006). Moreover, the 'fast track' land reform programme contributed to vandalism and theft of the available irrigation equipment that existed in commercial farms (Moyo, 2004). Perhaps this is why Richardson (2007a) argued that the post 2000 land reforms 'ruined the vital insurance policy that Zimbabwe had in times of drought'. This has led to an increased reliance on dry-land farming under increasingly uncertain weather conditions amid fears of climate change.

Maize producers are largely represented by farmers associations with the objective of promoting, advancing and developing production as well as members' interests. In principle, these interests are subsumed in the facilitation of horizontal linkages among maize producers and traders in the maize industry. The Commercial Farmers Union (CFU) has in the past provided a variety of technical and advocacy support services including research and extension, as well as agronomic and grain quality management training techniques. The Zimbabwe Commercial Grain Producers' Association (ZGPA), a subsidiary of the CFU, has approximately 500 members left (down from about 4500 before the beginning of the land acquisition exercise under the 'fast track' land reform programme). The Zimbabwe Farmers Union (ZFU) and the Zimbabwe Commercial Farmers Union (ZCFU) represents smallholder farmers. The functioning of the CFU has been compromised by recent and on-going developments of continued land occupations under the 'fast track' land reform programme that has severely depleted the number of white commercial farmers.

2.5.3.2   *Grain Storage and Trade*

Efficient and reliable storage plays a key role in stabilising prices, food and feed supplies. Zimbabwe's grain storage industry has been typified by a pervasive GMB monopoly that arose naturally from decades of controlled marketing of maize. The "Growth with Equity"

policy in the 1980s led to the establishment of a country-wide network of GMB silos as part of an expansion drive that was meant to absorb the previously colonially marginalised communal farmers into mainstream grain markets. This established infrastructure has therefore ensured the *de facto* monopoly of the GMB in grain storage.

The GMB's total storage capacity is estimated at 5 million tonnes. The silo grain storage consists of ten main depots in which bulk grain is stored in grain complexes with a total storing capacity of 733 500 tonnes. All depots can store bagged grain on either hard stands or in sheds with a national capacity of up to 4 266 500 tonnes.

During the market control era, all maize was stored through the GMB as it was forbidden by law for anyone other than the GMB to keep grain for more that 30 days after harvest. Market control policies mandated the GMB to assume the costly function of maize storage and this became a major contributor to fiscal deficits and the GoZ had to sell off large amounts of surplus within the region at a loss (Rukuni and Eicher, 2006). Prudent measures to reduce costs in the early 1990s downsized the GMB's storage function.

After the 1992 drought, a 'Josef rule', otherwise known as a discretionary Strategic Grain Reserve (SRG) was in principle briefly followed through the implementation of a strategic reserve policy which subscribed at least 500 000 tonnes of physical stock and 400 000 tonnes of monetary equivalent to fill the national human grain requirement of 900 000 tonnes (Muir-Leresche and Muchopa, 2006). This policy was a measure to ensure consistent maize supply in the event of market shocks after the untimely effects of the 1992 drought condemned a major part of the population to hunger at a time when the GMB was downsizing its operations as part of the ESAP initiative. While the SRG was in reality discretionary, the policy eventually became unsustainable and collapsed in 1998 due to the escalating GMB debt. From 2000, the GMB was given the mandate to maintain strategic reserves of up to a maximum of 936 000 tonnes of maize (Sukume and Guveya, 2009). However, low production in the recent years has made it difficult to maintain strategic reserves, with critical foreign currency shortages precluding the use of import markets to replenish reserves (ibid).

While much of the storage infrastructure, particularly in rural areas, significantly increased GMB operational costs, no meaningful private sector participation materialised as the GoZ

adopted economic structural adjustments to ease its fiscal burden. The lack of adequate private sector participation in remote areas has been widely argued to be unsustainable. Rather, the movement of grain that came with market liberalisation would allow for spatial arbitrage opportunities between areas of higher and lower production.

During the period of ZIMACE, no account of the capacity of private sector storage was documented in the literature, although the general belief is that warehousing systems and on-farm storage, together with other private players, contributed a meagre proportion of national grain storage. In fact, most private players made use of GMB infrastructure for storage. Nonetheless, the liberalisation of the grain sector in 2008, after a decade-long spell of controlled maize marketing, has seen an increase in the importance of on-farm storage, together with other private players in the storage industry, including Croplink, Intergrain, Denote Enterprises and Staywell, offering private commercial storage. While larger millers have vertically integrated themselves to assume their own storage, they have also directly engaged private traders. For instance, National Foods, the largest grain processor in the country contracts Intergrain to procure grain. The current market conditions in the storage sector suggest that private storage prices are being generated through 'bids' and 'offers' in a free market. The state-owned GMB silos are therefore now under economic pressure to operate within a free market system, to compete with other grain storers and to have a lower throughput. The deregulated situation, with multiple owners of stored grain, implies a need for a more sophisticated and cost-effective administration and a diversity of market information required for efficient competition among private warehouses, GMB and on-farm storage.

2.5.3.3   *Maize Processing*

Zimbabwe's maize processing industry consists of the maize milling sector responsible for the processing of maize to maize meal for human consumption and stock feed. There are several key established industry players that have traditionally dominated the maize processing sector and these are:

- National Foods Ltd.
- Blue Ribbon Foods
- Premier Milling, operating as a division of Clearwaters Estates (Pty) Ltd

- Nutresco

- Makonde Industries (Pty) Ltd.

- Grain Marketing Board

Over the years, the maize milling sector has been characterised by the proliferation of small to medium and larger millers. Currently, there are approximately 485 medium to large scale millers found in and round urban areas throughout the country, and hundreds more small-scale ones found in Rural Service Centres (RSCs) (ZGMA, 2009).

Before 2000, the high concentration in the milling industry had arisen from decades of the controlled grain marketing system in which maize was transported to industrial millers and animal feeders. Although the GMB maintained a monopoly for maize imports, the board has at times of emergency given permission for processors and stock feed manufacturers to import maize (Sukume and Guveya, 2009). Large-scale millers, through license agreements, became vertically linked to the GMB. During this time, unlicensed or "informal" traders and millers were typically restricted from procuring maize from the board. This single-channel flow of grain from rural farms into the urban milling system provided preferential access to dominant large millers and subsequently impeded the development of more small-scale players. Table 2.9 lists Zimbabwe's current largest millers according to milling capacity.

Table 2.9:   List of Largest Maize Millers in Zimbabwe

Maize Millers	Capacity (Tons/Hr)
National Foods Ltd (Harare)	38
Rainbow Foods	33.1
Basic Foods	27
Ilanga Foods	21.5
National Foods Ltd (Bulawayo)	20
Blue Ribbon Foods	18
Maize for Africa	16
Makonde Industries	15
Simboti Millers	14
Multifoods Milling Company	13.8
Gwai Millers	12.4

Source: ZGMA (2009)

The combined effect of market deregulation and the easing of grain procurement processes in 2008 saw a sharp increase in the number of both formal and informal millers. According

to the Zimbabwe Grain Millers Association (ZGMA), there are almost 150 maize millers in Harare alone and the industry currently employs approximately 5 300 people. The average national milling capacity utilisation is estimated at 2.7 million tonnes/annum or 59.5% of the available capacity. The potential capacity is in the order of 5 million tonnes/annum. According to the ZGMA, twelve of their top millers have a milling capacity of more than 3 million tonnes/year, which is approximately 60% of the total local capacity. It is difficult to award market shares to each of the big companies in the milling industry since this information is confidential. However, Table 2.8 above gives an indication of potential market shares based on milling capacity. It is important to note that this information, although it may not show the market shares, can provide a rough estimate of the possible concentration in the milling industry.

Large-scale millers like the GMB, National Foods and Blue Ribbon Foods usually perform agro-processing activities in conjunction with commodity trading, logistics, polythene bag as well as packaging manufacturing and sometimes agricultural support services as part of their integrated functions. The large-scale and medium-scale millers are mostly situated in the industrial sites of towns and cities. These do not cater for individual clients requiring their maize milled, but rather mill on a large scale; selling refined and straight run maize meal to individuals, retailers, and wholesalers in the formal markets. The threshold used to differentiate between large-scale and small-scale millers is, however, not clear. However, industry experts estimate the medium-scale millers to have an average large-scale milling capacity of about 15 tonnes/hour whilst the medium-scale millers have a milling capacity of approximately 8 tonnes/hour (ZGMA, 2009). Products of large scale millers are mostly packaged in well-known brands whilst those of medium-scale millers are packed in unbranded packages. Medium-scale millers normally cater for small retailers whilst the large-scale millers cater for established retailers. The small-scale millers, a segment which mushroomed after the ESAP in the 1990s, are mostly situated around high density areas in major cities and towns and also in rural areas. These have a through-put of a bucket for every three minutes and, depending on the availability of customers and how well they function, they can process at most 0.25 to 0.30 tonnes/hour (Kapuya *et al.*, forthcoming). Small scale-millers cater for walk-in customers and they charge, on average, US$ 1.00 for milling straight run maize meal and US$ 2.00 for milling refined maize meal (ibid).

2.5.3.4   Retailing and Consumption

Zimbabwe currently utilises 5 000 tonnes of maize meal a day or 35 000 tonnes of maize meal per week, which translates to 1 825 million tonnes of maize meal per annum (Kapuya *et al.*, forthcoming). Table 2.10 below, provides a summary of the extraction rates of the various types of maize meal. Over 80% of all the maize meal sold in the Zimbabwe market is roller maize meal while super refined maize meal sales make up less than 20% of total sales (ibid).

Table 2.10:   Extraction Rate of Various Maize Meal Types

Maize Meal Type	Extraction rate (%)
Super Refined	62.5
Roller meal (Sifted)	88.7
Mugaiwa (Unsifted/Straight run)	98.7

Source: Kapuya *et al., (*forthcoming)

Although an extraction rate of 62.5% is reported for super maize meal, some industry specialists regard this figure as "conservative". The best-selling super refined maize meal brands among the elite, Parlenta (Red Seal) and Ngwerewere (Blue Ribbon) only had a 55% extraction rate. Nonetheless, the most the popular brands among the 'former' urban middle class and the poor is the (sifted) roller meal brands which include Chibataura (Blue Ribbon) or Red Seal roller meal, which are reported to have accounted for an average of 60% of sales (ibid).

Generally, maize and maize meal prices have been stable since the liberalisation of the markets in 2008, with maize meal prices averaging about US$ 0.28/kg whilst straight-run and refined maize meal prices average between US$ 0.40/kg and US$ 0.60/kg, respectively (Esterheuzien, 2010).

Domestic markets for maize meal and other maize products have been dominated by wholesalers such as Mahommad Mussa, Bhadhella, RedStar, Metro Peech and Jaggers. Retail supermarket chains such as TM, OK, SPAR, Friendly, Gutsai and other smaller retailers within the Retailers Association of Zimbabwe (RAZ) form the major outlets for maize meal. The most popular maize meal brands are Red Seal, Victoria and Blue Ribbon (Ngwerewere) brands. The volume of imports has visibly declined on supermarket shelves

despite prices being comparatively cheaper and this is primarily because of brand loyalty in favour of local products (Kapuya *et al.*, forthcoming).

2.6   MAIZE PRICE FORMATION

While the last section explored the maize-to-maize meal value chain, this section attempts to establish how prices were formed in the maize market. Important to note is that Zimbabwe's maize market was historically a net exporting market, in which prices were largely determined by market policy and weather (Takavarasha, 1994). The maize sector's market policy was in the past typified by an epoch of interventionist approaches. This market system entailed a Grain Marketing Board (GMB) administered and fixed pricing system based on a pan-seasonal and pan territorial framework (Muir-Leresche and Muchopa, 2006). Whilst a 'pseudo free market' existed during the 1990s as part of a general move towards a more market-oriented development approach, the GMB attempted to manipulate maize market prices through purchase and sale operations, ostensibly for food security and/or price stabilisation purposes (Mano, 2003). Within this framework, the determination of domestic maize prices was based on policy that would be informed by import parity price trends in the domestic and regional maize markets. Thus, policy set the ceiling price at the import parity price and floor price at the export parity price respectively, with the price band reflecting market fundamentals within which private grain trade regimes operate (ibid).

However, it is important to note that Zimbabwe's maize equilibrium prices seldom occurred strictly according to these policy prescriptions. The influence of government negotiations with the Commercial Farmer's Union (CFU), lobby efforts and, more significantly, factored considerations of GMB's maize forecasts which were based on the state of the trading account projections, stock levels, expected purchases and sales income, as well as transport, handling and storage costs, meant that the pricing framework remained fairly complex (Takavarasha, 1994). This sentiment is implicitly reflected in Figure 2.3 below:
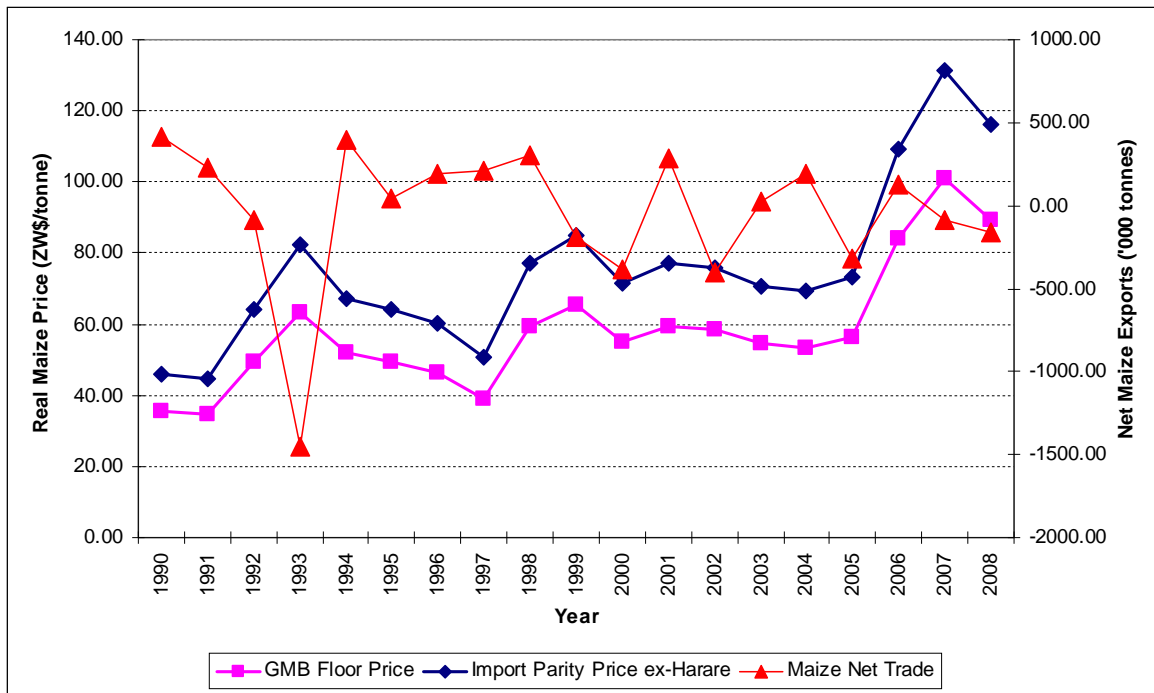
Figure 2.3: **Maize Price Trends: 1990-2008 (Constant at 2000)**

Source: Adapted from Agricultural Statistical Bulletin (2007)

The real maize price for most years fluctuated around the export parity regime, with high production and exports keeping prices relatively low. Prices in this case also seemed to be determined by adverse weather conditions, domestic food self sufficiency and the net trade position, which was highly positive in most years. As shown in Figure 2.3 above, the sharp drop in the net trade in 1993, as an after-effect of the devastating 1992 drought, saw only a marginal increase in price, this reflecting responses of implicit government intervention through purchase and sale operations in the market that kept prices at low levels. In light of the relatively complex nature of board operations and other exogenous forces acting on the maize market, Valdes and Muir-Leresche (1993) deduced a simplified price equation in which the producer price of maize was an additive function of GMB lagged ending stocks and lagged producer prices. They expressed this equation mathematically as:

Equation 2.1 $$P_t = b + b_0(ENDSTOCK_{t-1}) + b_1 P_{t-1}$$

In Equation 2.1, P_t represents the current GMB maize producer price, $ENDSTOCK_{t-1}$ represents the lagged closing stock, P_{t-1} represents the lagged producer prices, b represents a constant, b_0 is the unit change in price caused by a unit change in the closing stocks, and

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b_1 is the unit change in the current price caused a unit change in the previous seasons' price. According to this equation, government's maize prices were determined by previous year's prices and available stocks at the end of the season.

However, this equation may be overly simplified, not capturing the influence of the regional markets on domestic prices, and therefore the salient market features that sufficiently depict the influence of maize trade and policy. Given the fact that markets fluctuated around the export parity prices (as shown in Figure 2.3), this suggests that parity prices may have been somewhat correlated with domestic prices. Industry experts argue that under ESAP, maize trade was driven by regional prices, adverse weather conditions, location, and to some extent arbitrage opportunities. From this perspective, it may thus be plausible to model the domestic price as a function of the parity prices, although domestic prices would be regarded in this case as predetermined in the domestic market system. The exchange rate is factored into the domestic prices, and linked to regional maize prices to reflect the influence of the regional markets on domestic prices.

The transition to a deregulated environment in 2008 has necessitated vast adjustments as grain producers, traders and processors are now able to trade in a 'free' market environment, responding to the forces of supply and demand in setting prices. In practice, they all look to the prices generated through the informal commodities market whose benchmark or reference prices offered in the 'spot' market of daily trading in maize, are derived from the South African Future's Exchange (SAFEX) which mirror world prices. The prices for contracts and options are generated through 'bids' and 'offers' which fundamentally reflect the views of market participants on the prices of the maize and maize products at different points in time. Without a formal platform for maize trading, market participants are facing increased price risks, which are in turn increasing search costs and consequently, transactions costs. Inevitably, these costs are being passed onto the consumer in the form of higher maize prices and maize commodities.

An important recent development has been the influx of cheaper maize grain from Brazil, Argentina and South Africa which has put downward pressure on domestic prices. Brazilian, Argentinean, and South Africa free on board (fob) prices have become an important reference point for domestic market participants in their price discovery processes. Grain buyers are using the technique of quoting landed prices ex-Harare to

select options between local and imported grain. To calculate the prices at which buyers can opt for local or international grain, market buyers use an import/export parity calculation. For example, if grain millers can buy imported maize (including the cost of transport, insurance, the tariff, the exchange rate, etc.) for cheaper than locally produced maize, they will do so until local producers are able to supply maize as cheaply. This is called an import parity price, a regime in which Zimbabwe is currently operating since the nation turned into a net maize importer in recent years.

The supply and demand factors that are currently affecting maize prices include weather conditions, consumer preferences, government policy, trade agreements, changes in living standards, expectations, and technology. Currently, the landed price for maize ex-Harare from Randfontein South Africa is US$ 220/tonne while domestic farmers can only produce profitably at US$265/tonne (Zimbabwe Commercial Grain Producers (ZCGP), 2010). Local domestic maize selling prices are around US$300/tonne, making imports more attractive for millers relative to local grain (ibid).

2.7   CURRENT STATE OF ZIMBABWE'S MAIZE SECTOR

Several reports have indicated the state of the maize sector in Zimbabwe and revealed that the maize sector is confronted by a number of challenges. These challenges include:

- Limited market institutional capacity to respond to periodic maize shortages, which appear to be increasing in frequency and scale (ZIMVAC, 2009);
- Weak synchronisation between farm credit, input supply and access to maize markets, and therefore restricted uptake of productive farm technologies by communal farmers (Moyo and Sukume, 2009);
- Limited access to working capital and difficulties in accessing agricultural finance emanating from unfavourable borrowing conditions (Kapuya *et al*, forthcoming);
- Inconsistent and uncertain input supply which has been exacerbated by a failure to mobilise resources to acquire production inputs. The sector is also currently experiencing high costs of production inputs primarily fuel, maize seed and fertilizer which are being imported (Esterhuizen, 2010);

- Lack of commercial farming skills due to inadequate training in production and crop management emanating from poor extension services and therefore limited transfer of technology from research (Kapuya *et al.*, forthcoming, Moyo *et al.*, 2009).

The outlined market conditions have persisted throughout the post 'fast track' land reform period and these constraints have led to an intermittent function of maize markets that has eventually led to diminished rather than increased market performance. The general insights from the literature and evidence from maize market output trends over the last decade therefore underlines the 'fast track' land reform period as a phase in which maize markets have been subdued.

2.8   SUMMARY

The main aim of the chapter was to review Zimbabwe's maize sector. The general impression created by the review in this chapter is that Zimbabwe's maize market has undergone significant structural transformation in terms of policy and regulation. The chapter articulated an overview of Zimbabwe's agricultural sector and the maize market in order to illustrate the effects of market policies at particular points in time. The overall assessment of the maize sector provides an essential foundation for distilling fundamental insights that could better inform the maize model specification given to be given in Chapter Five.

CHAPTER 3

REVIEW OF COMMODITY MARKET MODELLING IN ZIMBABWE

3.1   INTRODUCTION

The previous chapter outlined key developments which define the transformation of Zimbabwe's maize sector over the last forty years. The structural changes of the sector as discussed previously are marked by three main shifts. Firstly, a gradual shift in sectoral maize output contributions, where the communal sector's contribution to total output grew from 58% in the 1980s to over 90% in the post-2000 era. The secondly change, closely linked to the first transformation, is the 'fast track' land reform programme that reframed the fundamental structure of the farm sector. Thirdly, the pricing and marketing of grain was transformed from a controlled system to a relatively free market dispensation during the 1990s, following which the GoZ re-introduced price controls and marketing restrictions from 2001 to 2008. From 2008 to the present, the maize market has been shifted back to a free market.

All these changes have affected the maize sector in ways that have not been well-understood by policy makers. It is against this background that such changes are taken into context and carefully assessed to anticipate and understand the impact of particular shifts in the maize market. While corrective measures are already under way, as reflected by the shift from controlled to free markets in 2008, there is still an urgent need to understand the implications and impacts of policies implemented hitherto. In particular, the 'fast track' land reform policy has been a landmark shift, the impact of which has not yet been unpacked. This goes along with the fact that the food crisis experienced after its implementation needs to be understood within the context of the 'fast track' land reform as a process that guides the development of future agricultural policy.

As such, commodity modelling as a methodology helps to raise awareness in understanding policies, in predicting and in better understanding commodity market price movements (Meyer, 2005). The essence of this chapter is, therefore, to provide a

fundamental basis for understanding the context and background of market modelling in agricultural commodity markets. By definition, commodity market models are a simplified representation of reality, and the attempt here is to provide a powerful synthesis of theory and evidence synthesised that provides a plausible analysis and prediction of market behaviour (ibid). This chapter's discussion is thus divided into two sections. The first section provides a discussion of the econometric tools and techniques used in modelling. The second section provides an overview of the macro-level world grain market models and commodity models in Zimbabwe, under which previous modelling studies are reviewed.

3.2 BACKGROUND OF COMMODITY MARKET MODELLING

Agricultural commodity markets are characterised by a complex set of inter-related economic, technical, bio-physical and institutional aspects which are not easily understood. The essence of econometric modelling techniques in this regard is to capture these market attributes and, through the use of computer software technology, apply it to enhance our understanding of markets and their response to external shocks as policy analysts. Given a time series data set, it would, therefore, be possible to predict price and output supply given a set of policy conditions. The essence of the whole exercise is to come up with useful solutions to problems faced in agricultural markets.

It is against this background that foremost macro-econometric models were developed in the period following the Great Depression of the 1930s, during which time the maize markets began to receive particular attention in Zimbabwe though the then Rhodesian Maize Board. The initial groundbreaking model structures necessarily sought solutions that could lessen the economic hardship emanating from the economic slump during the 1930s. This is the period in which Keynesian models became popular as enthusiastic econometricians, such as Tinbergen, increased the scope and scale of economy-wide models.

A rich body of literature has since emerged on the development and improvement of models from this period. Zalm (1998) pointed out that shortcomings of the initial models developed in the first three decades after the Great Depression rested in the failure of economists and policy analysts to construct, manage and apply these models to the relevant

problems they intended to solve. One of the major pitfalls in modelling was identified from the "Lucas Critique" which pointed out that models that are not structural would not yield reliable estimates due to changes in government policy as they do not capture 'the new rules of the game' (Maddala, 1992). This was basically a realisation among econometricians that structural breaks related to transitions into new policy regimes were critical in models and, as such, failure to capture policy reforms in the models would give less reliable parameter estimates. The initial solution to this problem, as proposed by Robert Lucas, was to capture the micro-foundations of agent behaviour in the economy.

Antecedent from these tremendous developments in the theoretical connotations of econometric methodology was an application of econometrics to commodity modelling. The resultant improvements in the predictive performance and forecasting ability of commodity models led to a gradual appreciation of their utilisation in price, supply and policy analysis. Therefore, from a renewed amount of confidence, commodity models, supported by high quality data, have been usefully utilised for market analysis, forecasting future prices and quantities as well as policy analysis.

3.3   COMMODITY MODELS IN WORLD GRAIN MARKETS

In quantitative policy analysis, agricultural markets have been modelled at various scales; that is, as single markets, multiple markets, multi-sector systems or as economy wide equilibrium models. Partial equilibrium models on one extreme seek to capture the unique dynamic relationships of a particular market or sector, such as agriculture. Within the scope of partial equilibrium analysis, the particular sector in question is closed and has no linkages with the rest of the economy, which essentially implies that the sector is affected by the rest of the economy but has no direct effect on the economy itself (Van Tongoren *et al.*, 2000; Calcaterra, 2002). Thus, the effects of the rest of the economy (and the world) are treated as exogenous. As such, partial equilibrium models can either be single or multi-commodity market systems, with the latter capturing the marginal effects and interrelationships between markets.

Economy wide models at the other extreme give a total representation of a national economy, including the international trade dimension of the economy. Economy-wide models such as the Global Trade Analysis Project (GTAP) and Industry Forecasting

Project at the University of Maryland (INFORUM), not only present unique general equilibrium features such as international trade effects, but also present factor transfers between sectors in the economy. These economy wide models can be classified as macro-econometric models, input-output models or general equilibrium models that focus on the aggregate macro-economic variables of national economies. Calcaterra (2002) refers to such models as applied general equilibrium or multi sector models.

With much variation existing in the scope of analysis of commodity markets, it is nonetheless partial equilibrium frameworks that have been extensively applied to sector markets. The advantages of partial equilibrium approaches rest on several strengths. Firstly, using partial equilibrium analysis is empirically simple and the analysis thereof reasonably approximates the general effects of trade policy changes where weak links between commodities and their supplier or output sectors may exist (Perali, 2003). Secondly, partial equilibrium analysis provides useful information on the impact of trade and policy changes at very detailed product and sectoral levels, hence allowing for the utilisation of widely available trade data (Lang, 2008; Thurlow and Holden, 2005; Wubeneh, 2006). Partial equilibrium modelling has become particularly relevant given the process of global integration of markets, which presents far reaching implications for the domestic farming sector and related supply and marketing issues in the economy (Meyer, 2005). As such, partial equilibrium models present a uniquely significant way of illustrating the integrated nature of local, regional and world agricultural markets.

Several partial equilibrium models have been developed in the last two decades and these differ in model design, agricultural commodity types and the number of countries. Such models include the Bureau for Food and Agricultural Policy (BFAP) model, AGLINK, European Simulation Model (ESIM), FAO World model, Food and Agricultural Policy Research Institute (FAPRI), General Agricultural Policy Simulation (GAPsi), Static World Policy Simulation (SWOPSIM) and World Agricultural Trade Simulation Modelling System (WATSIM). Among these, AGLINK, the FAO World Model, FAPRI and GAPsi are dynamic recursive models. Van Tongoren *et al*. (2000) pointed out that all these models differ in terms of their regional emphasis. For instance, the FAPRI model focuses on the US, GAPsi on the EU countries and the ESIM model on Eastern Europe. The number of countries included in the models ranges from 1 in the MISS and BFAP model

up to 147 in the FAO World Model, with the sectoral and product variations spanning from 13 in the GAPsi and FAO World Model up to 29 in the WATSIM Model.

3.4   COMMODITY MODELS IN ZIMBABWE

3.4.1   Background and Context

The environment within which commodity models are conducted has changed tremendously in Zimbabwe over the past four decades. All the past market policy shifts have presented changes to the maize industry, yet none have matched the scope of the 'fast track' land reform policy (Moyo, 2004). It is against this background that the consequent persistent maize market shortages, a signal that suggests a demand for applied and evidence-based analysis, be probed to inform the extent to which the 'fast track' land reform policy has impacted on the maize sector. This process forms part of a measure to guide the development of current and future maize policy strategies in strengthening the grain markets in Zimbabwe.

Richardson (2006; p18) paused an important question that essentially forms the epicentre of this thesis: 'What if [fast track] land reforms had not taken place'? Although Richardson's (2006) and Richardson's (2007a) empirical analyses went as far as attempting to inform policy debate on the extent to which 'fast track' land reforms impacted the macro-economy and maize markets, policy analysts such as Moyo *et al.*, (2009) and Moyo and Yeros, (2009) still feel that empirical tools have been employed in a rather fragmented way with respect to Zimbabwe's food crisis. Yet the existent knowledge gap re-emphasises the importance and necessity of econometric tools which can be utilised to estimate the impact of this policy shift on the domestic maize markets.

However, whilst this study makes every effort to present an understanding of 'fast track' land reform impacts on maize market performance under a given set of policy conditions, anticipated challenges of exogenous variables such as astronomical inflation and exchange rates, as well as erratic inaccurate production data that emanated from Zimbabwe's economic instability have, however, made the very nature of innovative modelling work of this kind difficult, if not impossible. Zimbabwe's market conditions after 2001 have presented analytical challenges, and these pertain to the dysfunctional institutional and

economic environment that has violated the fundamental assumptions of econometric modelling. Astronomical exchange and inflation rates have limited the scope of econometric analysis to Zimbabwe's markets within the 'fast track' land reform period. It is important to note that inflation in Zimbabwe increased from 112.1% in 2001, to over 9 million% in 2007 (Cato Institute, 2009).

Modelling markets under unstable economic conditions typified by such data distortions would be even more difficult, if not impossible. An improvised model therefore had to be developed through fundamental assumptions pertaining to exchange and inflation rates. In this case, crafted underlying institutional and economic assumptions permit a baseline maize model to be estimated through a set of hypothetical conditions of what the Zimbabwean markets would have looked like at a given point in time.

This specific approach represents a mode synonymous with the BFAP model, whose dynamic models also account for partial equilibrium price policy effects within and across commodity subsectors. The term 'dynamic' essentially refers to the adjustment processes of time which will be in the form of lagged independent variables that capture the lasting effects of policies. As Calcaterra (2002) pointed out, the dynamic adjustments can be included in equilibrium models in various ways, though more popularly in a recursive sequential manner such that equilibrium is attained at each point as the adjustment moves over time.

3.4.2   Review of previous agricultural market modelling studies and their results

The study attempts to undertake maize market modelling against the backdrop of fairly considerable modelling work previously done in Zimbabwe's agricultural sector. Virtually all of the available agricultural commodity models in Zimbabwe were conducted for the tobacco and maize sectors, and these models specifically sought to analyse the farmer responses that resulted from price policy shifts.

Early modelling work by Masanzu (1981) made use of a Nerlovean supply response model technique that employed data that ranged from 1961 to 1975, a period when Zimbabwe (then Rhodesia), was under sanctions and a civil war. The author revealed that own price

elasticity for maize was 0.64854 and the model included a dummy variable for war and peace which yielded an elasticity of 0.51684. The relevance of this variable was underlined by its significance in the model and improved the R^2 to 0.49127. This indicated that structural and institutional changes were important in improving the predictive power of a model.

In a study yet to be reviewed, Mutangadura (1993) modelled a commercial sector maize supply function in Zimbabwe using an OLS technique for a single equation for maize supply. The author focused only on the commercial sector, and the GMB marketed output was modelled as a function of own producer price, fertiliser price, and rainfall, with soybean price being used as a substitute crop. The results indicated that lagged maize producer price effects significantly influenced marketed output, with an own price elasticity of 1.14. Maize normally has a much lower elasticity than reported by Mutangadura (1993), and this anomaly may be explained by the absence of dummy variables that capture policy shifts and institutional changes in the analysis. Therefore, the model results were not used for the purposes of forecasting.

Townsend and Thirtle (1994) studied a supply response of small scale farmers in Zimbabwe. The study used data from the sample period 1975-1990, a period during which the government used post-planting price regimes and fixed pan territorial and pan seasonal prices. The variables used included the volume of loans, number of GMB depots, increased land through resettlement programs, population of communal areas, public research and extension expenditures and the amount of rainfall. An Error Correction Model for communal maize production was fitted to the data, and results showed that the relative price of maize as well as the number of loans significantly affected output. Their results concluded on a short run and long run own price elasticity of 0.78 and 1.01, respectively.

The most recent econometric model related to Zimbabwe was by Thiele (2003) who employed a Nerlovean method in a multi-product cross-country case study of how Sub-Saharan African (SSA) farmers responded to incentives. The study looked at aggregate maize, cotton and tobacco sectors covering the period 1965-1999 and employed Johansen's multivariate co-integration approach. The author concluded that the net impact of real prices on output was 0.30 for Zimbabwe. The less than unitary estimated supply elasticity, according to Thiele (2003), reflected outstanding discrimination against agriculture in

Zimbabwe (and the rest of SSA) which suggested the need for more agricultural and macro-economic policy reforms.

Cutts and Hassan (2003) in their SADC econometric model for simulation and policy analysis revealed that maize in Zimbabwe had a long run supply elasticity of 0.3605, and a short run elasticity of supply of 0.4484. With the effects of the Zimbabwean food crisis setting in at that particular juncture, the SADC maize market outlook was premised on a range of policy assumptions, which were that the maize area harvested in Zimbabwe would decline from its forecasted baseline level by 50% in 2002 (781 617 hectares), followed by a 20% drop in 2003 and a 10% reduction in 2004. Through these assumptions, the study was able to conclude on the possible impact of the political crisis in Zimbabwe which was evaluated as indicated in Table 3.1 below.

Table 3.1:   Actual and Percentage Change on the Market Outlook for Zimbabwe

YEAR	2002	2003	2004	2005	2006	2007
Change in Area (Ha)	-781 617	-322 390	-164 663	0	0	0
Area% change	-50	-20	-10	0	0	0
Change in Production (tons)	-977 021	-402 987	-205 828	0	0	0
Production% change	-50	-20	-10	0	0	0
Change in Stock (tons)	-97 606	-482 424	-202 942	-93 151	0	0
Change in Stock% change	-33	-150	-57	-24	0	0
Change in Food Use (Ton)	-410	-288	-114	-22	0	0
Food Use% change	-0.03	-0.02	-0.01	0	0	0
Change in Net Trade (ton)	-1 074 218	-885 123	-408 657	-93129	0	0
Net Trade% change	-800	-465	-175	-34	0	0
Change in Price (Lc/ton)	1 444	1 226	583	137	0	0
Price% change	12	10	4	1	0	0

Source: Cutts and Hassan (2003)

From the baseline results, area harvested and production had the expected percentage decreases, with both stock change and Zimbabwe's net trade position experiencing huge adjustments. The prices of maize in Zimbabwe increased by 12% , 10% and 4% from the baseline forecast in 2002, 2003, and 2004, respectively. From the empirical results (in Table 3.1 above), a long term decrease in area harvested in Zimbabwe would have long term adverse effects. With the study's imperative specifically looking at possible scenarios that could improve food security in the region, the authors endogenised the Zimbabwe crisis and the baseline made the assumption that the political problems in the country persisted. This was probably the first modelling study that went beyond merely stating the

maize producer responses, as it went on to give possible implications of various policy scenarios.

While past studies have given great insights into maize producer responses to price and pertinent agricultural policy reforms, none to date have quantified the proximate impact of the 'fast track' land reform policy on the maize market. The existence of crippling persistent maize shortages stress the need for empirical studies to transcend derived producer responses and assess their inter-linkage with maize production structure and supply as it relates to the 'fast track' land reform policy. This implies that empirical analysis should instead go on to give a clear and elaborate holistic overview of the maize market inter-linkages. Closing this knowledge gap will require dimensions of maize policy to be put into context given the past effects of pertinent policy reforms on agricultural markets. In closing the evidence gap, this study will estimate the baseline model for the maize market that will allow for analysis of the impact of the 'fast track' land reform policy and assessed its link to maize production and supply within a set of given policy conditions.

3.5   SUMMARY

The purpose of this chapter was to review econometric modelling of agricultural markets. The first section of the chapter thus briefly discussed the evolution of econometric modelling as it relates to commodity modelling. The chapter went on to discuss modelling from the global perspective and then commodity modelling in the Zimbabwean context. The essence was to provide a framework for modelling Zimbabwe's maize sector. A discussion of the previous research work on Zimbabwean commodity models was therefore explored and, drawing on the work of other scholars, the knowledge gap was revealed. Bearing in mind the fact that no model is able to serve all purposes, it is important to note that the specific applicability of any model rests upon the theoretical framework, as well as the estimation methodologies. These are discussed in the following chapter.

CHAPTER 4

THEORETICAL FOUNDATION OF MODELLING COMMODITY MARKETS

4.1 INTRODUCTION

The confidence and effectiveness of commodity modelling has been described in various ways. Van Tongoren *et al.*, (2000) explain commodity models as systematic and comprehensive in the analysis and forecast of market behaviour. In this respect, commodity models have emerged as a powerful methodological technique for analysing and examining complex commodity markets. However, more often than not, econometric results are given more attention than the methodological and theoretical foundation used to derive the results. In light of the modeller's confidence emanating from tremendous advances in econometric modelling as discussed in Chapter Three, it is worth discussing the basic theory that underpins the model development exercises.

The crux of this chapter is, therefore, to provide the basic fundamental market supply and demand framework. The essence of the chapter lies in the attempt to relate market behaviour as expressed in the form of mathematical equations. In a step by step process, the chapter will gradually unpack the underlying micro-foundations of conventional model equations that have been put forward by other scholars in an attempt to depict typical market behaviour. Thus, while Chapter Two focused on a description of market conditions, this chapter ties in the mathematical dimension of such behaviour as it relates to supply and demand.

The first section will focus on the literature pertaining to supply response theory as it relates to agricultural production. It is necessary to understand supply response theory because it explains the behaviour of producers in the market and how they behave with changes in prices and policy. Therefore, various models of supply response are discussed. The second section will provide a review of the demand theory. Demand theory allows one to understand the behaviour of human and livestock consumption, seed use and grain storage in the maize market. In the third section, the focus is on the basic underlying theory

of derivation of respective supply and demand multipliers. These supply and demand multipliers are the essential framework upon which the maize model is constructed. The chapter ends with a summary of the aspects discussed in the chapter.

4.2   THE SUPPLY THEORY

A supply schedule is fundamentally a relationship between output supply and real price level (Tweeten *et al*., 1989). The law of supply postulates a positive relationship between output supplied and the price of a particular commodity, and thus the curve is upward sloping (Handerson & Quandt, 1980). Theory suggests that the market supply of a product is determined by the own price of the commodity, the price of substitute, the price of inputs, as well as technology, weather and other related factors such as infrastructure. Changes in own price of the commodity induce the movement along the supply schedule while the change in all the other aforementioned variables shift the supply curve.

Coleman and Young (1989) argue that the supply model requires a dynamic specification since farmers change supply after a time period given a change in the supply variables. Thus, the lapse in time that allows for farmers to rationally adjust their resources and respond to changes in the independent variables is typical with agricultural production and as such, the lagging of farmer responses in supply reflects the nature of agricultural commodity markets. The biological nature of agricultural production implies that there is no instantaneous response to price and non price factors that may occur during the production process. In addition; the fact that agricultural production takes place under uncertain environments is uniquely significant (Meyer, 2005). This important attribute necessitates the need to introduce a time variable that captures this phenomenon, and lagging variables is one way of capturing this attribute.

4.2.1   Auto-distributive Lag Models

A classical example of a lag model is the cobweb model, which Muir-Leresche (1985) argued to be a good representation of the maize industry market behaviour in Zimbabwe. This model simply states that the level of current supply is contingent upon the price in the prior period, which essentially means that the farmers rationally adjust their output to the

prevailing prices (Mutangadura, 1993). Due to the time lag, the rational adjustment does not occur immediately, but may become apparent in the market after a period of time. This scenario may best depict the Zimbabwean situation where institutions are less effective, and responses are thus erratic and perceptible after a time lag in the market. Algebraically this may be presented as follows:

Equation 4.1 $\qquad Q_t = \alpha + \beta P_{t-1} + u_t$

In Equation 4.1, Q_t represents the quantity produced, is a constant, P_{t-1} is the lagged price and u_t is a random error term. The above equation simply implies that the current supply is a function of the price of the previous period. In the same respect, Greene (2003) pointed out that the effect of one variable may endure through several periods due to institutional failures and other market constraints giving a distributed lag relationship such as:

Equation 4.2 $\qquad Q_t = \alpha + \beta_0 P_t + \beta_1 P_{t-1} + \beta_2 P_{t-2} + \beta_3 P_{t-3} + ... + \beta_k P_{t-k} + u_t$

This model is a very useful tool in estimating the supply response in agricultural commodity markets. The possibility of successive lagged terms becoming correlated as a result of multi-collinearity problems inevitably leads to biased and inefficient OLS estimates. However, OLS can still be applied to yield efficient estimates through diagnostics, provided the data is stationery to correct for the build up of errors from successive lags. Alternatively, Maximum Likelihood Estimation (MLE) and instrumental variable estimation methods have usually been argued to be easier and less tedious methods that yield the desired properties.

4.2.2 The Partial Adjustment Model

A fundamental feature unique to agricultural production has been the concept of partial adjustment. Muchapondwa (2009) argued that the partial adjustment technique is commonly used to model the gradual adjustment of agricultural producers to changes within the production environment. The principle of this technique rests on the idea that a change in supply from one period to the next can be expressed as some portion of the difference between the current supply levels and a desired supply level. Rational

adjustment, as Askari and Cummings (1977) argued, takes place in each period as farmers seek to attain some long run equilibrium level of supply as expressed in the equation below:

Equation 4.3 $\qquad Q_t - Q_{t-1} = \partial(Q_t^* - Q_{t-1}) + u_t$

Collecting like terms together and making Q_t the subject and will reduce Equation 4.3 to:

Equation 4.4 $\qquad Q_t = (1 - \partial)Q_{t-1} + \partial Q_t^* + u_t$

Q_t denotes the current level of output, Q_t^* is the desired long run equilibrium level of output, Q_{t-1} is the level of output from the previous year. The adjustment factor ∂ reflects the extent to which the farmers have adapted their output supply to the changes in the prices from the prior period. Thus, $\partial=1$ means that there has been a complete adjustment in output levels from the previous period to the current period. If $\partial=0$ on the other hand, then no adjustment has taken place, which implies that expected supply equals the actual supply $Q_t^* = Q_t$. Therefore, expected supply is equal to a constant and a portion of the expected price in period t as shown in equation 4.5 below:

Equation 4.5 $\qquad Q_t^* = \alpha + \beta P_t^*$

Estimating Equations 4.3, 4.4 and 4.5 proves problematic due to the fact that expected supply is an unobservable variable. In order to get a function of observable variables, a relationship between Equations 4.5 and 4.3 is assumed such that Equation 4.5 can be fed back into Equation 4.3 to get an equation of observable variables:

Equation 4.6 $\qquad Q_t = \alpha\partial + (1 - \partial)Q_{t-1} + \partial\beta P_{t-1} + u_t$

From the Equation 4.6, the adjustment coefficient (∂) can therefore be used to calculate the short run and long run effect. The short term effect is the estimated coefficient of the price variable ($\partial\beta$) and the long term price effect which is obtained by dividing the short term price effect by the adjustment factor which yields (β).

4.2.3 The Adaptive Expectations Model

The fundamental concept of the adaptive expectation models is premised on the forward looking behaviour of agricultural producers. The assumption here is that producers base their decisions on certain future expectations regarding prices. Thus, cropping decisions are premised on the expected prices at the time of planting and Askari and Cummings (1977) provided a step by step process of deriving this behaviour. It can be expressed algebraically as follows:

$$\text{Equation 4.7} \qquad Q_t = \alpha + \beta P_t^* + u_t$$

Where Q_t denotes the current level of output and P_t^* represents the expected price to prevail at time t. In this particular model, the prices prevailing in the past period lead to revised expectations of the following period, with the revision being proportional to the error in the previous expectation (Greene, 2003). This revision can be algebraically presented as follows:

$$\text{Equation 4.8} \qquad P_t^* - P_{t-1}^* = \gamma (P_{t-1} - P_{t-1}^*)$$

Collecting the like terms from Equation 4.8 means it can be re-written as follows:

$$\text{Equation 4.9} \qquad P_t^* = \gamma P_{t-1} + (1 - \gamma) P_{t-1}^*$$

What Equation 4.9 essentially illustrates is that a revision in period t is a function of past prices plus the error in expectations in that previous period. γ is referred to as the coefficient of expectation, and if $\gamma = 0$ it means that the actual prices have no effect on the expected prices. If, on the other hand, $\gamma = 1$, then expected prices are equal to the actual prices in the previous period. This implies that a perfect relationship has prevailed between the past period and present prices. The expected price in this case can now be expressed as a function of expected prices and actual previous prices over an extended period of time, a relationship outlined in Equation 4.10 below:

$$\text{Equation 4.10} \qquad P_t = \gamma P_{t-1} + (1 - \gamma) P_{t-2} + (1 - \gamma)^2 P_{t-3} + (1 - \gamma)^3 P_{t-4} + \dots$$

Equation 4.10 illustrates that producers base their price expectations upon an extrapolation of past prices.

4.2.4 The Nerlove Supply Model

The Nerlovean expectation model developed by Nerlove (1979) is based on a combination of the partial adjustment model and the adaptive expectation model. In its simplest form, the model assumes that there exists a desired level of supply Q_t^* which is contingent upon an expected price level P_t^* which can be presented as follows:

$$\textbf{Equation 4.11} \qquad Q_t^* = \alpha + \beta P_{t-1}^* + u_t$$

Initially, Nerlove assumed away the supply shifters and subsumed in his model a partial adjustment component (Equation 4.12) that captures the adjustment of actual supply toward the desired level of supply. The adaptive expectation component (Equation 4.13) is used to determine the farmer's expectations regarding the market prices.

$$\textbf{Equation 4.12} \qquad Q_t = (1 - \partial)Q_{t-1} + \partial Q_t^* + u_t$$

$$\textbf{Equation 4.13} \qquad P_t^* = \gamma P_{t-1} + (1 - \gamma)P_{t-1}^*$$

Substituting Q_t^* in Equation 4.11 into Q_t in Equation 4.12 will thus yield:

$$\textbf{Equation 4.14} \qquad Q_t = \alpha\delta + (1 - \delta)Q_{t-1} + \delta\beta P_{t-1}^* + u_t$$

Substituting Equation 4.11 into Equation 4.12 will give an equation of observable time series variables that can be easily incorporated into the model.

$$\textbf{Equation 4.15} \qquad Q_t = \alpha\delta + (1 - \delta)Q_{t-1} + \delta\beta[P_{t-1} + (1 - \gamma)P_{t-2} + ...] + u_t$$

The application of OLS to Equation 4.15 will yield biased and inefficient estimates due to the auto-correlation of error terms and a stochastic lagged dependant variable. OLS may be used only after Error Correction mechanisms have been employed to allow for a time

invariant error term that is stationary. Alternatively, Maximum Likelihood Estimation (MLE) as well as the instrumental variables estimation may also be used in order to yield estimates with desired properties.

Given the intuitive appeal of the Nerlovean Adaptive Expectation Model, it has thus been used extensively over the past two decades in modelling the supply of agricultural commodities. Despite a growing body of literature arguing against the Nerlovean supply response model (Braulke, 1982; Townsend, 1997), the Nerlovean Partial Adjustment model still remains the most popular among modellers.

4.3   DEMAND THEORY

The principle of demand, unlike the supply theory, postulates an inverse relationship between price and output purchased (Coleman & Young, 1988). This implies a downward sloping curve on the cartesian plane. In the maize-to-maize meal value chain, consumer demand may be captured by the maize meal retail prices at a particular point in time. However, the consumer is one of several market players in the value chain. Thus, demand can be partitioned into three components namely: consumer/human demand, feed/livestock demand, seed demand and maize inventories. In all cases, each component can be partitioned into 'direct' and 'inventory' sub-components. The direct sub-component can be classified as direct demand, or demand at a retail level. Direct demand can thus be demand for either maize meal or raw maize grain. The inventory sub-component is part of stock that is being stored for future use, and this can be captured in the form of on-farm and off-farm processing or storage. Under this section, these different components of demand are discussed.

4.3.1   Human Demand

Ideally, consumer demand is demand of a good in its final form. However, the human demand for maize in this study is assumed to be the demand for raw grain. This is done for reasons of simplifying the study, and these will be discussed in the next chapter. The human demand function is premised on the utility maximisation theory. The assumption here is that consumers are rational decision makers with defined and non-satiated preferences. A key supposition is that the consumer chooses a combination or bundle of

goods that maximise utility subject to prices and a level of income. The utility maximisation problem is stated mathematically as:

$$MaxU\,(x_1, x_2,...x_n)$$

Equation 4.16

$$s.t.$$

$$m = \sum_{i=1}^{n} p_i x_i$$

In this expression, $U(x_1, x_2,....x_n)$ represents the consumer's utility function. $m = \sum_{i=1}^{n} p_i x_i$ is the consumer's budget constraint which is made up of the consumer's total available income m. The price per unit of commodity x_i is p_i. The utility function conforms to particular properties which include quasi-concavity and twice differentiability (Crawshaw and Chambers, 2003). Solving the consumer problem involves setting up an auxiliary function, otherwise known as the Lagrangean which is written as follows:

Equation 4.17: $\quad L = U(x_1, x_2,..., x_n) - \lambda(\sum p_i x_i - m)$

The Lagrangean theorem sets out an optimal choice referred to as the utility maximisation condition which satisfies the First Order Conditions (FOC) with respect to x_i and λ.

Equation 4.18: $\quad L_i = \partial L / \partial x_i = \partial U(x_i) / \partial x_i - \lambda p_i = 0 \quad$ for all $i = 1, 2,.... n$

Equation 4.19: $\quad L_\lambda = \partial L / \partial \lambda = (\sum p_i x_i - m) = 0$

In the FOC, the derivatives of the Lagrangean with respect to x_i and λ are set at zero such that Equations 4.18 and 4.19 are equal to zero. The solution to λ represents the rate of satisfaction derived from spending an additional dollar on the commodity. The simultaneous solution to x_i yields the demand function for commodity x_i as an implicit function of own prices substitutes and consumer's incomes.

Equation 4.20 $\quad x_i = x_i(p_1, p_2....p_i, m)$**,** $i = 1, 2..., n$

The demand function for commodity x_i, which represents the individual consumer demand, can be aggregated by multiplying the demand for x_i by the total number of consumers within the market. If commodity x_i is maize, then the demand for maize can be expressed as:

Equation 4.21: $\qquad Q^{mz} = f(p_m, p_s, m)$

4.3.2 Livestock Demand

In Chapter two, it was briefly highlighted that feed is also a component of total consumption, and the levels of feed use over time were given in a maize balance sheet. This is despite the fact that data is sketchy and therefore, usually under-estimated. However, understanding maize feed use demands an understanding of the feed sector. The feed sector's maize demand is given by the profit maximisation condition in Zimbabwe's livestock sector. Broadly, the livestock sector utilises a variety of feed commodities and it may be assumed that the production function in the livestock industry is a function of maize, wheat, sorghum and soybean. The livestock production function can therefore be expressed as:

Equation 4.22: $\qquad Q_L = f(Q_{mz}, Q_w, Q_{sg}, sb)$

To get the derived demand for maize feed, a Lagrangean is set up in the same manner as the derived demand for x_i in Equation 4.20. The underlying solution after setting up the FOC equal to zero allows for the determination of the derived demand function:

Equation 4.23 $\qquad Q_L = g(P_L, P_w, P_{sg}, P_{sb})$

The derived demand for maize in the feed sector is a function of output price (livestock) and the price of substitute commodities.

4.3.3 Seed Demand

Since part of maize produced goes towards seed maize, which in turn is used in the production of maize, it implies that production drives the demand for seed. Seed demand is theoretically derived from the producer's profit maximisation problem. The FOCs of the profit maximisation problem yields a derived demand for inputs:

Equation 4.24: $\qquad x_s = x_s(p_{mz}, p_{oi})$

The expression of Equation 4.24 illustrates the seed input demand as a function of maize prices p_{mz} and the price of other inputs p_{oi}.

4.3.4 Inventory Demand

Inventory demand, on the other hand, is the demand for storage and speculation/precaution. The speculative demand reflects future expectations on the availability of grain and future maize market policy conditions. Also an important factor is the fact that the production of maize only occurs for a period whilst consumption occurs throughout the year. As such, the purpose of maize inventories is to even out the supply throughout the year in line with the consumption trend. In Zimbabwe, maize inventory demand was reflected by GMB's ending stocks, which were critical in price considerations for the following season. Therefore, prices played a role in the behaviour of stock holding. In summary, GMB stocks can be specified as:

Equation 4.25: $\qquad S_t = s(S_{t-1}, P_t, Q_t, Q_{t+1})$

In Equation 4.25, stocks are expressed as a function of lagged ending stocks (begging stock), current price, current production and anticipated production in the next period.

After the 1992 drought, the government implemented a buffer stock policy that ensured that the inventory was able to provide consistent supply in case of exogenous shocks or droughts. Theoretically, for precautionary purposes, a constant level of stock (set at half a million tonnes, sufficient to cover demand for three months) had to be available at any

given time. Apart from the precautionary demand which is treated as a constant, there would be a transactions demand component, which is expressed as a fraction of production. The Strategic Grain Reserve policy would thus be expressed as:

Equation 4.26: $\qquad S_t = \omega_1 + \omega_2 Q_t$

Q_t represents the current total maize production, ω_2 is that part of production that government keeps while ω_2 is the constant minimum amount of stocks that should be available.

4.4 SUPPLY AND DEMAND MULTIPLIERS

Elasticities are values that express the relationships between the dependant and independent variables in the demand and supply equations (Coleman & Young, 1988). In this section, the derivation of elasticities is reviewed.

4.4.1 Derivation of Elasticities

The supply and demand elasticities form the crux of the study's analysis, as they represent the fundamental relationships between individual independent variables and the dependent variable. Own price elasticity reflects the effect of a price change on the product quantity holding other factors constant (Tweeten *et al.*, 1989). Elasticities basically denote the relative changes in variables which are preferred for measuring responsiveness of output supply to producer price policy. Mathematically, the proportionate change in maize output supply (Q_m) induced by a proportionate change in the maize output price (P_m) holding other factors constant is expressed as:

Equation 4.16 $\qquad E_{op} = \dfrac{\Delta Q_m}{\Delta P_m}\left(\dfrac{P_m}{Q_m}\right) = \dfrac{\partial Q_m}{\partial P_m}\left(\dfrac{P_m}{Q_m}\right)$

This formula basically is an expression of the ratio of the change in quantity supplied (or demanded) over the change in price by the ratio of the average price over the average quantity. Neo-classical theory postulates that own price elasticity of supply has a positive

sign which is underlined by the positive relationship between price and quantity supplied. Own price elasticity of demand on the other hand is negative which suggests a negative relationship between price and quantity demanded. The cross price elasticity denotes the effect of the price of the substitute crop; soybeans (P_s) on the maize quantity supplied (Q_m). The cross price elasticity of supply can be outlined as follows:

$$\textbf{Equation 4.17} \qquad E_{cp} = \frac{\Delta Q_m}{\Delta P_s}\left(\frac{P_s}{Q_m}\right) = \frac{\partial Q_m}{\partial P_s}\left(\frac{P_s}{Q_m}\right)$$

The cross price elasticity of maize for soybean is expected to have a positive sign. In the case of inputs, the input price elasticity measures the proportionate change in maize output induced by the proportionate change in input prices. The input price elasticity can be expressed as:

$$\textbf{Equation 4.18} \qquad E_i = \frac{\Delta Q_m}{\Delta P_i}\left(\frac{P_i}{Q_m}\right) = \frac{\partial Q_m}{\partial P_i}\left(\frac{P_i}{Q_m}\right)$$

Neo-classical economic theory postulates that a negative relationship exists between the output and the input price involved in producing the commodity. As a point to note, all the above elasticities reflect the relative (rather than absolute) changes in variables which is a more convenient measure of output responsiveness to price policy changes. Mirer (1988) argued that mathematically, the log ratio of the output supply to factor price changes is very close to the ratio of the percentage change. Therefore, to simplify the analysis, the model equations may be in the form of a log-linear specification which essentially allows for the parameter estimates to be directly imputed and utilised as elasticities.

4.5   SUMMARY

In light of the tremendous advances in econometric modelling discussed in Chapter Three, it is worth discussing the basic theory that underpins the model developments. The chapter sought to lay a theoretical foundation of the study by presenting the theory of price and adaptive expectations, supply response and demand. The fundamental economic theory of supply and demand forms the basis upon which the model framework is built. The

theoretical concepts discussed in this chapter will thus aid in the understanding of the conceptual underpinnings of the maize model itself. Taking into account these theoretical concepts, Chapter Five will extend this theory framework to develop the structure of the model.

CHAPTER 5

STRUCTURE OF THE ZIMBABWEAN MAIZE MODEL

5.1   INTRODUCTION

In order to understand the holistic maize model, it is imperative that one understands the basic building blocks that make up the model itself. In unpacking the model components, a flow diagram will outline the basic fundamental biological, institutional and economic attributes of the maize sector and how these are interlinked. The biological, institutional and economic factors of maize production were discussed in Chapter Two and these will provide critical guidance to the empirical estimation processes of the Zimbabwean maize model. In this respect, the scope of this chapter is to provide a framework for the structure of Zimbabwe's maize model. The basic structural set up of the model is based on the theoretical foundation established in Chapter Four.

Before the econometric model can be constructed, it is necessary to outline the steps taken to build the basic equations that make up the holistic model itself. The first part of this chapter shall therefore present the concept of the model structure and its components. This will provide a sound basis for a discussion of the model equations that will be outlined and specified in the second section of the chapter. From there, the modelling procedures and estimation processes will be discussed. In the final section of the chapter, a summary of the chapter will be given.

5.2   CONCEPTUAL FRAMEWORK AND MODEL CLOSURE

Under this section, the concept of partial equilibrium modelling is explored as a necessary step to understanding the maize model. Important to note is the point that the partial equilibrium maize model is made up of domestic supply and demand components that are linked by a trade and price component. This concept is illustrated in Figure 5.1 below.

In the maize supply component, total maize output harvested is determined first. This is derived from maize output harvested from both the commercial and communal sectors and

the respective yields per sector. This is due to the dual nature of the maize sector as discussed in Chapter Two; with the motivation stemming from the supposition that each sector produces maize based on differing responses due to differing resource endowments. Theoretically, the decisions made in each sector will be influenced by the producer price of maize, input prices, substitute prices, government policies and the previous years' area planted. After the maize producers make their production decisions, the bio-physical conditions, such as yield and rainfall, will eventually determine the total production of the crop. The total supply of maize in Zimbabwe is then calculated by adding total production to beginning stock and total imports. The imports in this case are largely determined by government and these import considerations take into account the domestic production figures for the season and beginning stock against the prevailing maize demand.

In the demand component, the total demand is determined by human consumption, feed and seed use, grain exports and ending stock. Human consumption is a major part of the maize quantity demanded and is determined by the income, consumer price of maize as well as prices of substitutes and complements. Feed and seed[19] markets are also an important part of the maize demand, consuming an estimated 20% of the total maize quantity (Rusike, 1998). Exports are the excess maize demand from the domestic market and these are also determined by government. Ending stock also forms part of the demand for maize and this is largely determined by parity prices, local maize production, and consumer price of maize, beginning stock in period t and government policies. Ending stock in the current period is equal to beginning stock in the next period. This relationship is expressed in the flow diagram by a dotted line (as shown in Figure 5.1 below).

The final component of the model is the price and trade block. These two variables formalise the interaction of the maize supply and demand blocks. The linkage of the supply and demand blocks is termed 'model closure' and this is discussed in the next subsection.

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[19] Critical information on feed and seed use data is unavailable and, as a result, the two variables are derived from estimations in the calculation of total supply and demand.
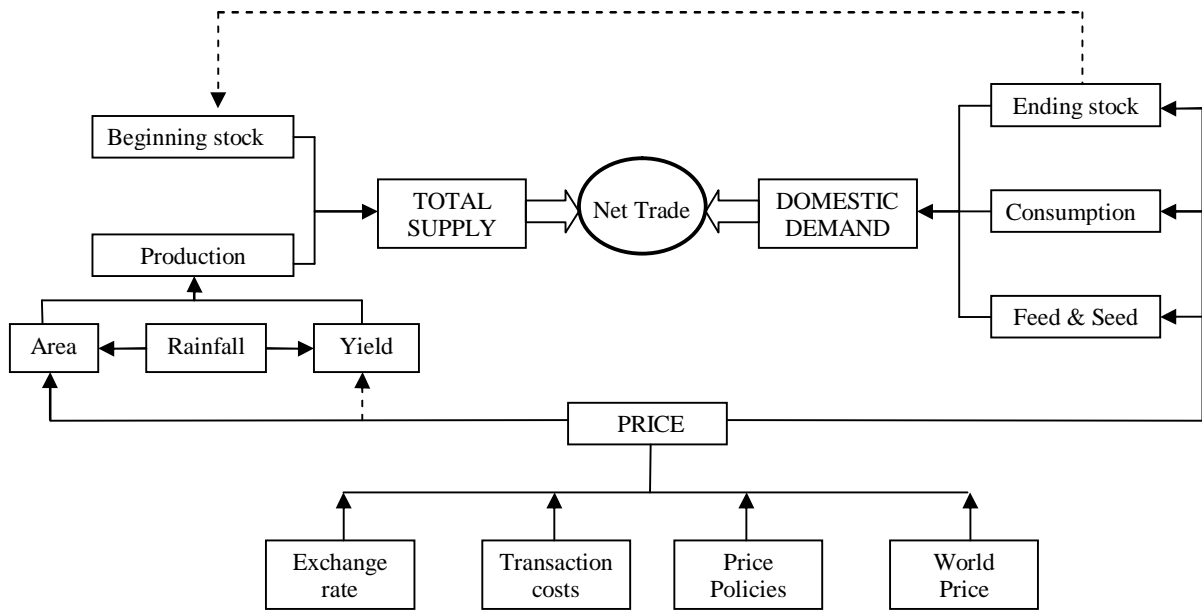
Figure 5.1: **Diagram Illustrating the Maize Market Model**

Source: Adapted from Meyer *et al.* (2006)

An important component of the modelling process is the approach on how to 'close' the model. From a modelling perspective, 'closing' a simultaneous or recursive simulation model resolves the way in which market equilibrium is attained in the model. The specification of the linkage used to 'close' the partial equilibrium model is termed 'model closure' (Meyer *et al.,* 2006). Various model closure techniques exist in line with the various ways market equilibrium is attained in respective markets; and the choice of closure technique in Zimbabwe's maize model is a net trade identity equation. Within the framework of controlled and semi-controlled market regimes, market equilibrium is therefore determined by net maize trade.

The rationale behind the use of the net trade identity is premised on the equilibrium pricing conditions of Zimbabwe's maize market. Historically, Zimbabwe's net trade position influenced maize prices and these prices were also specifically derived from the import and export parity prices as the market shifted from net exporting to net importing positions. The Zimbabwean government's use of parity price trends to peg maize producer prices meant that the price linkage equation had to incorporate the influence of the regional market where Zimbabwe is a price taker. As such, the price variable outlined in the

diagram incorporates the SAFEX derived maize price (world price), exchange rate, trade and price policies, all of which are linked directly to the domestic maize price. The implicit assumption is that the regional maize market conditions transmit into the domestic market by a given margin. This price relationship is illustrated in Figure 5.1 above. However, this means that specific assumptions have to be made concerning the price transmission relationship between the regional market and the local market. These will be discussed in greater detail in the next chapter.

5.3   SPECIFICATION AND STRUCTURE OF THE MAIZE MODEL

This section discusses the equations that were used in the maize model. In elaborating how the equations were specified, the discussion separates the building of the three main blocks in the model to allow the reader to follow how the model was constructed.

5.3.1   The Supply Block

On the basis of the theory foundation of supply and demand discussed in Chapter Four, supported by the flow diagram of the maize sector, this section presents a specification of the various equations for each component of the Zimbabwean maize model. The modelling exercise began with the estimation of the maize area harvested equations for both the communal and large-scale commercial sectors respectively. The maize acreage response functions illustrate the farmers planting decisions and postulated equations capture the variables that appropriately influence the farmer's decision to plant maize. On the basis of the partial adjustments in area planted over time discussed in Chapter Four as well as the government policies discussed in Chapter Two, the maize acreage function for the commercial sector is postulated as:

Equation 5.1: $LSCAREA = f(LSCAREA_{t-1}, P_{t-1}^m, P_t^s, P_t^i, RAIN, G)$

The above equation represents the area planted for the large scale commercial sector ($LSCAREA$) expressed as a function of the lagged large-scale commercial farmer's area harvested ($LSCAREA_{t-1}$), the lagged maize prices (P_{t-1}^m), the soybean price which is considered as a substitute for maize (P_t^s), the price for fertiliser which is considered a

critical input price (P_t^i), the yearly average rainfall ($RAIN$) and government policies (G). For the communal sector, the equation for the area planted was postulated as:

Equation 5.2: $\quad\quad SSCAREA = f(SSCAREA_{t-1}, P_t^m, P_t^s, P_t^i, RAIN, G)$

The above equation represents the area planted for the communal sector ($SSCAREA$) expressed as a function of the lagged area ($SSCAREA_{t-1}$), the producer price of maize (P_t^m), the producer price of sorghum (P_t^s) which is considered to be a maize substitute price for communal farmers, the price for fertiliser which is considered a critical input price (P_t^i), the yearly average rainfall ($RAIN$) and government policies (G). The difference between communal and large scale commercial area equations are the substitute commodity prices. In communal farms, sorghum appears to be an ideal substitute as it is sometimes used for meal and brewing, and also grown in the same season in the communal farming areas. For large-scale commercial farms, soybean appears a suitable substitute because it is a cash crop grown in the same season as maize, using the same inputs as maize, and is normally used in a rotation with maize.

The aggregate maize production equation for both of the two sectors is an identity that is expressed as follows:

Equation 5.3:

$$PROD_t = (LSCAREA_t * LSCYEILD_t) + (SSCAREA_t * SSCYEILD_t)$$

Therefore maize production for each sector is calculated by multiplying the area harvested for each sector by the yield for each growing season. The total maize production is a summation of the production of the two sectors. The yields in this study are treated as endogenous, and are expressed as a function of rainfall in the model.

An important supply variable, apart from production, is food aid. In the model, food aid was expressed as a function of production and a random error. The thinking behind this is that the quantity of food aid in any given year is dependent on the level of maize production. The equation was specified as follows:

Equation 5.4: $\qquad$ $FOODAID_t = f(PROD_t, e)$

The total supply of maize is hence made up of the total maize production and the beginning stock (stated in Equation 5.5 as $BEGSTOCK_t$) in April of each season. Thus, the total supply of maize is an identity that is expressed as follows:

Equation 5.5: $\qquad$ $SUPPLY_t = PROD_t + FOODAID_t + BEGSTOCK_t$

5.3.2 The Demand Block

Estimation of demand started off with a per capita consumption function expressed in Equation 5.6. Here the maize per-capita consumption is specified based on the consumer utility maximisation theory, which implies that the consumers maximise satisfaction from maize consumption subject to income. As such, the Per Capita Consumption equation was expressed as follows:

Equation 5.6: $\qquad$ $PCC_t = f(P_t^m, P_t^s, PCGDP)$

PCC_t denotes the total maize per capita consumption. Retail data for maize meal is unavailable, hence P_t^m denotes the GMB selling price for maize and P_t^s denotes the commodities that can be used as a substitute for maize. $PCGDP_t$ represents per capita Gross Domestic Product (GDP) which denotes the per capita income. The per capita GDP is calculated by dividing GDP by the population, with the total population being taken as exogenous to the system.

Apart from human consumption, maize is also used for seed use and livestock feed. However, time series data on these variables is hardly available. Moreover, there is an unexplained, or unrecorded rather, stock use by farming households. Data on such stock use is largely unavailable and therefore, not adequately captured. Therefore, there would be a need to create a variable that captures the feed, seed and unexplained stock use. Thus, a 'residual' stock variable is captured as a component of demand that is expressed as follows:

Equation 5.7: $\qquad RES_t = f(PROD_t, P_t^m, Dummy)$

This 'residual' stock is assumed to be dependent on the level of production and observable prices on the market.

Another important component of demand is the maize ending stock. Ending stocks in period t become the beginning stocks in the next period ($t+1$) and these are outlined in the ending stock equation. In Chapter Two, it was mentioned that, after the 1992 drought, the government set out a policy that retained at least 500 000 tonnes as a precautionary measure. Although the implication of this policy measure is that only part of the ending stock was free for export or local sales, the discretionary nature of this policy, as will be discussed in Chapter Six, would be an important consideration. For estimation purposes, the following equation is postulated:

Equation 5.8: $\qquad ENDSTOCK_t = f(ENDSTOCK_{t-1}, PROD_t, P_t^m, G)$

Where $ENDSTOCK_t$ represents the current period ending stock, $ENDSTOCK_{t-1}$ denotes the free lagged ending stock (or the beginning stock in period t), $PROD_t$ represents current total maize production and a dummy variable is used to represent the effects of the drought on the ending stock.

5.3.3 Price and Trade Block

A maize net trade equation balances off the supply and demand components which in this case forms the closing identity. The trade component of the model was an identity equation for net trade (net exports) which in this case formed the closing identity. The equation was defined as beginning stock ($BEGS_t$), plus total maize production ($PROD_t$), plus food aid ($FOODAID_t$), minus human consumption ($CONS_t$), minus ending stock ($ENDS_t$) and minus residual stock (RES_t) (which constitutes livestock feed, seed and unaccounted on-farm consumption) in time t. The net trade identity equation is expressed as:

Equation 5.9:

$$NT_t = BEGS_t + PROD_t + FOODAID_t - CONS_t - ENDS_t - RES_t$$

$CONS_t$ in the Equation 5.9 equals the total human maize consumption. The net trade identity equation links up and equates to the others to balance off the export and import difference in the market.

As previously discussed, the price linkage equation is determined by the transmission relationship between the SAFEX price (world price) and the domestic maize price. Equation 5.10 defines the price transmission relationship as the domestic price expressed as a function of the world price:

Equation 5.10: $\qquad P_t^m = f(P_t^w, EXCH_t, TRANS_t, G)$

Where P_t^m represents the domestic producer price of maize and P_t^w is the world maize prices, $EXCH_t$ is the exchange rate, $TRANS_t$ is the transport differential of getting maize from Randfontein to Harare and G are the policies such as import/export duties.

5.3   MODELLING APPROACH

From the discussion of the chapter so far, it is apparent that the maize sector model in Zimbabwe consists of three main blocks, namely the supply, demand and trade and price components. These blocks contain sets of equations that may be either behavioural or identities. The behavioural equations are those that are formulated on the basis of economic theory, and these include the area, consumption, and the ending stock equations. It is against this background that the expected signs conform to *a priori* theory; that is a positive sign for the output price, rain and negative sign for the substitute crop price in the supply function. The behavioural equations may consist of exogenous and endogenous variables. Exogenous variables are predetermined and are taken as given whilst endogenous variables are determined from within the model. Table 5.1 below classifies the model's endogenous and exogenous variables, respectively:

Table 5.1:   List of Endogenous and Exogenous Variables

Endogenous	Exogenous
Area	SAFEX maize price
Yield	Substitute Price Index of Soybean and Sorghum
Demand (Feed, seed use and human use)	Time Trend (Technology Index)
Net Trade	Private Expenditure (GDP)
Price of Maize	Population
Ending Stocks	Supply Shifters (Policies and Rainfall)
Supply (i.e. production and food aid)	Self-Sufficiency Ratio (Production/consumption)

5.4   REGRESSION AND MODEL SOLVING

Having identified the supply and demand blocks, and separating the exogenous and endogenous variables, the subsequent stage of the modelling process involved performing the regression of the equations in the SPSS software package. From there, the simulation model was constructed in an Excel spreadsheet by outlining the standard list of equations. The model consists of a total of seven behavioural equations, namely two area equations, two yield equations, an ending stock equation, a demand and a price equation. Two identities, namely the production and net trade equations, complete the model to form part of a system of simultaneous equations containing interdependent variables. Since the simultaneous equation model system contains variables that feed back into other equations, this inevitably leads to a correlation of error terms. This implies that the least squares method is biased and inconsistent (Granger & Newbold, 1974; 1977).

To avert the problem of biased estimates, a number of alternative procedures are normally employed. These include the Seemingly Unrelated Regression (SUR) approach as well as two or three stage least square (2SLS or 3SLS) estimations. The more popular among these approaches, however, is the 2SLS which allows for useful parameter estimation in over-identified equations (Pundyck & Rubinfeld, 1998; Gujarati, 2007; Greene, 2003). Nonetheless, a combination of these approaches was used. After obtaining the parameter estimates which are constant right through the data range and the projection period, these parameters were used to calculate elasticities. The parameters were incorporated into the model and the model equations were solved for equilibrium; which essentially means a solution for the simultaneous equations is derived.

The solution, technically called the baseline, represents the equilibrium output in each time point that would be produced in the maize market under a stable political, technological, institutional and economic environment within a given set of pre-2000 existing policy conditions. The maize model in this case is calibrated to the base year (2000) by adjusting the intercept, and validated by examining its predictive ability for the period 1992-2000. While validation statistical analyses may be computed, an *ex post* simulation analysis provides a powerfully useful validity test. In this regard, for each endogenous variable, the model's performance is judged based on a visual inspection of the graphical plot of the actual versus simulated plot for the historical period. How well the model performs is therefore dependant on how well it tracks actual data, particularly its ability to pick up the turning points of this data.

5.5   SUMMARY

The purpose of this chapter was to present the overall structure of Zimbabwe's maize model. The chapter started off with a discussion of the concept of the model, which was illustrated through a flow diagram that displayed how the biological, institutional and economic variables in the maize market were interconnected. The sections that followed articulated the basic building blocks of the model illustrated in the flow diagram. The equations within each of the supply, demand and price linkage blocks were therefore specified. The final section provided a discussion of the modelling procedures. In the next chapter, the empirical estimates of the mode are presented.

CHAPTER 6

RESULTS OF THE MAIZE MODEL

6.1   INTRODUCTION

While the previous chapter focused on outlining and articulating the model structure as well as the equations within each of the respective blocks that make up the model, this chapter extends on that framework to present the empirical results of the model. The results from the regression modelling are outlined and explained following the exact structure of discussion from the preceding chapter. The results of the equations are explained through a background reflection of Zimbabwe's maize market structure informed from discussions in Chapter two. While the context of this chapter is mainly drawn from the preceding chapters, it epitomises the underlying relationships between all the variables in Zimbabwe's maize market derived from econometric methodology.

This chapter is thus organised as follows: the first part outlines the variables and the sources from which the variables are obtained. The second part outlines the model equation results in each of the three blocks of the model. The equation estimates will be reported and a lucid discussion on each equation will be presented. The final part concludes with a summary of the chapter's discussion.

6.2   THE DATA AND VARIABLES

The data set that was analysed for each variable was a time series from 1970 to 2000 (presented in the Appendices). It was obtained from the following secondary sources: the MAMID's (2007) Agriculture Statistical Bulletin and GMB reports providing the time series for area, output and yield data for maize by sector as well as the maize producer prices; the Meteorological Services of Zimbabwe provided the average annual rainfall time series data; The African Institute of Agrarian Studies (AIAS) provided critical maize output data, maize yields as well as rainfall data that complemented the other data set derived from the Agriculture Statistical Bulletin, the Central Statistical Offices (CSO) and Meteorological Department. The Statistical handbook from the Food Agriculture

Organisation's (FAO) and the FAO online statistical database also provided production, yield, and consumption data, population time series and world grain prices. The International Monetary fund (IMF) handbook and the Reserve Bank of Zimbabwe (RBZ) provided exchange rate data; the CSO provided data of the GDP and Consumer Price Index (CPI) used in the calculation of the real producer prices. Global Insight provided the baseline projections for the period from 2000 onwards. The data for maize ending stock and fertiliser was particularly scarce, and was obtained from a variety of literature which included past studies on the maize sector, and grey literature.

The major challenge in data collection was the deficiency of the data set, particularly ending stock data on maize. Generally, the price data at the farm and retail level could not be found, and the lack of price-related parameters in the estimated per capita consumption demand function therefore compelled the assumption of using the producer price as a proxy for the retail price. In addition, there was a lack of time-series data on transport costs in the calculation of parity prices. Consumption and trade data was aggregate data providing no distinction between the various maize grades and types of maize (white or yellow). Thus, while maize is mostly consumed and traded as a differentiated commodity, the price data only captured average aggregate prices, thus assuming the crop as a homogenous commodity. Feed data at the commodity level was derived using a supply utilisation account of data on stocks, production, imports and exports. Consumption data only included 'on farm' consumption through the residual stock variable, which is believed to account for an unexplained part of consumption.

6.3   EMPIRICAL RESULTS

The equations reported in this section form the Zimbabwean maize model and are derived from a combination of OLS and 2SLS regression estimations in SPSS software and the results were used to construct the model in Excel. Important to note is the fact that the results were examined for consistency with an *a priori* knowledge of maize production, demand and trade conditions. In most instances, however, variables used in the theoretical equations outlined in the previous chapter were different from the ones described in this particular chapter.

With the assistance, judgement and discretion of maize industry experts and from literature which provided general information, maize market commodity knowledge was incorporated into the projection results. The consistency of the projection results was examined mainly by comparing the net trade position projected by production and demand for maize production and trading with the actual export and import differences.

The estimated results outlined in this section include the model's generated multipliers, t-statistics and p-values in the tables. The F-values, R^2, Adjusted R^2 and DW tests are reported below each table. The model consists of a total of nine equations which include seven behavioural equations and two identity equations. The behavioural equations include two area equations (one for each sector), ending stock equation, the per capita consumption equation and a price equation. Two identity equations included the total production equation and the net trade equation.

6.3.1 The Supply Block

The maize area harvested equations were split into two in accordance with sector and scale of production, namely the large scale commercial and the communal sectors. This allowed for the proper accounting of differences in the response behaviour that comes as a result of differences in resource endowments across the two sectors.

6.3.1.1 Communal Sector

Contrary to economic theoretical foundations, some analysts believe that Zimbabwe's communal sector maize production has on one hand been pushed more by non-market factors such as culture and tradition rather than profit, while on the other hand the sector suffers from segmented markets, information deficiency and institutional constraints. What this implies is that communal farmer's response to market prices would expectedly be limited by a combination of these factors, most of which are difficult to model.

Using a 2SLS technique, maize area harvested for the communal sector was nonetheless modelled as a function of the lagged area harvested, lagged rainfall, a dummy variable in 1987, real maize price, real soybean producer price to fertiliser price ratio (a competing crop and input cost, respectively) and the real sorghum producer price (a substitute crop).

The trend variable was used to capture the incremental levels of area over time, believed to have been caused by more land becoming available through progressive market based land reform.

Table 6.1:   Communal Sector Equation

Dependant Variable: Communal Sector Area

Variable	Co-efficient	Beta	t	Sig.	Elasticity	Mean Value
(Constant)	849.716		1.635	.124	-	-
LagSSCAREA	.131	.127	.537	.600	-	950.9
LagRAIN	.271	.232	1.083	.297	-	642.61
DUMMY87	195.129*	.485	2.328	.035	-	0.41
Maize Prices	12.843*	.475	2.417	.030	0.57	43.08
SYBN/FERT Price Ratio	-172.247*	-.491	-2.315	.036	-0.24	0.32
Sorghum Prices	-5.285	-.282	-1.384	.188	-0.997	42.81

R Square=0.620   Adjusted R Square=0.458
* indicates significance at the 5% level.

In the model, maize prices and substitute prices as well as the 1987 two tier price policy (included as DUMMY87) were found to be significant in affecting area harvested. According to the results of the model, soybean and fertiliser prices are considered simultaneously when farmers consider area to be planted. The significance of the price variables was contrary to the widespread notion that communal sector farmers are less inclined to respond to prices. While it was expected that rainfall would be significant, the model nonetheless, proved contrary. The insignificance of the rainfall variable may have been due to the problematic nature of the structural equation itself. The basic approach taken when constructing this model was to get the signs of variables correct while attempting to make sure that the structure of the model conforms to economic theory and the biological (and seasonal) nature of production. This is why the lagged area variable (LagSSCAREA) and lagged rainfall (LagRAIN) variables where imperatively included although they had very weak t-values. The equation did not show any signs of either auto-correlation or multi-collinearity.

The own short run price elasticity for maize for the communal sector was found to be 0.57, and the long run price elasticity to be 0.59. This is contrary to results by Townsend and Thirtle (1997), who found short run and long run supply responses of 0.78 and 1.01 respectively. The differences in the elasticities between this study's estimation and that found in Townsend and Thirtle's study may be attributed to differences in methodology

and the length of the time series. While this study considered data from 1970 up to 2001, Townsend and Thirtle's study employed an error-correction model that captured data from 1975-1990.

In the communal sector area equation, the lagged area and the trend variable significantly determined area planted. The dummy variable DUMMY87 was meant to capture the two-tier price policy that seemed to have contributed to increases in area planted. After an iterative process of trying various crop prices, the results of the communal acreage function showed that maize and soybean are competing crops; this being further justified by the fact that both crops are sometimes used in rotation and/or are grown in the same season and use the same resources such as labour and land. The latter is also true for sorghum, which is widely regarded as a substitute crop in communal areas.

As expected, *a priori*, rainfall had a positive influence on area harvested. However its lack of statistical significance in influencing area planted was a source of concern. The reason why rainfall was insignificant may be explained by the fact that the variable was included as average yearly rainfall (due to data constraints). Perhaps, if data was available, the inclusion of rainfall from November to March, or another variable that captures intra-seasonal rainfall variation would have yielded better results. The visual plot of the model against actual data is given in Figure 6.1 below:
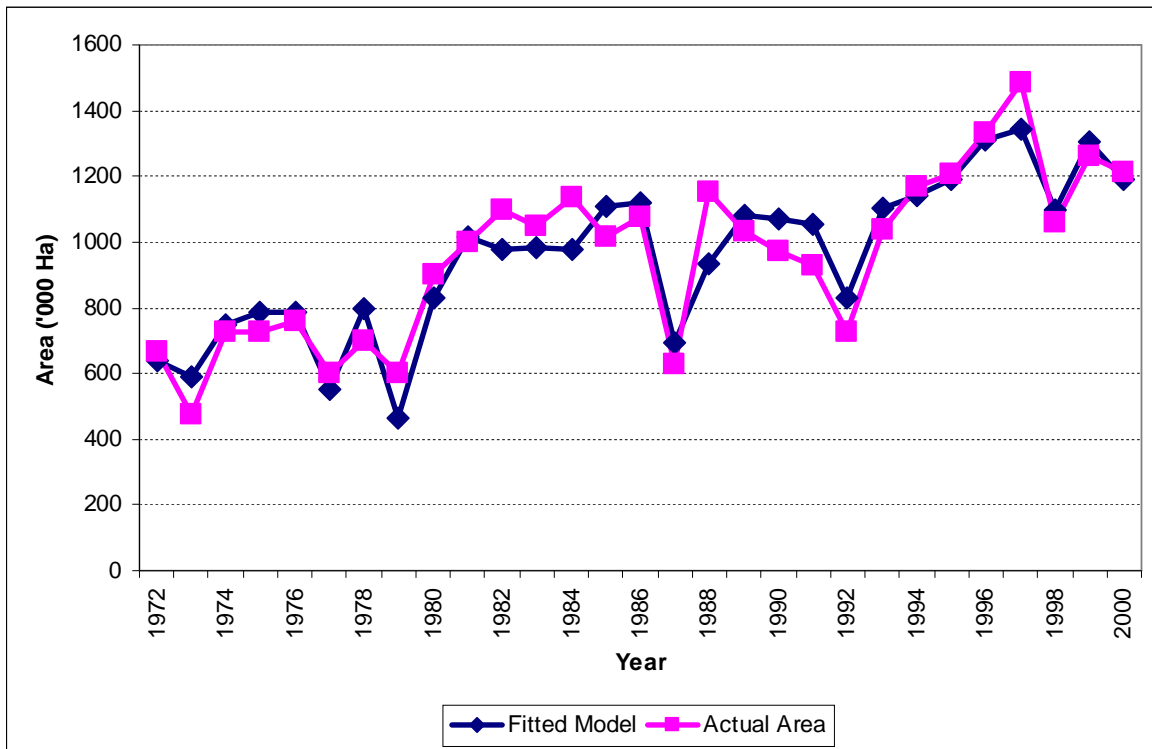
Figure 6.1: **Communal Sector Area Model**

With respect to maize yields, it was essential that the pre-2000 trend in yield be depicted in the model given that yields declined due to widespread input shortages in the post-2000 era, arguably as a consequence of the 'fast track' land reform policy. In this regard, a simple yield equation for the communal sector was used to estimate the outlook values for maize yields for the communal sector using an OLS technique. Because there was no trend in the yield over time, the yield equation was expressed as a function of rainfall and a dummy variable. The estimation results are presented below:

Table 6.2: **Communal Sector Yield Equation**

Dependant Variable: Communal Sector Yield

Variable	Coefficients	t Stat	P-value
Intercept	0.5018	4.250532	0.000279
Rainfall	0.00033	0.122286	0.90369
DUMMY89	0.5832	8.776785	5.89E-09

R Square: 0.859969   Adjusted R Square: 0.842466   F-Value: 4.83   DW: 1.94

The dummy variable in 1989 was in essence included to capture the unusual response behaviour of yield in that particular year. In 1989, national average communal yield increased to 1.54 tonnes/ha (from 1 tonne/ha in 1988) when rainfall had actually declined from 744mm/year to 605mm/year that season, a level that is below the normal average of 662mm/year. This unusual behaviour represented an outlier given the positive relationship

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between rainfall and yield, with both variables appearing to be moving together each season over time.

6.3.1.2 *Commercial Sector*

The second area equation was the large-scale commercial sector area harvested equation, which was typically modelled using the same variables as the communal sector model using a 2SLS technique. The equation contained the lagged large scale commercial area harvested, time trend, average annual rainfall, maize prices, soybean prices, fertiliser prices and a dummy variable to capture the sharp and unexplained area drop in 1977. The results of the model are shown below:

Table 6.3: Commercial Sector Equation

Dependant Variable: Large Scale Commercial Area

Variable	Coefficients	t Stat	Sig	Mean	Elasticities
Intercept	122.19	1.287	.212	-	-
Lag Area	.105*	1.697	.104	227.4	-
Trend	-8.301*	-3.57	.002	1	-
DUMMY77	-93.47*	-4.017	.001	0.32	-
Maize Prices	3.77**	2.032	.055	42.81	0.713
Average Rainfall	.058	1.947	.365	642.61	0.107
Fertiliser Prices	-.495	-0.571	.574	261.08	-
Soybean Prices	-.066	-0.080	.143	90.36	-

R Square: 0.673712   Adjusted R Square: 0.56495   F-Value: 6.194344
* indicates significance at the 1% level.
** indicates significance at the 5% level.

The model results show that the previous year's area harvested had a significant influence on the current area planted. Two variables in the model had very low t-values and these include soybean prices and fertiliser prices. It was however necessary to include them in the model because they gave the model the correct signs which conform to *a-priori* theory. Large scale commercial farmers also responded to current maize prices while negotiations with the GMB and the Agricultural Ministry for producer prices for the upcoming season were ongoing. The precipitous drop in area harvested in 1977 was statistically significant at 1% level. This abrupt drop in output may have been due to the liberation war which had intensified during this period and thereby possibly caused the disruption of commercial farm operation.

A 1% change in maize prices will induce a 0.7% change in commercial farm area. This means that, in general, commercial farmers are relatively unresponsive to price changes, although they are more responsive than the communal sector. Thus, one of the striking phenomena in the communal and commercial sector acreage functions has been the relative lack of, or more precisely, the small response to shifts in market policy. As a result, variables that captured shifts in government policy were not included due their lack of significance. It may be argued that much of government policy in the past and present has mainly targeted commodity pricing, within which the market policy shifts are implicitly captured. This is probably why the maize price variable was significant in both acreage functions. The predicted against the actual commercial area values were plotted against time and these are displayed below:
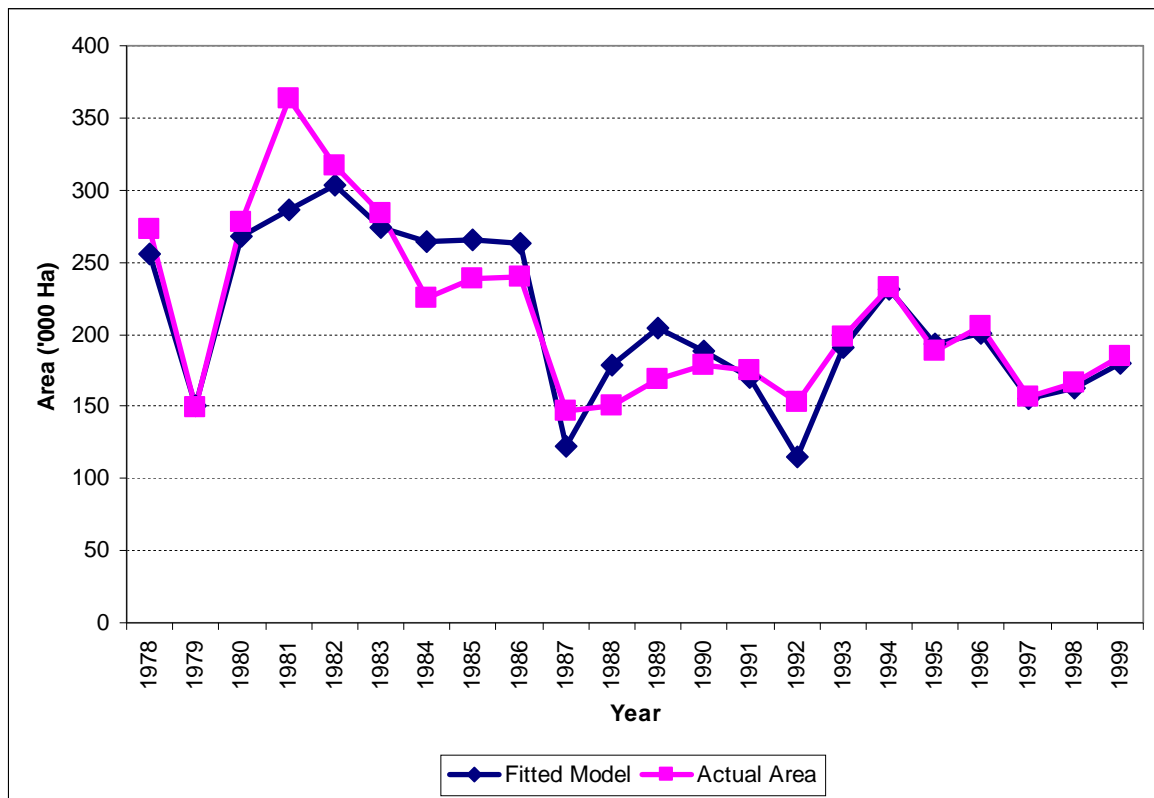

Figure 6.2:   **Commercial Sector Area Model**

For the commercial sector yields, a simple equation was estimated to obtain the outlook values for maize yield. Again, since there was no trend in the yield over time, the yield equation was simply expressed as a function of rainfall using OLS estimation. The estimation results are presented in Table 6.4 below.

Table 6.4: Commercial Sector Yield Equation

Dependant Variable: Large Scale Commercial Sector Yield

Variable	Coefficients	t Stat	P-value
Intercept	1.416807	3.329302	0.00261
Rainfall	0.003979	6.241868	1.32E-06

R Square: 0.599759   Adjusted R Square: 0.584365   F-Value: 5.87   DW: 1.86

The commercial yield equation with rainfall as an explanatory variable was significant and had a fairly high t-value.

6.3.1.3 *Food Aid*

It was necessary to measure food aid given its important contribution in times of drought shocks, particularly that of 1992. Moreover, food aid seems to have played an increasingly pivotal role in augmenting supply during the era of the 'fast track' land reform programme. In this study, food aid is a part of supply and was intuitively modelled as a function of production. The results of the food aid model are displayed in the table below:

Table 6.5: Food Aid Equation

Dependant variable: Food Aid

Variable	Coefficients	t Stat	P Value	Elasticities
Intercept	-3000.99	-0.07025	0.946281	-
Production	0.028*	-1.95584	0.009572	0.108

R-Square=0.9241   Adjusted R-Square=0.8735   Sig F=0.001649 F-value=18.26329
* indicates significance at the 1% level.

According to the results of the model, a negative relationship exists between production and food aid. The inclusion of production with a negative sign is logical given that food aid in the normative sense is meant to ease production shortfalls, and hence food aid is expected to increase in years of low production. Although simple, the food aid model seemed solid and followed actual data more closely (see Figure 6.3), expect in 1992. The decline in production that came as a result of the 1992 drought had a uniquely significant effect due to the fact that it was the worst in recorded history. One of the key issues of significant relevance is the elasticity of food aid to maize production. In this respect, this study found that, in the short-run, a 1% decline in production causes a 0.1% increase in food aid.

The food aid model was assessed by observing how well it traced actual data through a visual plot of predicted and actual food aid figures. These graphs are displayed below:
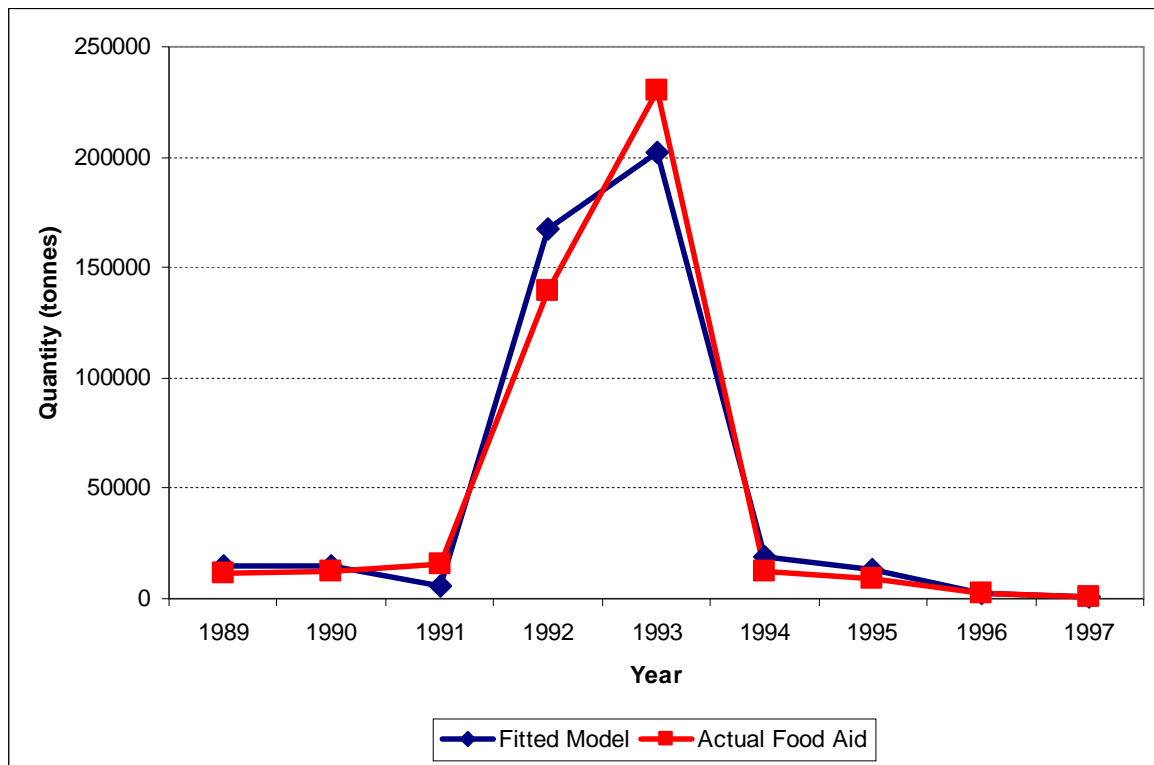
Figure 6.3: **The Food Aid Model**

The visual plots of the models in the supply block were deemed to trace actual data satisfactorily in most years.

6.3.2 The Demand Block

Domestic utilisation of maize consists of human consumption, ending stock, and an unexplained component that includes feed and seed use, as well as on-farm consumption that is normally not appropriately accounted for. In this study, a variable was created to capture the unexplained component, termed either "stock change", "residual stock" or "unexplained stock". This variable was strategically used to balance the supply and demand in the maize market as part of the excess stock that is unaccounted for in the balance sheet.

Literature on the maize utilisation stock points out that a major portion of consumption goes to human use; with a smaller portion of the maize stock also used for livestock feed.

Seed consumption on the other hand is relatively small, and reported market data on the seed and feed use is inaccurately estimated.

6.3.2.1   Per Capita Consumption

A domestic per capita consumption function was estimated using a 2SLS technique, with the explanatory variables being real maize prices, real sorghum prices and per capita income. The results of the model are reported in Table 6.6 below:

Table 6.6:   Per Capita Consumption Equation

Dependant Variable: Per Capita Consumption

Variable	Coefficients	t Stat	Sig	Elasticities
Intercept	105.66	6.46	.000	-
Real Maize Price	-.135***	-1.757	.084	-0.049
Real Sorghum Price	.0673	.687	.498	
Per Capita GDP	.0119	1.019	.324	0.130

R Square: 0.861221   Adjusted R Square: 0.832309   F-Value: 29.78747
* indicates significance at the 1% level.
** indicates significance at the 5% level.
*** indicates significance at the 10% level

As expected, real maize prices had a negative sign while sorghum and per capita income had positive signs. Sorghum is a justifiably used substitute crop because it is also an important staple crop particularly in rural Zimbabwe, and its consumption is also used in beer manufacture where it also competes with maize. Sorghum, despite its weak t-value, also allowed the per capita consumption equation to yield signs that conform to *a-priori* theory, which was an elusive feature for a range of trial equations that were attempted. Due to a lack of availability of retail data, the producer prices for maize and sorghum were however used as a proxy for the per capita consumption equation. Real Per capita GDP in the model was used to represent income.

The model results revealed that real maize prices are statistically significantly in determining per capita consumption. The own price elasticity of demand for maize was found to be -0.04902, reflecting that maize consumption is basically price inelastic by virtue of the crop being a basic staple. The Zimbabwean population does not switch easily from maize to sorghum, this being reflected by the cross price elasticity of 0.022406. In addition, the importance of maize is validated by the crop's income inelasticity, which the study found to be 0.130128, and this reflects that a 1% income increases maize

consumption by only 0.13%. A visual plot of the predicted and actual per capita consumption model is shown in the figure below.
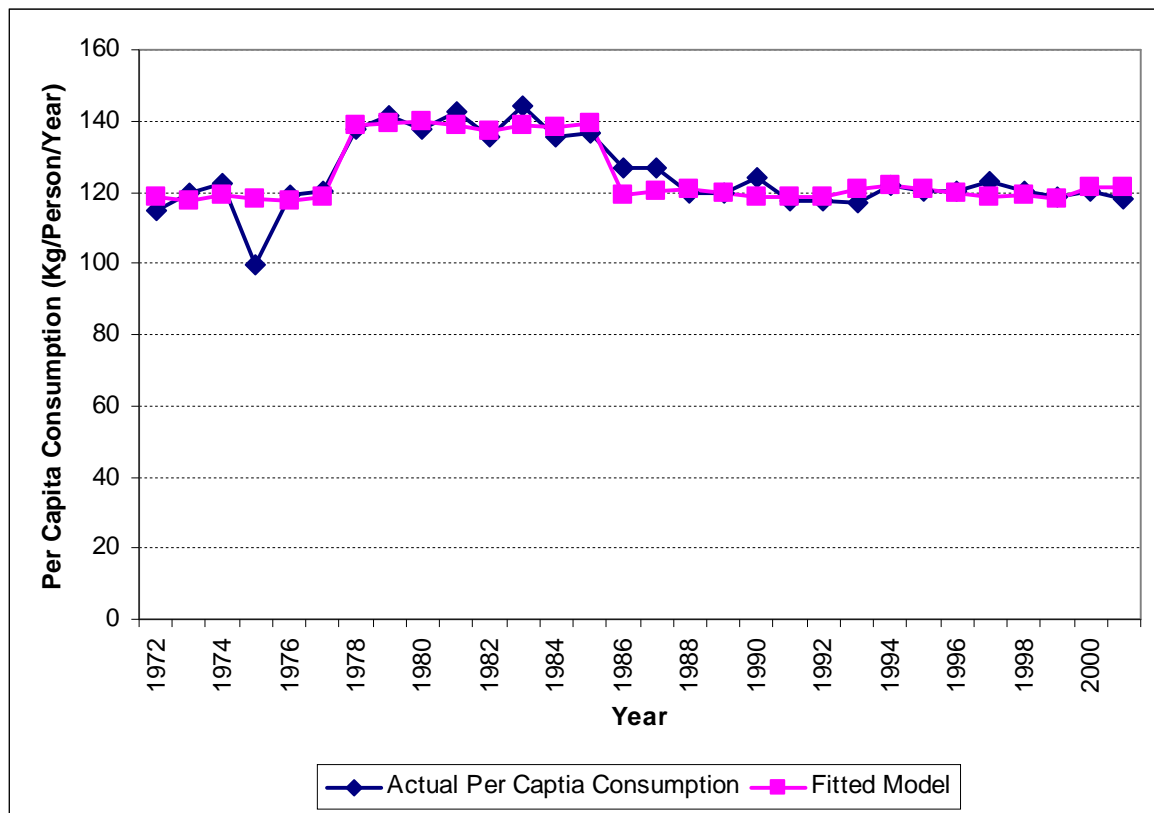
Figure 6.4:   The Per Capita Consumption Model

6.3.2.2   Ending Stock

Having articulated the estimated per capita consumption equation, this left only maize ending stocks as one other component of demand that had to be modelled. Data on ending stocks was however scarce and parsimonious, particularly during the Strategic Grain Reserve (SRG) policy era of 1993 to 1998. Ending stock values for this period had to be extrapolated using the available historical data, except for 1997 for which the value for ending stock was available. Important to note is the fact that ending stock values from the 1990s were also inaccurate, and the data had to be rationally adjusted to balance off stocks between supply and demand. After appropriate adjustments had been made, the data showed that the SRG policy was not strictly followed, as 'actual' stocks fell below the prescribed 500 000 tonnes of physical stock. This important trend implied the need to justifiably exclude the SRG policy in the model since it was not reflected in the data.

In light of this reality, the ending stock equation was modelled as a function of the beginning stocks (lagged ending stocks), current total production and lagged real maize prices. The OLS equation results were as follows:

Table 6.7:   Ending Stock Equation

Dependant variable: Ending Stocks

Variable	Coefficients	t Stat	P Value	Elasticities
Intercept	278.053	-0.17927	0.859	-
Lag Ending Stocks	.184***	1.7535	0.094	0.6412
Total Production	.087	1.1289	0.275	-0.0431
Lag Real Maize Price	-.320	-1.3418	0.1922	0.0195

R Square: 0.848413   Adjusted R Square: 0.812321   F-value= 14.025   Sig F= 0.07824

* indicates significance at the 1% level.
** indicates significance at the 5% level.
*** indicates significance at the 10% level

The ending stocks were found to be positively related to the levels of production in the current period. This implies that an increase in the levels of current production positively influence the quantity of ending stocks. This may be true in the sense that large amounts of output increase the amount of reserve stocks.

The equation showed that ending stocks have a negative relationship with lagged real maize prices, a reflection that government released stocks (and therefore decreased precautionary stocks held in its reserves) into the market to stabilise prices. Whilst storage models in past, such as those designed by Buccola & Sukume (1988) reflected a highly risk averse GMB approach to stocks, it is a particular matter of interest in this study to reflect on the degree to which government responded to price shocks on the market.

The study showed that price elasticity of ending stock demand was -0.01951, reflecting that a 1% increase in prices on average, was only met with a 0.02% decline in stocks. Although the small elasticity value appears trivial, it should however be kept in mind that ending stocks were rather high in the past, which at times ran into over a million tonnes. Therefore, one should be careful in interpreting this value, as it itself represents a significant amount of stocks. Thus, the small elasticity value not only shows that government kept high stock levels, but also validates claims by Buccola and Sukume (1988) that the GMB was risk averse to price shocks.

A visual plot of the performance of the model's predicted values against actual values is shown in Figure 6.5 below. The plot shows that the model tracks actual ending stock fairly well, particularly in the last 5 years of the simulation period in which the market was 'qausi-free'.
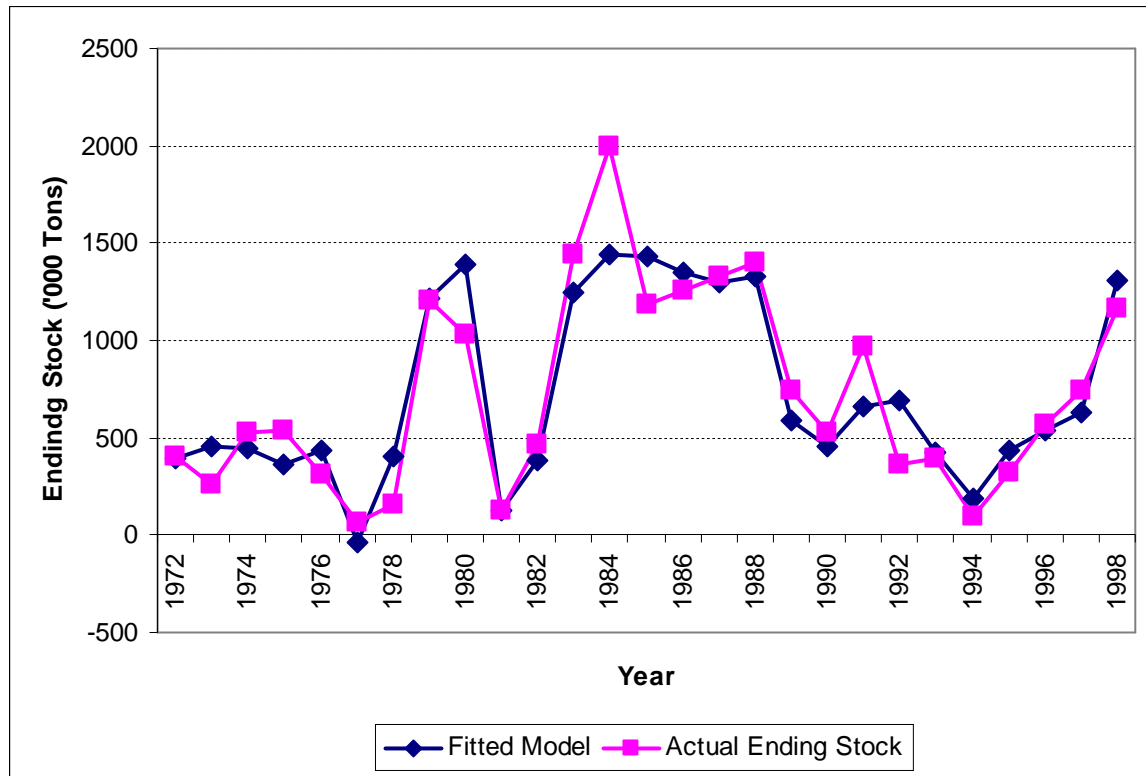
Figure 6.5:   **Ending Stock Model**

Apart from human consumption and ending stock, there is the residual demand estimate, an aggregate component of feed, seed and on-farm consumption. Modelling residual stock was particularly difficult due to the random and unexplained variation of the variable. Observations of the data show that in some years, the residual apparently assumed negative values implying that the data was not sound, and this brought a difficult dilemma to the analysis and the explanation of the behaviour of this variable. Clearly, the residual not only demanded a careful analysis, but also a pragmatic one. Thus, the residual was intuitively derived, and it was postulated that this part of the demand block would be affected by production and prices. The results of the residual model are displayed below:

Table 6.8:   Residual Stock Equation

Dependant variable: Residual Stocks

Variable	Coefficients	t Stat	P value	Elasticities
Intercept	405.00	1.12	0.310745	-
Production	.0924**	1.17	0.001892	0.0345
Real Maize Price	2.5038	2.76	0.328047	0.1213
DUMMYLENDS	.0001*	5.32	0.095123	0.6046

R Square: 0.848413   Adjusted R Square: 0.812321   F-value= 9.1208 Sig F= 0.00436

* indicates significance at the 1% level.
** indicates significance at the 5% level.

A dummy variable was assigned for the period in which the residual assumed negative values. The model results revealed that production had a significant positive effect on the amount of maize used for seed, feed and other discretionary and unexplained uses.

6.3.3   Exports

Net exports were an important consideration of the government in setting prices. Zimbabwe's maize market was traditionally a net exporting market prior to 1998, the year that a ban on maize exports was instituted. The model estimated exports using data from 1970 to 1998 and forecast them beyond 1998. The question here is what the amount of net exports would be if Zimbabwe had maintained its net export position. The results for the export function are displayed below.

Table 6.9:   The Export Equation

Dependant variable: Maize Exports

Variable	Coefficients	t Stat	P Value	Elasticities
Intercept	-507.0388	-1.170885604	0.261189	-
Parity Price Ratio	414.3097*	1.835414474	0.087774	2.7791
Lag (SSR)[20]	38.6579	1.120043039	0.281541	0.11341
DUMMYLEX	-262.4574***	-4.554912922	0.000449	-0.7700

 R Square= 0.74113   Adjusted R Square= 0.66717   F-value= 10.0205   Sig F= 0.000482

* indicates significance at the 1% level.
*** indicates significance at the 10% level

In the export equation, exports were expressed as a function of the export parity/import parity price ratio, the lagged self-sufficiency ratio (defined as production/consumption),

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[20] Self Sufficiency Ratio = Production/Consumption

and a dummy variable for the years that exports were zero. The price ratio was significant at 10%, indicating that border prices had a positive influence on exports.

Below is the goodness of fit plot of the export model. The model's predictions tracked actual data fairly well as it captured the turning points.
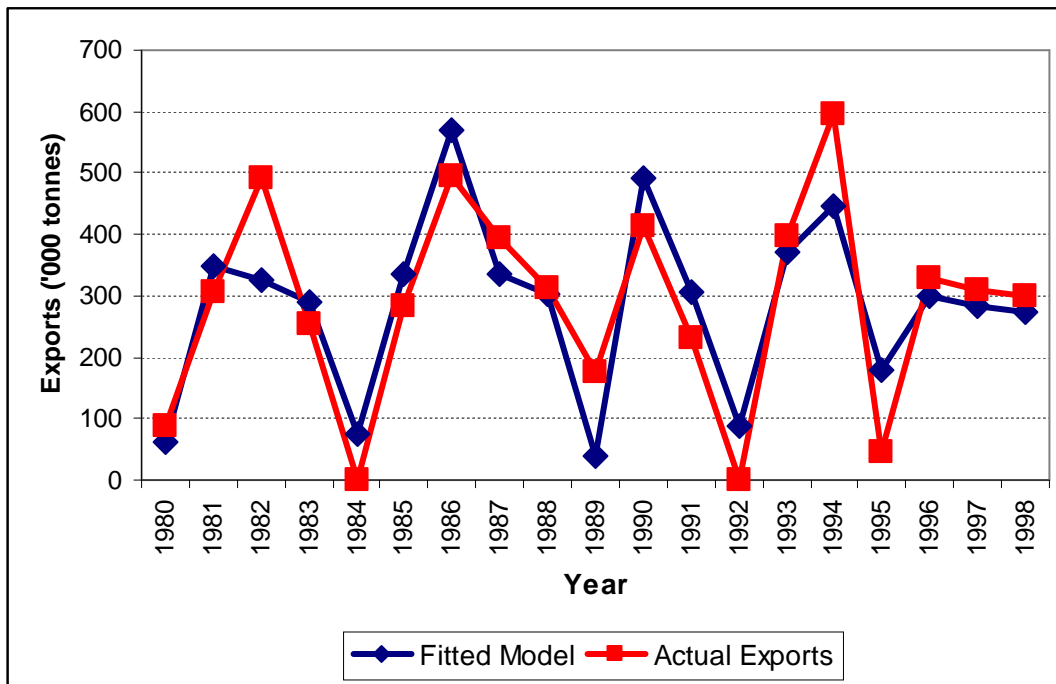
Figure 6.6:   The Export Model

6.3.4   The Maize Price Linkage Equation

The formulation of the maize price equation was a critical part of the model design. The rationale behind the price linkage was informed by the argument by Takavarasha (1991), and Takavarasha (in Rukuni & Wycoff, 1992) discussed in Chapter Two. Since prices under the GMB price stabilisation policy were informed by parity price trends in the regional markets, with price floors and price ceilings quoted from export parity prices and import parity prices respectively, border price trends were thus included in the price equation.

To test the congruency of price movements between local and parity prices, the assumed underlying relationship had to be validated through a correlation test. The results of the correlation test, as shown in Table 6.13 below, revealed that the parity prices were

positively correlated with the domestic price at 1% level of significance. This means that parity prices and domestic maize prices move together in the long run.

Table 6.10:   Maize Price Correlations

		Export Parity	Import Parity	Domestic Price
Export Parity	Pearson Correlation	1	0.874[**]	0.549[**]
	Sig. (2-tailed)		0.000	0.010
Import Parity	Pearson Correlation	0.874[**]	1	0.703[**]
	Sig. (2-tailed)	0.000		0.000
Domestic Price	Pearson Correlation	0.549[**]	0.703[**]	1
	Sig. (2-tailed)	0.010	0.000	

** Correlation is significant at the 0.01 level (2-tailed).

Given this relationship, it would therefore be plausible to link the regional prices (SAFEX quoted prices) to the domestic price such that the domestic price is some portion of the parity price. A linear estimation of the real domestic maize prices against landed import parity prices ex-Harare (quoted from SAFEX Randfontein prices) was therefore carried out and yielded the following results:

Table 6.11:   Maize Price Linkage

Dependant Variable: Real Maize Prices

Variable	Coefficients	t Stat	P Value	Elasticities
Intercept	31.212	10.38	.000	-
Import Parity Prices[21]	.0725**	2.41	.028	.1758
Trend	.6134*	4.60	.0003	3.458

R Square: 0.900839   Adjusted R Square: 0.876049   F-Values: 36.33861

* indicates significance at the 1% level.
** indicates significance at the 5% level.
*** indicates significance at the 10% level

The price model revealed, as expected, that the import parity price was significant at the 5% level of significance. Of particular note was the need to ascertain the extent to which the local market responded to SAFEX derived world prices. In this regard, the elasticity of local prices with respect to parity prices was calculated and found to be 0.1758. This means that a 1% increase in SAFEX-derived world prices would only induce a 0.18% increase in local maize prices. This meant that despite the high correlation between the

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[21] The equation used SAFEX Randfontein prices plus a transport differential from Randfontein to Harare.

domestic prices and the regional prices, the transmission, or responsiveness of domestic prices was very low. This meant that although local and regional prices moved closely together, the change in domestic prices was however relatively marginal due to the influence of government intervention in the maize market strategically meant to shield the local market from world price shocks. This government intervention included the purchase and sale operations under supply and price stabilisation measures. Therefore, it is important to note that the price model, although linked to the regional prices as reflected by the correlations, also reflected the protection from government interventions in the form of a 'price stabilisation policy' that was discussed in Chapter Two.

In the real maize price model displayed below, the predicted price outcomes are plotted against actual prices (constant at 2000 price levels).
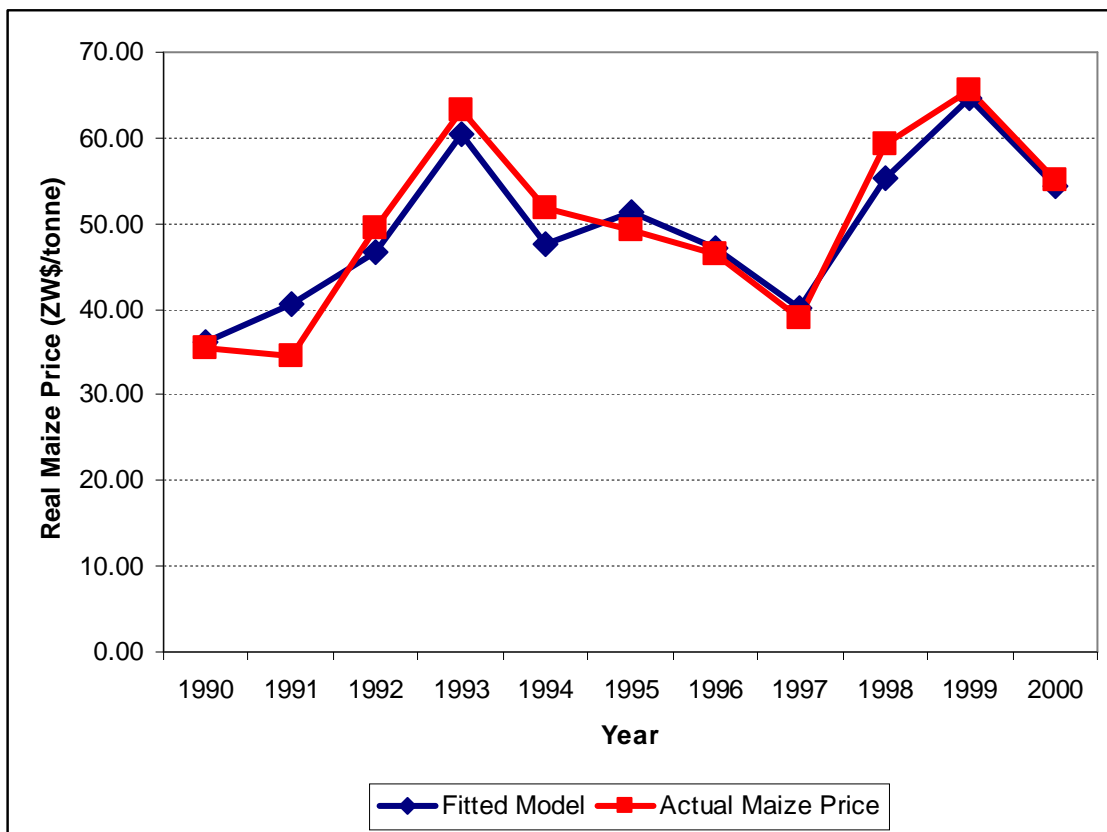
Figure 6.7: **The Maize Price Model**

The visual plots reveal that the price model tracked actual real prices fairly well, particularly after 1991 when the structural market adjustments were initiated.

6.4 SUMMARY

The purpose of this chapter was to present the results of the maize model. The first section outlined the time series variables and the data sources. This was followed by a display of the results of the maize model. The outlined results were discussed, linking this to the market conditions that were discussed in Chapter Two. The model development exercise is completed through a process of validating the model equations, and this study validated the equations through an *ex post* visual inspection of the fitted models. Though very basic, a visual inspection of the model is a powerful way of determining the simulation performance of a model. In this exercise, the simulated plots of the model were compared with the actual data and the way the model mimics the turning points of the data reflect how well the model performs. At the researcher's discretion, the graphical results show that the prognostic ability of the model was fairly accurate. Based on this validation criterion, the model can thus be used for conducting policy analysis. Therefore, the estimated single equations outlined in this chapter were collapsed into a system of simultaneous equations in Excel to produce baseline projections that would allow for the analysis of the effects of the 'fast track' land reform policy on the performance of the maize sector during the period of the expropriation of commercial farms. The policy analysis will be done in Chapter Seven.

CHAPTER 7

BASELINE AND POLICY ANALYSIS

7.1   INTRODUCTION

Each of the preceding chapters has systematically been building an econometric model for the Zimbabwean maize market. Having developed the partial equilibrium maize model in Chapter Six, this chapter aims to extend the argument further by estimating the baseline projections for the maize market during the 'fast track' land reform period. In what forms the crux of the entire thesis, the baseline projections are set to provide the proximate effects of the 'fast track' land reform impacts on specific market variables in Zimbabwe's maize sector.

In order to produce a best estimate of the likely market outcome during the period of the 'fast track' land reform period, the model's projections are based as much as possible on official forecasts from Global Insight (1999) for the exogenous variables for the simulations during the period from 2001 up to 2010. Exogenous variables for which official forecasts were unavailable, a trend was extrapolated from given official projections. The model put in place specific assumptions that would allow for the generation of the likely outcomes given the market trends and trends in macro-economic conditions in the last five years before the implementation of the 'fast track' land reform. These are discussed in the next chapter.

The chapter is therefore partitioned into two sections. The first section will present the assumptions of the baseline, from which the projections of Zimbabwe's maize sector are drawn. The foremost of these assumptions is that no further policy shifts occurred after 2001, implying that the projections are based on what could have happened if the 2000 macro-economic and institutional conditions had prevailed into the 'fast track' land reform period. Accompanying this key supposition is a specific set of assumptions on the production environment which will allow for the simulation of the baseline, and these will be specified and the baseline will thus be presented.

The second section will build on the presented set of assumptions and go on to explore the proximate impacts of the 'fast track' land reform policy shift on Zimbabwe's maize sector. In what forms the first scenario, the 'with' or 'without' 'fast track' land reform scenarios are analysed and these are compared to determine the impact of the 'fast track' land reform policy on the maize sector. Given the unprecedented fall of the Zimbabwean dollar over the 'fast track' land reform period, the study explores a second possible scenario where the model attempts to mimic a similar depreciation during the same period albeit under stable conditions subsumed in the model's assumptions.

7.2   THE BASELINE ASSUMPTIONS

When the impact multipliers generated in Chapter Six, the model needed to be solved in Excel for a period during which the 'fast track' land reform was implemented. To generate a re-simulated baseline, various assumptions were made regarding the values of exogenous variables. The first assumption was that no changes in the institutional (including land reform and therefore private property rights) and macro-economic conditions took place beyond the year 2000. Because the study assumed that the agricultural policy and the macro-economic environment that existed in 1999 continued into the future period, the baseline projections should therefore be considered as a market outlook rather than a forecast.

Projections for the GDP and the exchange rate were obtained from Global Insight (1999) and the World Bank provided population estimates. According to Global Insight (1999), the GDP was projected to increase to ZW\$28.21 billion in 2005. The exchange rate was projected to depreciate consistently to ZW\$102.5/ US\$ in 2005. The World Bank estimated that population increased to 12.46 million in 2008. Table 7.1 below displays the projections of the exogenous variables used in the model.

Table 7.1:   Projections of Exogenous Variables

Variable	2001	2002	2003	2004	2005	2006	2007	2008
GDP (ZW$ billions)[a]	25.64	26.17	26.61	27.36	28.21	28.83*	29.46*	29.46*
Exch. rate (ZW$/US$)[a]	82.50	87.50	92.50	97.50	102.50	108.06*	113.92*	120.09*
Rainfall (mm)[b]	728.6	465.7	602.0	712.3	529.0	821.9*	884.2*	662.0*
Population (millions)[c]	12.50	12.52	12.51	12.50	12.48	12.46	12.45	12.46

Sources: [a]Global Insight (1999), [b]AIAS (Various Issues), [c]World Bank (2010)
          *Estimates based on the Global Insight (1999) outlook

NB: GDP and Exchange Rate are given at 2000 prices

Projections from Global Insight (1999) were made at a time when the 'fast track' land reform was not anticipated. As such, the assumption here is that no 'fast track' land reform took place. However, Global Insight (1999) only provided projections up to 2005. Projections after 2005 were extrapolated from those given by Global Insight (1999).

An important assumption made in this study was that Zimbabwe remained a net-exporter of maize as has been traditionally the case in its domestic market. This meant that the model assumed that there was no instituted export ban on the maize sector. As such, exports were forecasted through an export equation that captured the historic behaviour of exports. The export model was then shocked for the forecast to capture the influence of the 2002 and 2005 droughts.

To get more robust and credible results, the baseline projections incorporated 'actual' rainfall values for which rainfall data for the period of the 'fast track' land reform was available. This allowed for the determination of droughts that occurred in the projection period, which also improved the performance of the model. To further strengthen the argument, actual population figures obtained from the World Bank (2009) were used for the period during the 'fast track' land reform era in which data was available. Having put the model assumptions together, the performance of the maize sector without the 'fast track' land reform policy was thus ascertained. The results of the re-simulated baseline are outlined in the next section.

7.3   THE RE-SIMULATED BASELINE VS. ACTUAL OUTCOMES

Based on the assumptions discussed in the preceding section, the model generated an artificial dataset of 'would be' outcomes without the 'fast track' land reform. This market outlook of the Zimbabwean maize sector is technically referred to in this study as a re-simulated baseline (this term shall be further defined in the first sub-theme under this section). The re-simulated baseline, otherwise referred to as a market outlook, reflects the general picture of the Zimbabwean maize sector if no 'fast track' land reform occurred. This implies that the performance of the market in the re-simulated baseline is founded on the assumption that no 'fast track' land reform took place in 2000 and stable political and macro-economic conditions prevailed. The 'fast track' land reform policy decision can thus be assessed by looking at the differences between the baseline and the actual market values of what occurred during the land reform era.

The maize sector was affected to various extents by the dynamic interplay of four variables which shall be unpacked under this section. These include GDP, exchange rate, rainfall and land transfers between the communal and commercial sectors. Theoretically, the consistent fall in actual GDP translates to a fall in per capita income and therefore a collapse in demand. The consistent depreciation in the exchange rate caused by a dwindling export base had an effect on the price incentives which influenced farmer responses, and therefore area planted, which in turn affected production. There is also the influence of rainfall on production which has been widely debated in the literature. Then, during the same period, there were on-going land transfers between the communal and commercial sectors, whose composition affects yield and output. Important to note is that land transfers between the communal and commercial sectors were still going to occur even if the 'fast track' land reform policy was not implemented because there still existed a framework for land acquisition before 2000. The model therefore attempted to unpack each of these aspects under two scenarios. The first scenario, called the 'fast track' land reform scenario, shall compare the re-simulated baseline against actual outcomes to show the impact of the policy on the maize sector taking into account the effects of rainfall, exchange rate and per capita income. In the second scenario, a 'trial run' of the depreciation in exchange rate is simulated to assess the impact of the devaluation of the dollar on the sector.

7.3.1 Scenario One: The 'Fast Track' Land Reform Policy

A comparison of the 'actual' outcomes versus the re-simulated baseline is displayed in Table 7.2 below. In the table, the re-simulated baseline is stated as 'baseline', and these two terms are used interchangeably because they technically hold the same meaning. A baseline is a market benchmark against which various policies are analysed, and in this study, the term 're-simulated baseline' implies that the benchmark is re-set against a retroactive market scenario *ex-post facto*. The percentage change displayed in the table represents the difference between the re-simulated baseline and what actually occurred in the maize market. This difference represents the 'fast track' land reform policy's impact on the maize sector. Important to note is that the 'baseline' outlined in Table 7.2 for each endogenous variable reflects the benchmark of Zimbabwe's maize market and the model's full response to rainfall, but not any other policy shock. This sets the study's argument into perspective, as the model's simulated output gives a logical and empirical basis upon which to respond to unsubstantiated claims of the 'fast track' land reform policy's influence on maize production taking into account the effects of rainfall.

One important point the model captures is the influence of rainfall on the maize market. While previous arguments in support of the 'fast track' land reform policy have stressed that droughts have been the main cause of Zimbabwe's food crisis, the model shows that the effects of droughts would have been far less severe if the pre-2001 maize market conditions had persisted into the 'fast track' land reform period. As shown in Table 7.2 below, maize production in 2002 would have been 1.42 million tonnes, which is above the 604 000 tonnes actually produced under the 'fast track' land reform policy. In the 2005 drought season, 1.574 million tonnes of maize output could have been produced against the actual 916 000 tonnes. The maize market therefore produced 57.44% and 41.8% less output than what could have been produced in the 2002 and 2005 droughts had the government not implemented land reform. Moreover, maize produced in 2006 and 2007 would have surpassed 2 million tonnes under the pre-2001 pseudo-free market system and agricultural policies. Thus, in 2007, maize production was 48% less what the market could have produced without the land reform policy.

Table 7.2:   Impact of the 'Fast Track' Land Reform Policy

	2001	2002	2003	2004	2005	2006	2007	2008
Commercial Area '000 Hectares								
Baseline	145.63	122.66	124.85	131.38	118.40	138.83	147.28	150.25
Actual	155.89	128.83	126.58	93.01	70.44	62.84	55.68	n/a
% Change	7.04	5.04	1.39	-29.21	-40.50	-54.73	-62.19	-
Communal Area '000 Hectares								
Baseline	1350.42	1319.26	1382.96	1474.91	1463.72	1606.94	1713.14	1793.43
Actual	1084.10	1199.02	1225.79	1400.80	1659.42	1650.16	1390.13	n/a
% Change	-19.72	-9.11	-11.36	-5.02	13.37	2.69	-18.85	-
Total Area Harvested '000 Hectares								
Baseline	1496.05	1441.92	1507.81	1606.29	1582.12	1745.76	1860.42	1943.68
Actual	1239.99	1327.85	1352.37	1493.81	1729.87	1713.00	1445.82	1445.82
% Change	-17.12	-7.91	-10.31	-7.00	9.34	-1.88	-22.29	-25.61
Commercial Yield tonnes/ha								
Baseline	4.20	3.15	3.69	4.13	3.40	4.57	4.82	5.00
Actual	3.42	2.28	1.91	1.94	1.11	1.57	1.45	n/a
% Change	-18.63	-27.55	-48.37	-53.12	-67.45	-65.55	-69.81	-
Communal Yield tonnes/ha								
Baseline	0.85	0.78	0.82	0.85	0.80	0.87	0.89	0.81
Actual	0.92	0.26	0.67	1.08	0.51	0.84	0.78	n/a
% Change	7.80	-66.96	-18.51	26.99	-36.88	-3.93	-12.71	-
Total Production '000 tonnes								
Baseline	1759.97	1420.65	1593.07	1791.45	1574.08	2039.26	2234.16	2198.10
Actual	1526.48	604.67	1058.98	1686.02	916.06	1485.04	1161.10	471.00
% Change	-13.27	-57.44	-33.53	-5.89	-41.80	-27.18	-48.03	-366.69
Maize Prices ZW$/tonne								
Baseline	53.07	53.84	55.32	57.66	59.25	62.88	65.97	68.27
Actual	87.25	69.28	152.61	81.26	79.32	84.45	100.86	101.86
% Change	64.41	28.68	175.85	40.92	33.87	34.30	52.89	49.20
Net Trade '000 tonnes								
Baseline	405.26	-436.01	355.71	627.39	-8.09	830.56	850.53	563.71
Actual	-88.66	-763.59	-340.17	-184.90	-685.98	-250.66	-385.65	n/a
% Change	-121.88	75.13	-195.63	-129.47	8383.33	-130.18	-145.34	-
Total Domestic Use '000 tonnes								
Baseline	2923.07	2049.00	2093.93	2283.65	2081.54	2529.79	2761.70	2730.78
Actual	2689.57	684.67	1178.98	1756.02	1036.06	1605.04	1281.10	n/a
% Change	-7.99	-66.59	-43.70	-23.10	-50.23	-36.55	-53.61	-

Source: Model Results
NB: n/a in 2008 means actual data was unavailable
From 2008, no data that distinguishes communal and commercial area and yield was found

7.4.1.1   *Maize Area Harvested*

The impact of the 'fast track' land reform on total sectoral maize area harvested is difficult
to gauge due to the restructuring and shifts of land between and across the communal and
commercial sectors. However, from an abstract point of view, we may take the area
harvested between the respective sectors as per definition of commercial and communal
sectors outlined in Chapter Two.

The results of the re-simulated baseline shown in Table 7.2 above indicate that the actual total area harvested was consistently below the re-simulated baseline in all of the first seven seasons except in the year 2005 in which actual area harvested was 9.34% above potential (see also Figure 7.1). This implies that overall; the 'fast track' land reform programme negatively affected total maize area harvested. In particular, the negative effect was especially severe on the commercial sector maize area harvested between 2004 and 2007, where the expropriation of commercial farms led to an impact of a commercial maize area decrease of 29.01% in 2004. The impact became more severe each year with the commercial maize area declining consistently to 62.19% below potential in 2007 (see Table 7.2). It is the considered view of the author that this precipitous decline in commercial maize area harvested by way of the 'fast track' land reform policy shift could be explained by two underlying reasons. Firstly, land transfers from the commercial to the communal sector perhaps led to much of the loss in area planted being attributed to the stalling of farming operations as a result of the unrest and uncertainty experienced during the reform period. Secondly, the decline in commercial maize area, which produced the sector's maize seed input, led to seed shortages that were then experienced during the reform period and this led to the overall decline in yields. This vicious cycle is therefore argued on the logical grounds that the expropriation of commercial farms severely reduced the total maize area planted.

The re-simulated baseline predicts an upward trend in total maize area harvested that was going to fluctuate between 1.441 million hectares and 1.860 million hectares between 2001 and 2007. Higher levels of overall total area harvested would have presumably been driven by the steady commercial maize area harvested levels of plus 118 000 hectares that would be underlined by the increase in the importance of the seed and feed markets. Presumably, feed use was set to increase following the increase in stock feed prices that necessitated the need for farm-based feed production. Additionally, the growing significance of the beef and livestock exports within the region and to the European Union market was expected to play a greater role in driving the increase in commercial land area under maize which would in turn, indirectly contribute to higher total maize area harvested.
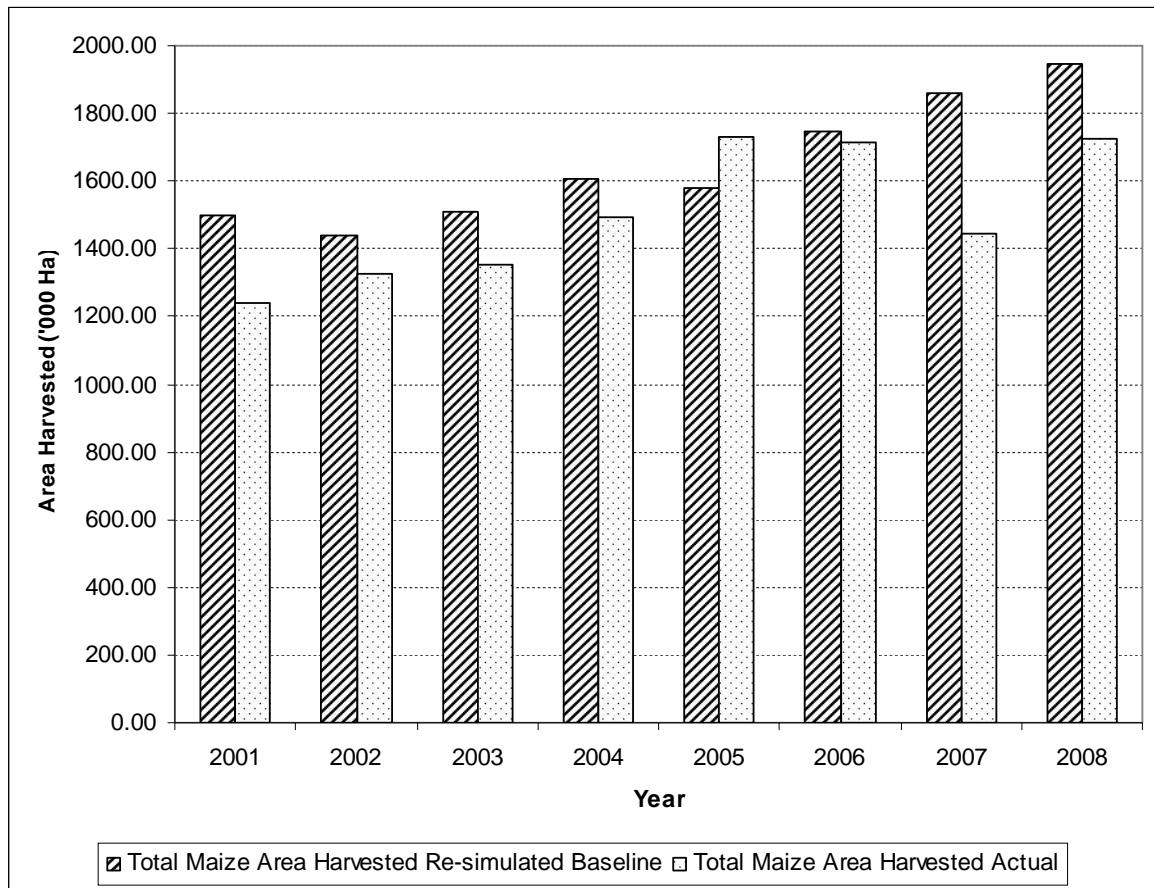
Figure 7.1:   **Total Maize Area Harvested: Re-simulated Baseline vs Actual**

Figure 7.1 above illustrates graphically, from an aggregate national perspective, the year-on-year total maize area harvested of the re-simulated baseline versus the actual 'fast track' land reform scenario. The lower levels of total maize area harvested actually realised under the 'fast track' land reform policy may suggest that the pre-2000 on-going land transfers under the then land acquisition framework would have achieved greater levels of aggregate maize area harvested than the 'fast track' land reform policy. This is argued because the projections from 2001 to 2007 of area harvested are based on trends that the model captures in area harvested between the communal and commercial sectors of the pre-2000 dual system.

7.4.1.2   Total Maize Production

The baseline model showed that actual total production was much less than potential during the 'fast track' land reform period. A graphical illustration of the baseline against actual values shows that the baseline is in essence an upward shift of the actual output

trajectory in the years of the land reform period (see Figure 7.5 below). Thus, a visual inspection of the re-simulated baseline on total maize output thus shows that the baseline model almost mimics the trajectory pattern of actual output, with the expected drops in output in the 2002/03 and 2004/05 drought seasons being observed. This means that Zimbabwe's maize market performed below potential in the period of the 'fast track' land reform period.
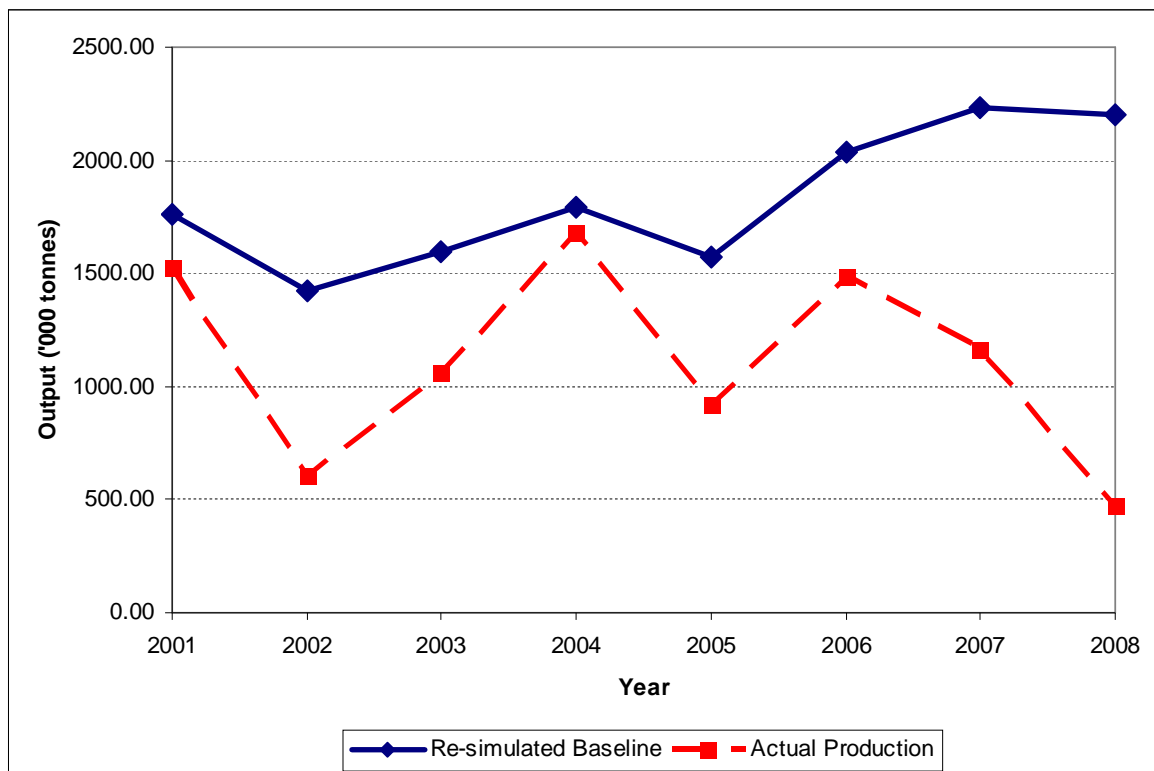
Figure 7.2: Total Maize Production

Total production was 13.27% less than what could have been produced in 2001, the year that the 'fast track' land reform policy was formally implemented (see Table 7.2). A cautionary note is however placed on misreading this percentage difference in this particular year, as there is a risk of misplacing the production impact on the 'fast track' land reform policy. The 'fast track' land reform policy, due to lagged effects of agricultural production, would appropriately have taken at least a season after implementation for its effects to be clearly visible. Therefore, in 2001, it is difficult to ascertain the impact of the 'fast track' land reform policy. However, the 2002 policy impact of the 'fast track' land reform may have been an empirically better and stronger starting point to observe the

marked effects of the 'fast track' land reform policy. In 2002, output was 57.44% less than what could have actually been produced. Although other scholars argue that a drought had more to do with the decline in output in 2002, the rainfall variable in the model allowed for the delineation of the 'fast track' land reform policy impact, which was a negative 57.44%. In the 2005 drought season, total maize production was 41.8% less than what could have been produced without the 'fast track' land reform. In 2007, the baseline showed that the maize sector could have produced almost 48.03% more than what was actually produced.

From the 2005 drought, maize output was expected to recover more strongly in 2006 to reach output levels above 2 million tonnes, this against a drop in 'actual' output of the 'fast track' land reform policy scenario. The drop in actual output to 471 000 tonnes in 2008 (which was 367% below potential output that could have been produced) was arguably attributed to widespread input shortages caused by the weakening of the previous commercial sector-communal sector structural link that strengthened the seed and input supply base for the entire maize sector. The drop in production, apart from being affected by marginally less rainfall, may also have been exacerbated by the deepening political and economic crises that were arguably triggered by the 'fast track' land reforms.

7.4.1.3   *Net Maize Trade*

The market's net maize trade is defined as the volume of exports minus imports. Prior to 1999, Zimbabwe's net trading position was positive, implying that it exported more maize than what it actually imported. However, the 'actual' net trade position has been negative since 1999 and this trend persisted after the expropriation of the commercial farms as shown in Figure 7.6 below. The persistent negative maize trade has been attributed to an increasing reliance of the domestic market on commercial imports and food aid due to insufficient local production, and to a fair extent, the discretionary ban of exports after the collapse of the strategic grain reserve (SGR) policy.

The assumption made in the re-simulated baseline was that there was no export ban in 1998 and exports of maize continued. Assuming that Zimbabwe had not banned its exports, the baseline revealed that the market could have remained a net exporter throughout the 'fast track' land reform period, except in 2002 where a deficit of 436 010

tonnes would have occurred due to a drought that would have prompted the use of discretionary stocks to augment market supply. The re-simulated baseline depicts that the highest net maize trade would have been achieved in 2006 and 2007, reaching above 830 560 tonnes and 850 530 tonnes, respectively. The 2005 drought was again expected to reduce the net trade position to below 8 090 tonnes, following which it was expected to recover with maize a fairly strong import demand being offset by high levels of production.

Yet, throughout the 'fast track' land policy reform era, Zimbabwe has had to import substantial amounts of maize in addition to the food aid that it has received owing to insufficient production.
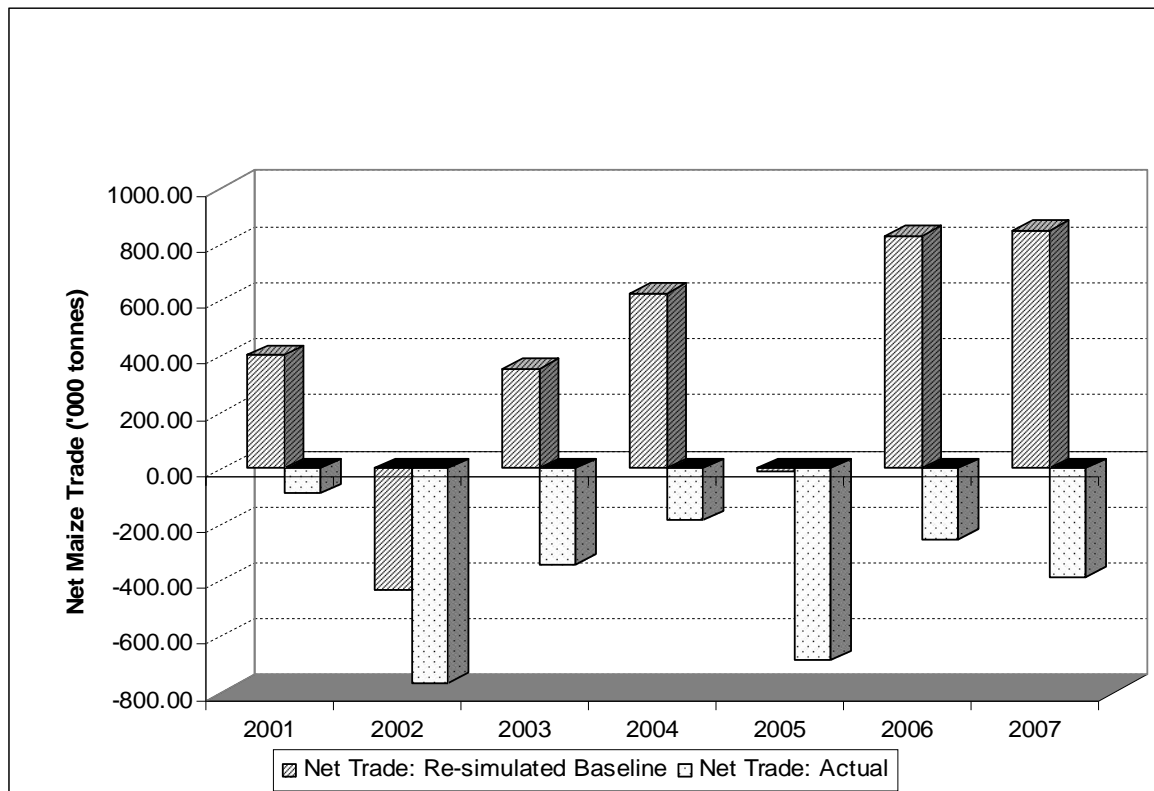

Figure 7.3: **Maize Net Trade**

Actual net maize trade under 'fast track' land reform remained negative, peaking in the 2002 and 2005 droughts to 763 590 tonnes and 685 980 tonnes, respectively (see Figure 7.3).

Positive net trade conditions predicted in the re-simulated baseline were expected to stabilise maize prices, with the market operating expectedly at a unique equilibrium that is distinct from the SAFEX market. The re-simulated baseline projected that prices were going to gradually increase from ZW$53.07 in 2001 to ZW$65.97 in 2007 (see Table 7.2).

Table 7.2 sets out the 'fast track' land reform policy had a 28.68% negative effect on equilibrium maize prices in 2002 and 2003 respectively. The greatest impact was going to be in 2003, the reform where prices increased by 175.85% compared to what they would have been under the re-simulated baseline.

7.4.1.4   *Total Domestic Use*

Figure 7.7 below reveals that demand for maize collapsed and this is shown by the per capita consumption of maize that declined sharply from 110 kg/person/year in 2001 to 92 kg/person/year in 2002. Since then, per capita consumption has not gone beyond 98 kg/person/year reflecting the slump in demand during the period of the 'fast track' land reform.
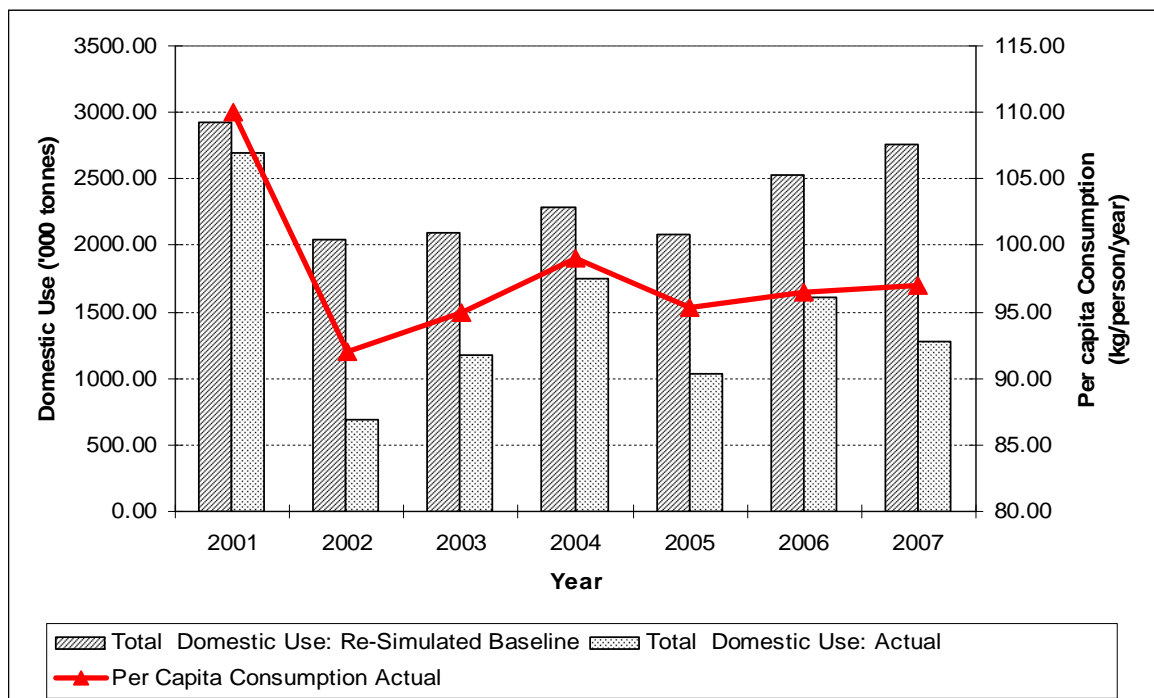

Figure 7.4:   Total Domestic Use and Per capita Consumption

The re-simulated total domestic use was going to remain fairly strong despite an initial decline in 2001 from 2.923 million tonnes to 2.049 million tonnes (see Table 7.2). According to the results of the model, the largest impacts on total domestic use were in the drought years of 2002 and 2005, while there was another large impact in 2007. In these years, Zimbabwe's maize market consumed 66.59%, 50.23% and 53.61% less than what the market could have consumed in 2002, 2005 and 2007, respectively (see Table 7.2). It is important to note, however, that arguing 'fast track' land reform impacts in this particular case may prove difficult because the decline in per capita consumption came as a result of a net combination of declining incomes and rising prices. As has been discussed in Chapter Two, even years of drought prior to the 'fast track' land reform also coincided with years of GDP decline (and therefore per capita income decline); and resultant price increases that came as a result of shortages depressed overall demand as well. Although it may be argued that the fall in incomes and price increases were ripple effects of the 'fast track' land reform policy, the gap between the re-simulated mode and the low levels of 'actual' domestic use and the lower per-capita consumption experienced during the peak of Zimbabwe's economic recession may not warrant a conclusion on the demand impact of the 'fact track' land reform policy.

7.3.2 Scenario Two: Absolute Change (from the Re-simulated Baseline) of a 12% Depreciation in the Exchange Rate

The first scenario gives the basis for further analysis of the Zimbabwean maize market within various situations. Since the macro-economic decline also affected maize markets, this perhaps stresses the need to explore what quantitative impact the fall of the dollar would have had on the behaviour of the maize producers and consumers under a 'well functioning' economy. Given, as a matter of fact, that the 'fast track' land reform policy occurred within the context of a decline in the macro-economy on the backdrop of an unprecedented fall in the value of the Zimbabwean dollar (and a concomitant increase in food prices), it would seem plausible to assess how a decline in the exchange rate would have impacted on the maize sector, assuming that the economy was stable.

Building on the model's simulated values given in the first scenario; this section gives a second scenario in which the projected Zimbabwean dollar/US dollar exchange rate is depreciated by an arbitrary 12% in 2002, assuming this to be as a result of the 2002

drought. The impacts of this depreciation are presented in Table 7.3 below shows the value differences between the baseline and the scenario in absolute terms. The results of the model revealed that a yearly depreciation of 12% on the Zimbabwean dollar under stable conditions was going to have an immediate impact on prices and production. A production increase of 9 090 tonnes would have been met with a human consumption decline of 890 tonnes in 2002. In real terms, the net price effect would only have been a marginal increase of ZW$0.51. The large production effect would have offset the price effect to result in a consistent increase in ending stocks. Net export increases would have been realised as the government disposed excess stock and capitalise on export gains that came as a result of a weaker dollar.

Table 7.3: **Absolute Change (from the Re-simulated Baseline) of a 12% Depreciation in Exchange Rate on the Maize Sector**

	2001	2002	2003	2004	2005	2006	2007	2008
Area '000 Ha								
Commercial Area:	0.00	1.93	4.62	8.67	13.22	21.46	31.41	41.97
Communal Area:	0.00	3.85	10.10	19.71	31.13	50.45	74.99	102.13
Total Area Harvested	0.00	5.78	14.72	28.37	44.36	71.91	106.41	144.10
Yield Tonnes/Ha								
Commercial Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Communal Yield	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Supply '000 tonnes								
Production: Total	0.00	9.09	25.34	52.51	69.93	142.16	218.03	300.95
Food Aid	0.00	0.00	-0.02	-0.02	-0.01	-0.03	-0.03	-0.03
Opening Stock	0.00	0.00	0.79	2.19	4.61	6.26	12.53	19.65
Total Supply Change	0.00	9.09	26.12	54.69	74.53	148.43	230.56	320.57
Demand '000 tonnes								
Ending stock	0.00	0.79	2.19	4.61	6.26	12.53	19.65	27.43
Consumption	0.00	-0.89	-2.11	-4.03	-6.24	-10.48	-15.68	-21.42
kg/person/year								
Per Capita Consumption	0.00	-0.07	-0.16	-0.29	-0.44	-0.72	-1.05	-1.39
'000 tonnes								
Unexplained Stock	0.00	8.61	25.40	53.85	72.48	147.54	230.28	321.23
Net Trade	0.00	0.48	0.71	0.84	2.05	0.89	0.28	-0.66
Total Demand Change	0.00	9.09	26.12	54.69	74.53	148.43	230.56	320.57
'000 tonnes								
Total supply	0.00	9.09	26.12	54.69	74.53	148.43	230.56	320.57
Total demand	0.00	9.09	26.12	54.69	74.53	148.43	230.56	320.57
Balance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maize Price								
Equilibrium Price	0.00	0.51	1.17	2.17	3.26	5.32	7.73	10.25

Source: Research Findings

The results show that a 12% yearly decline in the Zimbabwean dollar would have induced a consistent increase in production, with the greatest effect being in 2008 where production increases of 300 950 tonnes were to be realised. This would be in line with a much greater change in price (ZW$10.25). Increased prices would have increased the change in unexplained stock in the market, showing that on-farm consumption, seed and feed was going to respond to price increases as farmers opt to sell maize and capitalise on higher prices.

What this particular scenario shows is that a macro-economic decline (shown by the consistent depreciation in the exchange rate occurring within the context of a stable economic, political and institutional environment) would lead to increases in prices that would in turn have positive effects on the maize sector. This may imply that if exchange rate depreciation had occurred within a well functioning market economy under a land reform policy that upholds private property rights, then the exchange rate depreciation would have actually led to increased production and supply.

7.4   SUMMARY

The main aim of the chapter was to present the baseline and the impact of the 'fast track' land reform policy on Zimbabwe's maize market. In summary, the approach presented here tried to address this issue from three viewpoints: initially from the view of a deficiency in the analysis of Zimbabwe's 'land reform-food crisis' debate, secondly from the view that merely quoting statistics may not be sufficient to conclude on the 'fast track' land reform policy impact given the complexities of agricultural markets, and thirdly from the proposition that the 'fast track' land reform policy impact may be elicited from how the market would have performed under the assumption that the 'fast track' land reform policy was not implemented. In general, these pointers form the underlying argument of the development of the maize model and the basis for informing the 'fast track' land reform policy impacts.

Therefore, the baseline model that was constructed in Chapter Six was used to the make projections based on the various trends of exogenous variables in 2000. All the shifts in the political and economic environment after 2000 were not introduced into the model. The

fast track land reform policy was thus assessed based on the performance of the baseline model using a range of "what if" assumptions. Therefore, the baseline solutions discussed are as a result not only of the policy shifts that occurred before 2000, but also of the convergence of hypothetical political and economic stability within the period in question. The model was solved and the results were compared to the actual/observed market output, area, and net trade during the land reform.

From the baseline results, total maize production was 13.27% less than what could have been produced in 2001, the year that the 'fast track' land reform policy was formally implemented. In view of the 2002/03 drought, output was 57.44% less and 33.53% less than what could have actually been produced for the 2002 and 2003 seasons, respectively. In the 2005 drought season, the total maize production was 41.8% less than what could have been produced without the 'fast track' land reform. In 2007, the baseline showed that the nation could have produced almost 48.03% more than what was actually produced. Therefore, the proposition that the 'fast track' land reform policy immensely contributed to low maize production, and consequently maize self insufficiency, cannot be rejected and therefore still holds.

CHAPTER 8

CONCLUSION AND RECOMMENDATIONS

8.1   SUMMARY

The purpose and the general objective of the thesis aimed to develop a tool that could provide a basis for understanding the impact of the expropriation of commercial farms on Zimbabwe's maize sector.

In view of the study's objectives, the first part of the thesis provided an exposition of the structure of the maize sector, and the historical trends of the market to inform the econometric modelling process that would allow for the development of the baseline. In the subsequent chapters, the theory foundation was explored and the structure of the Zimbabwean maize model was developed. Development of the model started off with the estimation of single equations which were collapsed into a simultaneous system of equations through the use of a combination of ordinary least squares and generalised least squares techniques.

Global Insight projections of the exogenous variables were utilised, and assumptions were crafted pertaining to agricultural policies to allow for the development of the simulation model. This led to the generation of an artificial data set based on what the market would have looked like under a set of the pre-2001 existent policy conditions. By means of a comparative analysis between the actual versus 'would be' outcomes, the constructed model's projections for area harvested, total maize production and net trade of maize were then used to elicit the proximate effects of the expropriation of commercial farms.

The model developed in this dissertation contributes to an understanding of not only the general structure of the maize market, but also of the impact of the 'fast track' land reform policy on the Zimbabwean maize market based on how the market itself could have performed had these land reforms not occurred. The baseline model revealed that the maize sector performed below potential within the period of the 'fast track' land reform. The market model could be used as a tool that may assist the policymakers to design future strategies that will help enhance the maize sector performance and return to its potential. It

is hoped that this study will provoke a re-think of policy analysis of Zimbabwe's food crisis and trigger discussion on how to fully integrate land reform into market analysis.

8.2   CONCLUSION

Although the market model contributes to an understanding of Zimbabwe's maize sector, there is still a great need to refine the modelling process itself. The assumptions made in the model bring questions to the relevance and applicability of the model to the current Zimbabwean politico-economic environment. More so, the key question would be on the relevance of the elasticities from this maize model in the current 'new look' agrarian structure. Changes in the agrarian structure and resource endowments over the 'fast track' land reform period would probably have caused analogous changes in the elasticities from the commercial and communal sector as well as consumers.

Meanwhile, the economic collapse and the dysfunctional institutions under the 'fast track' macro-economic environment have not yielded to the effective application of econometric modelling. Hyperinflation during the 'fast track' land reform period is beyond the scope of econometric methodology, and this presents a stumbling block to the applicability of the models to Zimbabwe's economic situation. The econometric model had to therefore make some assumptions concerning inflation and the general macro-economic environment, making it possible to model markets in economically unstable conditions.

The scope of this study's model only considered the maize sector as a closed system and the rest of the commodity sectors were regarded as exogenous factors. The major focal area of future research will therefore have to be on integrating the model into a larger multi-sector model that takes into account the effects of other commodity and livestock sectors. Such interactions across commodity sectors will allow for a more comprehensive analysis. Developing similar models for the other subsectors will consequently lead to the full integration of models that may capture an alternative utilisation of resources among sectors in the wider agricultural sector.

8.2   RECOMMENDATIONS

After a decade of political instability and economic recession, Zimbabwe is left with a myriad of challenges to bringing its economy to full function. Arguably, the greatest of these challenges is how to overcome chronic food shortages and resuscitate its agricultural sector. After what has been widely argued to be a remnant of a 'fast track' land reform programme, ensuing market instability, low production and grain shortages have culminated in a decade-long food crisis, a development that warrants an important and urgent need for policy strategies to avert this crisis.

While policy analysts ponder over this debacle, a broad consensus is underlined by the necessary condition that successfully resuscitating Zimbabwe's agricultural sector would demand making the bulk of the smallholder farmers more productive. However, as a sufficient condition, the entirety of the agricultural sector needs to be nurtured in an environment typified by strategic incentives and market-enabling institutions that facilitate and sustain such productivity growth. The design and adoption of such policy strategies therefore needs to be informed by sound analyses on historical smallholder and commercial agricultural production and marketing patterns.

This succinct reflection comes against the abject failure of the 'fast track' land reform to sustain the performance of the maize sector, an indication that policy changes as well as changes in smallholder and commercial production and marketing over the past four decades are still poorly understood. As part of a broader strategy to improve the agricultural sector and our understanding of grain markets in particular, future policy must be drawn from applied and evidence-based analysis that accounts for past commodity production and marketing trends. This will, in turn, enable the formulation of adapted strategic policy measures which reflect and anticipate market challenges.

As a point of departure, the research suggests that the focus of re-developing the Zimbabwean agricultural sector be premised on an agricultural sector-wide model with a pertinent focus on food grain crops. This is because grain crops and food staples account for over half of Zimbabwe's cultivated land area, and also provide more than half of the country's caloric intake. Understanding impacts of prices, policies, productivity and output

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growth in food staple markets is expected to be a major driver of the development of the agricultural sector markets.

One pre-requisite underlying driver to developing markets however, is restoring investor confidence in the integrity of property rights to farmland. While the issue of (private) property rights has been widely debated in literature albeit amid inconclusive empirical results, it is the viewpoint of the author that commercial agriculture could improve with stronger institutional support in (private) property rights. While property rights are difficult to model, the results in this study were however underpinned by the implicit assumption that fundamental market-enabling (private) property rights remained in place. Therefore, the study recommends further reforms to be implemented in restoring investment confidence through market-enabling property rights.

REFERENCES

AIAS. (Various Issues). African Institute of Agrarian Studies and Community Technology Development Trust. *Development of Appropriate Agrarian and Land Reform Initiative for the SADC region (DALRI).* Land and Agrarian Reform in Zimbabwe. Regional Occasion paper Series.

Andersson, J. (2007). How Much Did the Expropriation of Commercial Farms Matter to Food Insecurity in Zimbabwe? *Journal for African Affairs.* October 9, 2007. http://afraf.oxfordjournals.orgs/cgi/context/citation [Online]. Accessed 29 November 2008.

Askari, H. & Cummings, J.T. (1977). 'Estimating agricultural supply response with the Nerlove model: a survey'. *International Economic Review* 18(2): 257-292.

Bautista, R.M. & Thomas, M. (2000). *Macroeconomic and Agricultural Reforms in Zimbabwe: Policy Complementarities: Toward Equitable Growth.* Trade and Macroeconomics Division International Food Policy Research Institute Washington, D.C. 20006, U.S.A. www.ifpri.org/pubs/abstract/128/rr128ch01.pdf Accessed 23 March 2009.

Bridges Trade BioRes (2002). *Sanitary and Phyto-sanitary Policy in Developing Countries.* 11 July 2002, Available at: http://www.ictsd.org. Accessed on 12th January 2010.

Braulke, M. (1982). A note on the Nerlove model of agricultural supply response. *International Economic Review* 23(1): 241-246.

Buccola, S.T. & Sukume, C. (1988). *Optimal Grain Pricing and Storage Policy in Controlled Agricultural Economies: Application to Zimbabwe.* World Development, Vol. 16, No. 3. pp. 361-371. 1988. Oregon State University, Corvallis. Available at: http://www.sciencedirect.com/science/article/B6VC6-

458XG82_18/2/89c0e49512469b52a9cda032a6e840d9 Accessed on 25th March 2009.

Calcaterra, M. (2002). *Econometric Analysis of the Structure of the Regional Maize Sector in Southern Africa.* MSc Thesis, Department of Agricultural Economics, Extension and Rural Development. University of Pretoria. Pretoria. South Africa.

Cato Institute. (2008). *Individual Liberty, Free Markets and Peace.* Available at http://www.cato.org/pub_display.php?pub_id=9823 Accessed 23rd March 2009

Coleman, D. & Young, T. (1989). *Principles of Agricultural Economics, Markets and Prices in Less Developed Countries.* Cambridge University Press. New York.

CSO. (Various Issues). *Central Statistical Offices Zimbabwe Statistical Yearbook.* Government Publications. Harare.

Cross, E. (2009). *The Cost of Zimbabwe's Continuing Farm Invasions*. May 18, 2009 Economic Development Bulletin no. 12. Available on:
 http://www.cato.org/pub_display.php?pub_id=10206.

Cutts, M., & Hassan, R. (2003). *An Econometric Model of the SADC Maize Sector.* Paper Presented at the 41st Annual Conference of the Agricultural Economics Association of South Africa (AEASA), Pretoria. South Africa.

Davies R. (2004). *Memories of Underdevelopment: a Personal Interpretation of Zimbabwe's Economic Decline. In Zimbabwe: Injustice & Political Reconciliation.* Edited Raftopoulos R & Savage T. Pg 19-42. Weaver Press.

Elich, G. (2005). *Zimbabwe's Fight for Justice.* Centre for Research on Globalisation. Available at: http://www.globalresearch.ca/index.php?context=va&aid=160 Accessed 12th January 2010.

Esterhuizen D. (2010). *Zimbabwe Corn and Wheat Update*. Global Agricultural Information Network (GAIN) Report. Pretoria. Available at:

http://www.gain.fas.usda/Recent%20Publications/Corn%20and%20wheat%20update_Pretoria_Zimbabwe_2-1-2010.pdf   Accessed 10th January 2010.

Famine Early Warning Systems Network (FEWSNET), (2008). *Zimbabwe Food Security Alert.* September 24 2008. Avalialable at:
http://www.fews.net/docs/Publications/Zimbabwe_alert_2008_09_24%20final.pdf

Food and Agricultural Organisation (FAO), (Various Issues). *FAO/WFP Crop and Food Supply Assessment Mission to Zimbabwe Special Report.* FAO Corporate Document Repository. Available at:
http://www.fao.org/docrep/005/y9730e/y9730e00.HTM   Accessed from 15th May to 20th December 2009.

Food and Agricultural Organisation (FAO), (2008). *Food and Agriculture Organization Statistical Data Base*. http://apps.fao.org

Global Insight (1999). *Macro-economic Projections for Zimbabwe.* Unpublished

GMB. (Various Issues). *Grain Marketing Board Annual Reports.* Harare.

GoZ (2009). *Government of Zimbabwe Short Term Emergency Recovery Programme: Getting Zimbabwe Moving Again.* Government Printers. March 2009.

Granger, C.W.J., & Newbold, P. (1974). Spurious Regressions in Econometrics. *Journal of Econometrics* 2:111-120.

Granger CWJ & Newbold P. (1977). *Economic Time Series.* New York, Academic Press.

Greene W.H. (2003). *Economic Analysis. Fifth Edition.* Prentice Hall. New York.

Gujarati, D.N. (2007). *Basic Econometrics.* Seventh Edition. McGraw Hill. New York.

Handerson, D., & Quandt, C. (1980). *Microeconomic Theory*: A Mathematical Approach. McGraw Hill.

Jacobs, K., & Sumners D.A. (2002). *The Food Balance Sheets of the Food and Agriculture Organization: A Review of Potential Ways to Broaden the Appropriate Uses of the Data.* March 2002.Available at: http://193.43.36.14/abcdq/docs/FBS_Review.pdf. Accessed on 25th March 2009.

Jayne, T.S., & Rukuni, M. (1993). *Distributional effects of maize self-sufficiency in Zimbabwe: Implications for Pricing and Trade Policy.* Butterworth-Heinemann Ltd. Available at: http://www.sciencedirect.com/science/article/B6VCB-46R0F0S-B/2/dadfcdbeefe4d2fd7c36d1fb03be68b3 Accessed 29th March 2009.

Jayne, T.S., Chisvo, M., & Rukuni, M. (1994). Zimbabwe's Food Insecurity Paradox: Hunger amid Abundance. In Rukuni M. & Eicher CK. 1994. *Zimbabwe's Agricultural Revolution Revisited.* University of Zimbabwe Publications. Harare.

Jayne, T.S., Chisvo, M., Rukuni, M., & Masanganise, P. (2006). Zimbabwe's Food Insecurity Paradox: Hunger amid Potential. In Rukuni M., Tawonezvi P., Eicher CK., Munyuki-Hungwe M., and Matondi P. (eds). *Zimbabwe's Agricultural Revolution Revisited.* University of Zimbabwe Publications. Harare.

Jenrich, M. (2008). *Zimbabwe: Small-scale Farmers seen as Backbone of Food Security.* 15 May 2008. Integrated Regional Information Networks (IRIN), Harare. Available on http://www.irinnews.org/Report.aspx?ReportId=78222 Accessed 23rd March 2009.

Kapuya T., Saruchera D., Jongwe A, Mucheri T., Mujeyi K.,Ndobongo LT, Meyer FH (forthcoming). *The Grain Industry Value Chain in Zimbabwe.* An Unpublished Draft Prepared for the Food and Agricultural Organisation (FAO) of the United Nations (UN).

Lang, R. (2008). *A Partial equilibrium analysis of the impact of the ECOWAS-EU Economic partnership Agreement.* An Assessment of the impact of the Economic

Partnership Agreements between the ECOWAS countries and the European Union. ATPC Working Paper no 29. UNECA.

Maddala, G.S. (1992). *Introduction to Econometrics*. Second Edition, Prentice Hall.

Makadho, J., Matondi, P.B., & Munyuki-Hungwe, M. (2006). Irrigation Development and Water Resources Management. . In Rukuni M., Tawonezvi P., Eicher CK., Munyuki-Hungwe M., & Matondi P. (eds). *Zimbabwe's Agricultural Revolution Revisited*. University of Zimbabwe Publications. Harare: 255-278.

Mano, R. (2003). *Agricultural Commodity Marketing Challenges and Pricing Policy Strategies*. Presidential Land Review Committee: Technical Paper No 7. Unpublished Final Draft.

Masanzu, F.M. (1981). *Supply Response to Prices of Maize, Wheat, and Tobacco in Zimbabwe, 1961-1975*. Research Report for the Ministry of Agriculture, Zimbabwe.

Masters, W.A. (1991). Scope and Sequence of Maize Market Reform in Zimbabwe. *Food Research Institute Studies*, 23 (3): 115-129.

Master, W. (2007). *Distortions to Agricultural Incentives in Africa: Results from 17 Country Studies*. CSAE Conference on Economic Development in Africa March 20, 2007. www.agecon.edu/staff/masters

Matshe, I. (2003). *Impacts of the Fast Track Land Reforms on the Zimbabwe Economy*. African Institute for Agrarian Studies, Mimeo. AIAS Research Paper, Harare.

Meyer, F.H. (2005). *Modelling the Market Outlook and Policy Alternatives for the Wheat Sector in South Africa*. MSc Thesis, Department of Agricultural Economics, Extension and Rural Development. University of Pretoria. Pretoria. South Africa.

Meyer, F.H., Westhoff, J., Binfield, J., & Kirsten, J.F. (2006). Model Closure and Price Formation under Switching Grain Market Regimes in South Africa. *Agrekon* 45(4) 369-380.

Mirer, T.W. (1988). *Economic, Statistics and Econometrics*. Macmillan Publishing Co. New York.

Moyo S. (2004). *Overall Impacts of the Land reform Programme in Zimbabwe.* The African Institute for Agrarian Studies (AIAS), Harare.

Moyo, S. (2006). The Evolution of Zimbabwe's Land Acquisition: In Rukuni M., Tawonezvi P., Eicher CK., Munyuki-Hungwe M., and Matondi P. (eds). *Zimbabwe's Agricultural Revolution Revisited.* University of Zimbabwe Publications. Harare: 143-164.

Moyo, S., Scoones, I. & Cousins, B. (2009). *Livelihoods and Land Reform: The Poverty Impacts of Land Re-distribution in Southern Africa.* Some Comments and Reflections on the World Bank Land Study Terms of Reference. April 2009. Available at: http://www.lalr.org.za/news/worldbank0509 Accessed on 28th May 2009.

Moyo, S. and Sukume, C. (2006). *Agricultural Growth and Land Reform in Zimbabwe: Assessment and Recovery Options.* The World Bank Report. Environment, Rural and Social Development Unit-Southern Africa, AFTS1, Country Department 3 Africa Region.

Moyo, S. & Yeros, P. (2009). *Zimbabwe Ten Years On: Results and Prospects. Livelihoods and Land Reform*: The Poverty Impacts of Land Re-distribution in Southern Africa. February 2009. Available at: http://www.lalr.org.za/news/zimbabwe-ten-years-on-results-and-prospects-by-sam-moyo-paris-yeros Accessed 28th August 2009.

Muchapondwa, D. (2009). Supply response of Zimbabwean agriculture: 1970-1999. *African Journal for Agricultural and Resource Economics (Afjare).* Vol 3 No 1 March 2009. 28-42.

Mudimu, G. (2003). *Zimbabwe Food Security Issues Paper*. Forum for Food Security in Southern Africa.: ODI: London. Available at: http://www.odi.org.uk/projects/03-food-security-forum/docs/ZimbabweCIPfinal.pdf. Accessed on 24th January 2009.

Mudzonga E., and Chigwada T. (2009). *Agriculture: Future Scenarios for Southern Africa: A Case Study of Zimbabwe's Food Security*. Available online at: http://www.tradeknowledgenetwork.net/pdf/ag_scenarios_south_africa_zimbabwe.pdf Accessed 20th February 2010

Muir-Leresche, K. (1985). *Crop Price and Wage Policy in Light of Zimbabwe's Development Goals*. Unpublished DPhil Thesis, Department of Agricultural Economics and Extension, University of Zimbabwe: Harare.

Muir-Leresche, K. (1998). *Agricultural and Macro-Economic Reforms in Zimbabwe: A Political Economy Perspective*. TMD Discussion Paper No 29, Trade and Macro-Economic Division, IFPRI: Washington DC.

Muir-Leresche, K., & Muchopa, C. (2006). Agricultural Marketing. In Rukuni M., Tawonezvi P., Eicher CK., Munyuki-Hungwe M., and Matondi P. (eds). *Zimbabwe's Agricultural Revolution Revisited.* University of Zimbabwe Publications. Harare: 299-319.

Muir-Leresche, K. & Takavarasha, T. (1988). Pan-territorial and Pan seasonal pricing for maize in Zimbabwe. In Mudimu, G. & Bernstein (eds).In *Household and National Food Security in Southern Africa.* UZ/MSU Food Security Project, Department of Agricultural Economics and Extension.,University of Zimbabwe. Harare.

Musarara, T. (2009). *Are GMO's Harmful or Helpful?* The Financial Gazette, 11 June 2009. Harare. Available at: http://allafrica.com/stories/200906150581.html . Accessed on 15th January 2010.

Mutangadura, G. (1993). *Estimation of the Commercial Maize Supply Function in Zimbabwe*. Department of Agricultural Economics and Extension, University of Zimbabwe. Harare. Unpublished Paper.

122

Nerlove, M. (1979). The dynamics of supply: Retrospect and prospect. *American Journal of Agricultural Economics* 61(5):874-888.

Perali, F. (2003). *Partial Equilibrium Analysis of Policy Impacts (Part 1) Training Materials.* Ministry of Agriculture and Agrarian Reform: Damascus.

Pundyck, R.S. & Rubinfeld, D.L. (1998). Econometric Models and Econometric Forecasts. Fourth Edition. *McGraw Hill*. New York.

Rhorbach, D.D. (1989). *The Economics of Smallholder Maize Production in Zimbabwe. Implications for Food Security.* MSU International Development Paper No.11 1989. Available at: http://www.aec.msu.edu/fs2/papers/older/idp11.pdf Accessed on 24th March 2009.

Richardson, C.J. (2004). *The Collapse of Zimbabwe in the wake of 2000-2003 Land Reforms.* Lewiston. Edwin Mellen Press.

Richardson, C.J. (2006). Learning from Failure: Property Rights, Land Reforms, and the Hidden Architecture of Capitalism. *American Institute for Public Policy Research. Development Policy Outlook.* (2) 2006. Washington.

Richardson, C.J. (2007a). How much did the expropriation of Commercial Farms matter to food Insecurity in Zimbabwe? Rebuttal to Andersson. *African Affairs Advance Access*. Published October 9th 2007. African Affairs, 2007 106: 691-696. Available at http://afraf.oxfordjournals.org/content/vol106/issue425/ Accessed November 5th 2008

Richardson, C.J. (2007b).How much did droughts matter? Linking rainfall and GDP growth in Zimbabwe. *Journal for African Affairs* (London) 106, 424 (2007), p. 471.

Robertson, J. (2009). *The Zimbabwean Economy: Where to Form Here?* Available at: http://www.slidenet/Sokwanele/zimbabwe-economy-october-2009 Accessed 28th Decemeber 2009.

Rukuni, M. (1994). The Evolution of Agricultural Policy: 1890-1990. In Rukuni M. & Eicher CK.1994. *Zimbabwe's Agricultural Revolution*. University of Zimbabwe Publications. Harare: 15-39.

Rukuni, M. (2006). The Evolution of Agricultural Policy: 1890-1990. In Rukuni M., Tawonezvi P., Eicher CK., Munyuki-Hungwe M., and Matondi P. (eds). *Zimbabwe's Agricultural Revolution Revisited.* University of Zimbabwe Publications. Harare: 29-64

Rusike, J. (1998). Country Case Study: Zimbabwe. In Morris, M.L. (1998). *Maize Seed Industries in Developing Countries.* (eds). 303-320. Available at http://books.google.co.za/books?id=vrnTjmqc1RsC Accessed on 25th June 2009

Takavarasha, T. (1991). Agricultural Pricing Policy. In Wycoff JB & Rukuni M. 1992. *Food Security Research in Southern Africa: Policy Implications.* UZ/MSU Food Security Research in Southern Project. Department of Agricultural Economics and Extension, University of Zimbabwe: Harare.

Takavarasha, T. (1992). Agricultural Price Policy. In Rukuni M & Wycoff D. 1992. *Food security for Southern Africa.* 1987. UZ/MSU Food security in Southern Africa Project. Harare: 149-169

Takavarasha, T. (1993). Current Status of the Reform Proposal for Agriculture in Zimbabwe. In *Agricultural Reforms and Regional Market Integration in Malawi Zambia and Zimbabwe.* IFPRI Publications.

Takavarasha, T. (1994). Agricultural Price Policy. In Rukuni M. & Eicher CK. 1994. *Zimbabwe's Agricultural Revolution.* University of Zimbabwe Publications. Harare.

The Food Security Group, (forthcoming). *Analysis in Support of Building Markets in Africa: Identifying Strategic Opportunities for Promoting Smallholder Incomes and*

Food Security. Initial Draft. Department of Agriculture, Food and Resource Economics. Michigan State University.

Thiele, R. (2003). Price Incentives, Non-price factors, and Agricultural Production in Sub-Saharan Africa: A Co-integration Analysis. *Kiel Institute for World Economics.* Kiel, Germany 1372-1381.

Thurlow, J. & Holden, M. (2005). The Impact of the EU-SA Free Trade Agreement on Selected COMESA Countries. *The Southern African Journal of Economics.* 70 (2) PP 133-144.

Timmer, C.P. (1986). *Getting Prices Right, the Scope and Limits of Agricultural Policy in Africa.* Cornell University Press.

Townsend, R.F. (1997). Econometric Methodology 1: The role of Theory and Observation in Agricultural Economics Research. *Agrekon* 36 (4) September 1997.

Townsend, R. & Thirtle, C. (1994). *Dynamic acreage response: An error-correction model for maize and tobacco in Zimbabwe.* Occasional Paper No. 7, International Association of Agricultural Economics.

Tschirley, D., T.S. Jayne, M. Mukumbu, M. Chisvo, M.T. Weber, B. Zulu, R. Johansson, P. Santos, & D. Soroko. (1999). *Successes and Challenges of Food Market Reform: Experiences from Kenya, Mozambique, Zambia, and Zimbabwe.* Policy Synthesis No. 39. February 1999. USAID - Africa Bureau Office of Sustainable Development. Available at http://pdf.usaid.gov/pdf_docs/Pnadf603.pdf. Accessed on 28 August 2009.

Tweeten, L., Pyles, D., & Henneberry, S. (1989). *Supply and Elasticity estimation in Agricultural Policy Analysis: Tools for Economic Development.* Westview Press. Boulder.

Utete, C.M.B. (2003). *Presidential Land review Committee, Vol.1 Main Report.* Government of Zimbabwe Publications. Harare.

Valdes, A., & Muir-Leresche, K. (1993). *Agricultural Policy Reforms and Regional Market Integration in Malawi, Zambia and Zimbabwe.* International Food Policy Research Institute (IFPRI) Publication: Washington DC.

Van Tongoren, F. Meijl, H., Surry, Y. (2000). Global Models Applied to Agricultural and Trade Policies. A Review and Assessment. *Agricultural Economics.* Vol 26. 149-172. August 2000.

WFP. (2009). *World Food Programme Dataset.* Unpublished Data.

WTO (2002). *Training module on the WTO agreement on Sanitary and Phyto-sanitary measures:* Available at: http://www.unctad.org/en/docs/ditctncd20043_en.pdf Accessed on 20th January 2010.

Wubeneh, W. (2006). *A General Equilibrium analysis of the Impact of eliminating US Cotton subsidies on US and World Cotton Market.* Paper prepared for the 9th Annual Global economic Analysis conference. Addis Ababa, Ethiopia June 14-17, 2006

Zalm, G. (1998). The Relevance of Econometric Modelling for Policy Decisions. *Economic Modelling No. 15.* 309-316. 1998.

ZCGPA. (2010). *The Zimbabwe Commercial Grain Producers Association:* Unpublished Production Data. Crops Department of the Commercial Farmer's Union (CFU). Harare.

ZIMACE, (1999). *The Zimbabwe Agricultural Commodity Exchange (ZIMACE) Trader.* Morden Farming Publications: Harare

Zimbabwe Emergency Food Security Assessment Report. (2002). In Kalyanapu P (Undated). *Understanding the Causes of Malnourishment in Zimbabwe.* Pinkerton Academy: New Hampshire. Available at:

http://www.worldfoodprize.org/assets/YouthInstitute/05proceedings/PinkertonAcademy.pdf Accessed on 24th February 2009.

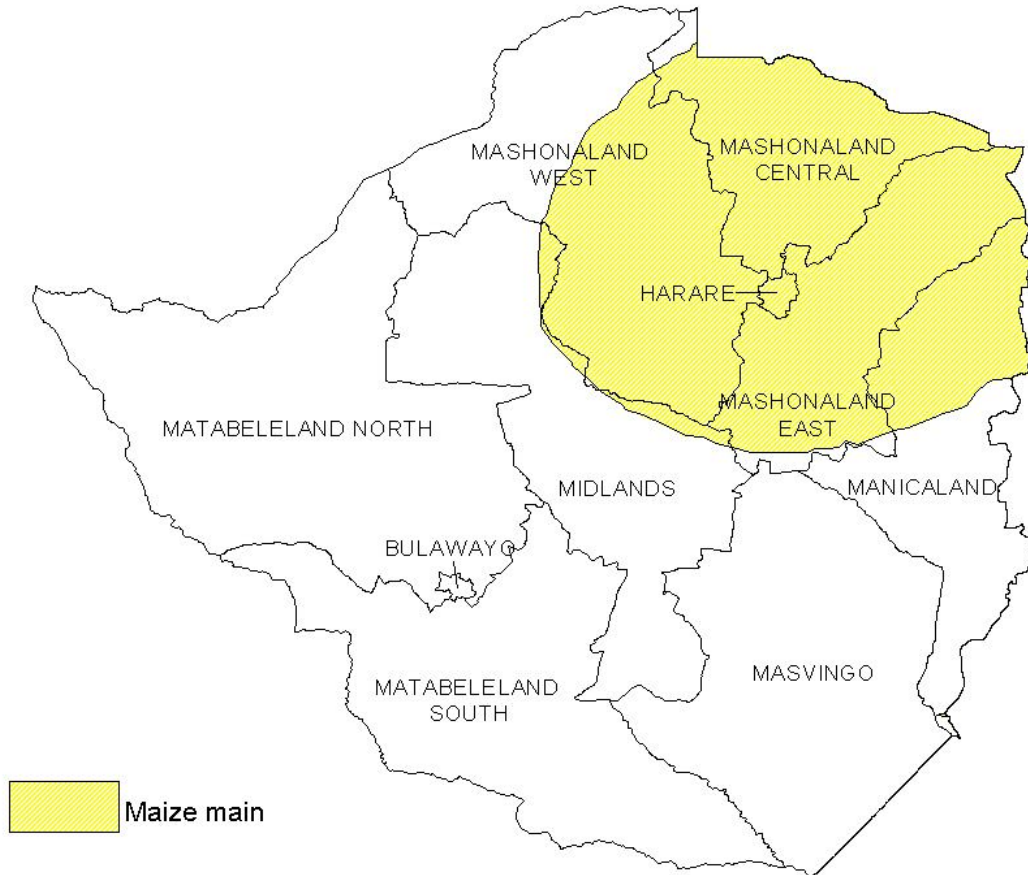ZIMVAC (Zimbabwe Vulnerability Assessment Committee Zimbabwe). *Monthly Food Security Update*: (Various Monthly Issues). Available at: www.fews.net/docs/Publications/Zimbabwe_200307en.pdf Accessed Jan 2008-June 2009.

ZGMA (2009). Zimbabwe Grain Millers Association. Unpublished Data.

APPENDIX A

The Main Maize Production Region in Zimbabwe

Source: FAO & WFP Zimbabwe (FAST Maize Crop Yield Forecast), 21st April 2005

APPENDIX D

Maximum Farm Sizes per Resettlement Model by Agro-ecological Region (ha)

Agro-ecological Zone	A1	A2			Peri-Urban
		SSC[a]	MSC[b]	LSC[c]	
I	12	20	100	250	
IIa	15	30	200	350	
IIb	20	40	250	400	
III	30	60	300	500	2 – 50
IV	50	120	700	1,500	
V	70	240	1,000	2,000	

Source: GoZ (2009)

[a] Smallscale Commercial sub-sector

[b] Medium Scale Commercial sub-sector

[c] Large Scale Commercial sub-sector

APPENDIX B

Zimbabwe's Farm Structure

FARM CLASS	LAND TENURE	FARM HOUSEHOLDS		AREA		
		NUMBERS	% OF TOTAL	HECTARES	% OF TOTAL	AVERAGE FARM
SMALLHOLDER	COMMUNAL	1,100,000		16.4		15
	OLD RESETTLEMENT	72,000		3.7		51
	A1	141,656		5.7		40
	SUB-TOTAL	**1,313,656**	**98**	**25.8**	**75.6**	**20**
SMALL TO MEDIUM SCALE COMMERCIAL	OLD SSCF	8,000		1.4		175
	SMALL A2	14,072		1		71
	SUB-TOTAL	**22,072**	**1.6**	**2.4**	**7**	**109**
LARGE SCALE COMMERCIAL	MEDIUM-LARGE A2	1,500		0.9		600
	BLACK LSCF	1,440		0.9		625
	WHITE LSCF	1,377		1.2		871
	SUB-TOTAL	**4,317**	**0.3**	**3**	**9**	**695**
CORPORATE ESTATES	COMPANY	657		1		1,522
	CHURCH	64		0.04		641
	PARASTATAL	253		0.6		3,922
	SUB-TOTAL	**874**	**0.1**	**1.64**	**4.8**	**1,878**
TRANSITIONAL	UNALLOCATED			1.3	3.8	
TOTAL		**1,340,919**		**34,141.00**	**100**	

Source: MAMID, (2009); Moyo and Yeros (2009)

APPENDIX C

Zimbabwe's GDP growth, Agricultural Contribution to GDP and Agricultural Sector growth

Year	National GDP Growth (%)	Agriculture's Contribution to GDP (% of total)	Agriculture's Growth Rate (%)
1980	10.7	15.7	24.3
1981	12.5	17.7	13.00
1982	2.6	16.1	9.00
1983	1.6	11.2	30.00
1984	-1.9	14.9	33.00
1985	7.0	22.7	52.00
1986	2.1	17.8	-22.00
1987	1.1	14.4	-19.00
1988	7.6	16.4	14.00
1989	5.2	14.9	-9.00
1990	7.0	14.8	-1.00
1991	3.2	13.5	-9.00
1992	-5.5	6.8	-50.00
1993	2	13.7	101.00
1994	5.3	17.1	25.00
1995	-0.2	13.5	-21.00
1996	9.7	20.4	51.00
1997	0.2	20.5	0.00
1998	-0.5	19	-0.07
1999	-2.7	23.7	25.00
2000	-4.8	18.6	1.7
2001	-8.5	28.8	14
2002	-11.9	18.5	-23.7
2003	-10.6	17.1	-14.5
2004	-4.2	18	-9.1
2005	-7.7	16.1	-5.4
2006	-4.6	18.5	11
2007	-2.8	18.5	2.4
2008	-	-	-11

Source: AIAS (Various Issues)