AN ECONOMIC ANALYSIS OF THE RELATIONSHIPS BETWEEN LAND VALUES, AGRICULTURAL COMMODITY PRICES AND LAND REFORM ISSUES IN SOUTH AFRICA

By

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2009

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The thesis is a special dedication to my parents.

ABSTRACT

This thesis is an implicit farmland value study which explores the possible effects of agricultural commodity prices, interest rate and land reform issues on farmland values. The study examines the impacts of these fundamental factors (interest rates and returns to farmland as determined by crop prices) on sugar cane farmland values, maize farmland values, on deciduous fruit (apples and pears) farmland values, and on aggregate South African farmland values. Expectations are that land reform influences the demand for farmland. Since farmland prices are demand driven, changes in the demand for farmland (as influenced by land reform issues) may result in changes in farmland prices. The study thus seeks to empirically examine, to a larger extent, the long-run influence of endogenous factors on farmland prices. Causes of cyclical behaviour in farmland prices are also examined.

The study draws on cross-sectional and time series studies of previous research on farmland values. The maximum likelihood Johansen (1991) procedure of cointegration is used to estimate the relationship between fundamental factors and farmland values. The logit model is used to estimate the influence of land reform on the demand for farmland, hence farmland prices.

Unit root and the Johansen cointegration test results proved that long-run relationships exist between farmland values and returns to farmland; the use of cointegration methods was thus recommended. Long-run changes in farmland prices are caused by fundamental factors. Short-run variations in farmland prices are caused by exogenous factors that affect net farm income and this lead to boom-bust cycles in farmland values.

Monetary sector variables were also found to be influential in farmland prices in South Africa. Money supply induces direct effects on farmland values as well as indirect effect through

agricultural commodity prices and input costs. An inverse relationship between deciduous fruit farmland values and exchange rate was found. The appreciation of the South African Rand against the US Dollar and other foreign currencies reduces profit margins for exporters because exported South African goods become expensive in foreign markets with the appreciation of the Rand. Likewise, the depreciation of the Rand increases profit margins as exports become cheaper in foreign markets with the Rand depreciation.

Results of the logit model prove that land reform issues influence demand for farmland and, hence, farmland values. The land reform grant has been recently reviewed; beneficiaries could now get R430 000 grant for their R500 000 own contribution. This might fuel the demand for farmland in the future; further research on relationships between land reform issues and farmland prices under revised grant scale is recommended.

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CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The agricultural sector provides a unique environment in which to study many interesting social and government policy problems. The sector is relatively important in South Africa because it provides subsistence and commercial means of living. Land is an important input factor for agricultural production. Owning farmland is one of the most attractive methods a person can employ to multiply, preserve and transfer family wealth. Forces influencing farmland values tend to favour high land values in the long run. Schmitz and Just (2003) regard land as a constant supply factor and assume that land earns most of the producer surplus.

Since land values are assumed to be a positive function of net farm income (producer surplus) therefore, agricultural commodity prices that determine net farm income could play a major role in farmland price determination. Cochrane (1958) observed that farm prices are always on the move. The variability of farm prices causes several farm problems. Cochrane (1958) describes some of these farm problems as variability of net farm income and uncertainty in planning production. Classical or Ricardian rent theory suggests that there is a link between net farm income and farmland values. It is the purpose of this study to determine what factors influence the value of farmland and thereby estimate a link, if any, between land values and those factors.

Past studies on factors affecting farmland values in South Africa and abroad reveal that a substantial proportion of variations in the dependent variable (farmland price) are explained by fundamental factors (net farm income and interest rates) (Henderson,2008; Featherstone and Moss, 2003; Falk and Lee, 1998; Schmitz, 1995; Nieuwoudt, 1980). Evidence from historical studies, especially cross-sectional studies also show that other factors apart from fundamental factors influence farmland values. For instance, variations in agricultural commodity prices trigger changes in net farm income and, hence farmland values. Henderson (2008) studied the influence of agricultural commodity prices on American farmland prices and documented results that changes in corn prices affect farmland values. The findings are in line with the argument that property values are a function of expected returns (Cooper, 1988; Schmitz, 1995; Falk and Lee, 1998).

The importance of the agricultural sector in bringing about economic development and sustainable social welfare is a crucial fact in South Africa. A necessary condition for economic growth in most developing countries is a transformed agricultural system that will ensure increasing domestic agricultural surplus. The agricultural sector in South Africa, like other economic sectors is under transformation. The industry has been deregulated and land reform programmes are being implemented. Including land reform issues as one of the factors that might affect land prices is one of the aspects of this study. Land ownership and income are unequally distributed in South Africa. Land values are high in South Africa and this makes it difficult for the majority of poor South Africans to gain access to land natives once possessed. Land redistribution programmes are doing little to address the skewed pattern of land ownership. Secondly, population growth rate, although constrained by HIV/AIDS pandemic, is increasing in South Africa. Population density is one of the factors affecting farm land values because people depend on fixed supply of land for food production (Clark, 1973). This causes agricultural commodity prices (food prices) to increase. Increases in farm commodity prices result in increases in net farm income which impacts on land prices. High food prices and land reform issues are some of the hotly debated current topics in South Africa. The study investigates the impact of these two factors (land reform issues and agricultural commodity prices) on land prices.

1.2 Problem Statement

The study seeks to investigate the relationships that might exist between farmland values and fundamental factors (interest rates and net farm income or returns to farmland). Secondly, it is assumed that monetary variables like money supply and exchange rate affect farmland values indirectly through agricultural commodity prices and input costs. Linkages between the agricultural sector and the monetary sector will be examined in order to estimate the relationships between the variables in the system (agricultural commodity prices, input costs, money supply (M3), interest rate, and exchange rate). The impact of land reform on land values will also be studied as land reform programmes might alter the demand for farmland in South Africa.

1.3 Objectives and Significance of the Problem

The study is a comprehensive analysis of the impacts of fundamental factors and land reform issues on South African farmland values. The main objective of the study is to develop time series models to estimate the effects of commodity price changes and interest rate on farmland values. The interaction of the agricultural sector and the monetary sector will be studied through variable relationships between these sectors. Changes in the demand for farmland as a result of the impact of land reform issues are also a subject of importance. Subject to the main objectives, the study also seeks to examine what proportions of area under cane (AUC) farmland value measure and value per hectare in sugar cane sub-studies are explained by changes in fundamental factors. Also, subsequent to the main objectives, the study will seek to examine the impact of export demand on apple and pear deciduous fruit farmland values.

The thesis is organised as follows: Discussion of the study areas for the agricultural commodities addressed in this study, as well as the production and consumption of these commodities are presented in Chapter Two. The literature review on farmland values and the impact of agricultural commodity prices on farmland values is discussed in Chapter Three. Chapter four provides the historical background on land ownership and land reform in South Africa. Chapter Five will discuss some theory relevant to the proposed study. The methodology as well as the models that will be used to answer the proposed research questions is discussed in Chapter Six. The empirical results are presented in Chapter Seven and the study summary and conclusions are drawn in Chapter Eight.

CHAPTER TWO

THE STUDY AREA

2.1 South Africa

The area under study, the Republic of South Africa, comprises of nine provinces. The provinces are KwaZulu-Natal, Mpumalanga, Gauteng, North West, Western Cape, the Free State, Limpopo and the Eastern Cape. South Africa is bounded in the west by the Atlantic Ocean and by the Indian Ocean in the east. The country is located at the southern tip of the African continent. Its total area is approximately 1219090 square kilometres. The country can be broadly divided into two main geographic regions: the interior plateau and the narrow coastal belt. The two regions are separated by a semi-circular band of mountain ranges, the Great Escarpment.

South Africa is not well endowed with areas of agricultural potential. The eastern seaboard and some areas below the Great Escarpment are well favoured and there is a steady decline in potential to the north and west (Christopher, 1982). The provinces North West, Northern Cape, Free State and Eastern Cape are all transitional, falling in areas of low and high potential. The Northern Cape is almost entirely of very low potential. The Western Cape has zones of higher potential in the south west and low potential in the interior. The Cape Folded Mountains separate these two potential regions of the Western Cape.

Christopher (1982) noted a broad relationship between categories of biological productivity and land use zone. Forestry and sugar cane cultivation are mostly found in the areas of high productivity, especially in the areas of KwaZulu-Natal and Mpumalanga. Maize and wheat farming are found in the moderate productivity areas of the Free State, the North West and the Western Cape respectively. Cattle and game farming is found in an arc like area stretching from Mpumalanga to the North West and Northern Cape provinces; sheep farming dominates the semi-arid Karoo region (Christopher, 1982).

South Africa is located between 22˚ and 35˚ south of the equator. The country is placed in the zone of tropical anticyclones. A circular cell of air, the Hadley Cell, which rises above the equator and subsides in the tropics dominates much of South Africa’s weather and climate (Christopher, 1982).

Cold fronts from the west and tropical fronts approaching from the east (oceanic influences) also play a significant role in influencing the strengths of weather systems across the country.

In terms of average annual rainfall there is a noticeable decrease in rainfall pattern from east to west. The distribution of rainfall over South Africa can be related to a weather system. Most of South Africa's annual rainfall occurs within six months of the year in the form of thunderstorms during the summer months. The south- western part of the country experiences winter rainfall.

The major constraint limiting agricultural production in South Africa is the availability of water. Rainfall is unevenly distributed across the country; this signals the importance of irrigation in the production of most crops. The national Department of Agriculture estimates the number of hectares under irrigation to be 1.3 million hectares. The country is self sufficient in all major agricultural products and is also a net food exporter in good years (National Department of Agriculture, 2006). However, with very low average rainfall and high variability within and between the seasons, agriculture is vulnerable to the effects of draught.

2.2 Sugar Cane Producing Areas

Sugar cane is an important export crop in South African agriculture. The South African sugar industry currently supports approximately 50940 small, medium and large scale producers. The cane producers collectively farm an estimated area of 426861 hectares (South African Cane Growers Association, 2006). Production of sugar cane extends from Northern Pondoland in the Eastern Cape, through the KwaZulu-Natal Coastal belt, KwaZulu-Natal Midlands and eastern part of Mpumalanga Province. These areas form what is commonly known as the Sugar Belt of South Africa. The area produces seasonally 22 million tons of sugar cane on average (SASA, 2006). Sugar cane contributes approximately 82 percent of the income from field crops in KZN (STATS SA, 2002). Large scale cane growers produce approximately 72 percent of the total production. Small scale growers produce about 19 percent and the remaining is planted by millers (SACGA, 2006). According to the results of commercial agriculture 2002 census, approximately 87 percent of the gross farming income earned from sugar cane in South Africa is produced in KwaZulu-Natal (STATS SA, 2002).

The initial success of the growing of sugar cane on the coastal lands of KZN in the 1850's and 1860's established a crop that has prospered in the province of KZN (Christopher, 1982). The KZN north coast was the first to develop; it developed rapidly and it was followed by the south coast. The Zululand coastal belt was opened up in the period between 1905 and 1950, overlapping into the adjacent eastern Transvaal (now Mpumalanga) and Swaziland. Sugar cane growing in the interior evolved during the mid-1960s. The slump in wattle bark prices and the boom in sugar industry as a result of a drop in Cuban production gave way to the development of sugar industry within the Natal Midlands, now KZN Midlands (SASA, 1997).

In 1904 white settlers were allowed to take up land in Zululand with government's intention of establishing 200 hectare farms for individual planters (Christopher, 1982). Large milling and Indian farmers were not allowed to take part in this new development. The Pongola Irrigation Scheme for sugar production was organised by the government in the 1930's northern Natal (northern KZN) and Mpumalanga areas. This was done at the expense of pastoral farming which was completely erased after the installation of the new irrigation system (Christopher, 1982).

The South African Sugar Belt falls within the Coastal Lowlands bioclimatic region. The relief of the area ranges from 0 to 475 metres. The area is generally humid with hot to warm summers and warm to mild winters. The average annual rainfall for the area is between 805 to 1400mm with most of the rain falling during summer months. The mean annual temperature ranges between 20°C and 22°C (Shuters-Macmillan New Secondary School Atlas for South Africa, 1995).

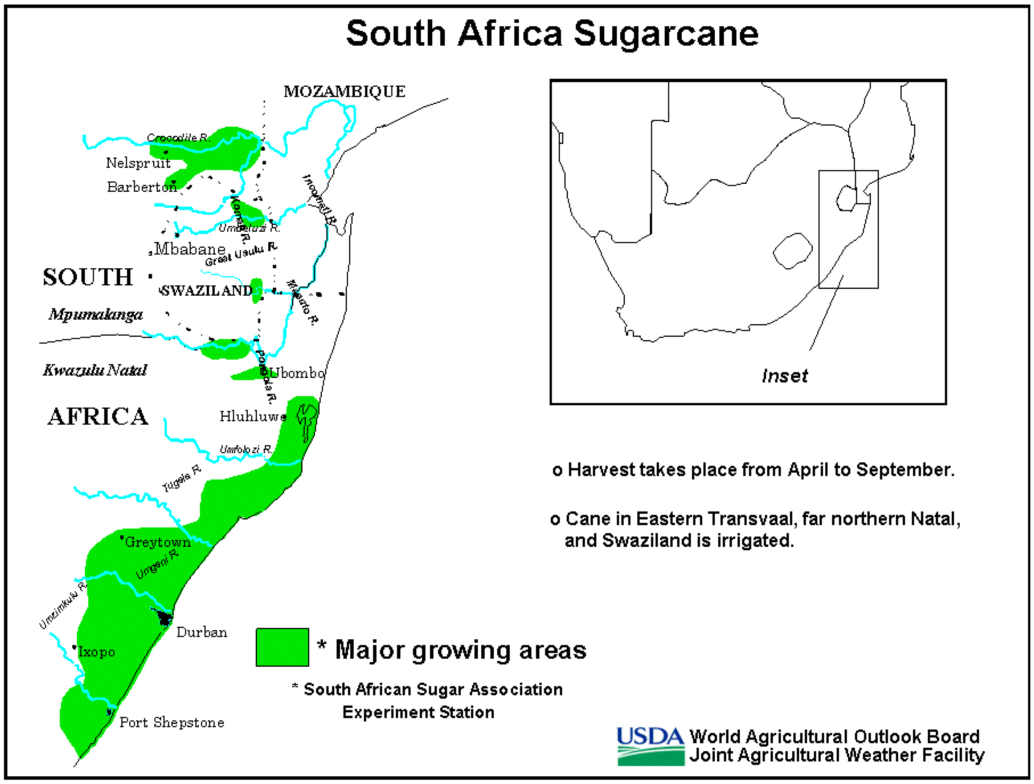

Figure 2.1: South African Sugar Cane Growing Areas

Source: USDA World Agricultural Outlook Board

2.2.1 Sugar Production and Consumption

The 2002/2003 production season of sugar cane reached a record level of 2.76 million tons. For 2007/2008 season, production is estimated at 2.27 million tons (SACGA, 2008). According to SACGA, an aggregate of 873842 tonnes of sugar production were destined for foreign markets during the 2007/2008 season. This indicates a decrease of 1.4% from 2006/2007 season. The national market enjoyed a total increase of 4.4% in sugar consumption; overall, the total percentage of sugar consumed locally is approximately 60%, while 40% is for the world markets (SACGA, 2008). Export sugar is sold at prices lower than domestic prices in order to make South African sugar competitive in the world markets. This is because major sugar producing countries have subsidised their sugar industries and, hence, their sugar prices are low. But the South African government has opted to support the industry through interventions such as tariff controls and there is also a working Sugar Cooperative Agreement among SADC countries (BFAP, 2008). The national agricultural statistics estimate national sugar income for 2007/2008 at approximately R7.5 billion; this include foreign income of approximately R2.3 billion (BFAP, 2008).

The South African Sugar Association has a dominant control over domestic market because it is the sole buyer and seller of sugar cane products in South Africa. The sugar Act (Number 9 of 1978) gave South African Sugar association the statutory power to divide sugar sale proceeds between growers and millers. Until 30 April 1985, the South African Sugar Industry was characterised by a unitary price scheme; the farmer received only one price for his product. The price was an average price of both domestic and export sales. Sucrose production was controlled by means of quotas which were allocated to certain areas of registered land. Quotas restricted production to quota holders, thereby resulting in high sugar prices. Revenues increased and this in turn resulted in high quota land prices. Ortman (1987) found that quota values in KwaZulu-Natal North Coast area in 1980 were about 60 per cent of sugar quota land value per hectare. The price of land in the regulated sugar industry consisted of real land value and quota land value combined together. This means that the relative price of the commodity influenced land value.

A two-tier price scheme was introduced on 1 May 1985 by the South African Sugar Industry. The purpose of the scheme was to reduce export losses caused by relatively low world sugar prices below costs of production. The scheme comprised two pools: The A-pool catered for domestic market requirements plus about 50 percent of normal annual sugar exports. In this pool, each sugar cane farmer was allocated sucrose production quota, as in the former single price scheme, which guaranteed a premium price above export prices. Quotas were only transferable within Mill Group areas. Production for the B-pool was voluntary and cane growers received the export realisation price which was a function of the world price. The export price risk was to be borne by an individual grower who chose to participate in the export market. There were no marketing costs levied to the farmer. The amount paid per ton of sucrose by SACGA reflected the net realisation price. The A-pool price in 1992 was R642.05 per ton of sucrose compared to R407.79 per ton B-pool sucrose, reflecting the gains for A-pool quota holders.

The Recoverable Value (RV) payment system replaced the sucrose payment system at the beginning of the 2000/2001 season. According to the South African Sugar industry (2008), the RV price of sugar cane per ton was R1105 during the period 2000/2001. In the period 2006/2007, the RV price was R1701.86. This means that the price had increased by 54 per cent from 2000/2001 season to 2006/2007 season. This change in cane prices means that net farm income has changed. Changes in net farm income have an impact on land prices.

2.3 Maize Production and Consumption

Maize producing areas should receive annual rainfall exceeding 350mm per annum because rain should be evenly distributed throughout the production season for efficient growth of plants. Soil fertility should be in the region of high to moderate to ensure good maize yields. Most of maize production in South Africa occurs in dry land areas. The major producing areas are the Free State (36.2 %), North West (32.4 %) and Mpumalanga (24%) provinces (SAGIS, 2006).

Maize is not a drought resistant plant and it thrives poorly in dry land. Maize requires considerable heat and plentiful water during production period (SAGIS, 2008). The major turn around in maize market was the establishment of major urban markets in Kimberly and later in the Witwatersrand (Christopher, 1982). Maize production expanded to fill the market in the 1890's. The first maize exports were witnessed in the early 1900's. The improvement in railway networks increased maize expeditions to other regions not exploited before. Technological advance (the introduction of hybrid seeds) in the 1950's also increased production of maize on same cultivated areas. Maize Average production in the early 1950's was 2.2 million tons; this volume increased substantially and by late 1970's South African maize production was fluctuating between 3.3 million tons and 9.9 million tons from static area of 4.5 million hectares (Chistopher, 1982). The increase in the volume of production resulted in increased demand for storage capacity. By 1977, the volume of storage had increased to 7.7 million tons from 0.9 million tons in 1967.

The area planted per year varies between 3.8 and 4.8 million hectares, which represent approximately 25 percent of South Africa's arable land. The South African Crop Estimate Committee (CEC) estimated that commercial maize area planted during 2007/08 season is 2.799 million hectares. The area planted in the previous season (2006/07) was 2.552 million hectares. This means that the area planted to maize increased by 9.7 percent in 2007/08. The expected commercial maize crop was 10.998 million tons and this is 54.4 percent higher than the 7.125 million tons for 2006/7. The expected average annual yield for white maize was 3.76 tons/ha whereas in the previous period the average annual yield was 2.66 tons/ha. The yield for yellow maize was projected at 4.21 tons/ha in 2007/8 whereas the 2006/7 yield was 3.03 tons/ha. The statistics report regards drought conditions experienced during the 2006/7 season as the main reason for the lower yields.

The South African maize industry was regulated by the government prior to 1 May 1997. The maize Board administered all sorts of arrangements relating to the marketing of maize. Marketing functions were funded by means of statutory levies (Department of Agriculture, marketing Division, 2003). A single channel fixed price system for maize on local market was used for pricing the product. The single-channel export pools for exports were operated by the Maize Board until April 1997. On 30 April 1997 the Maize Board operations were terminated; the maize Trust acquired all the Maize Board assets and was to use them for the entire benefit of maize industry. As from May 1997, producers are able to make their own marketing arrangements; prices are negotiated according to market forces. Contracts or futures prices are used for maize commodity pricing.

2.3.1 Maize Futures Market

Farmers protect themselves from troublesome transitory price fluctuations and try their best to give themselves a breathing room to adapt to fundamental changes in market conditions. Hedging with forward contracts is among the oldest and most used basic tool for managing risk (Kane et al, 2007). A forward contract is a legally binding agreement between two parties calling for a sale of an asset or product in the future at a price agreed upon today (Ross et al, 2001:613). In forward contracts the buyer is liable for delivery and for payment of goods. The seller has the obligation to make delivery and accept payment.

In South Africa, farmers hedge against the risk of commodity price fluctuations through futures contracts. A futures contract is a forward contract with the feature that gains or losses are realised each day rather than only on the settlement date (Ross et al, 2001:616). Because gains and losses are realised on daily basis, the seller pays up at the end of that day and a new deal is started again the following day.

South Africa is the largest producer of maize in the SADC region. The country's production during the year 2004/2005 was estimated to 11.45 million tons. The production forms approximately 45 percent of the total production of the SADC region (SAGIS, 2005). The country is also a significant supplier of maize to most SADC countries as well as Malaysia. Bearing these features, the South African Futures Exchange (SAFEX) is the largest futures exchange for white maize in the world. Maize commodity prices are determined by the interaction of forces in the SAFEX market. Since there is no government intervention in the market, price variations are experienced. Volatility in maize prices cause variations in net farm income that translates to farmland values.

2.4 Deciduous Fruits

The main deciduous fruit producing areas of South Africa are situated in the Western Cape and in the Langkloof area of Eastern Cape. These areas are characterised by warm dry summers and cold winters. It is generally accepted locally that June and July are the most critical winter months for deciduous fruits. If the mean temperature during these months exceeds 12.2ºC, delayed foliation to a severe degree could result. Late irregular blossoming and poor fruit set may prevail as a result unseasonal temperature (Christopher, 1982). The temperature of 12.2ºC is not far above 11.5 ºC which is the average for Western Cape deciduous fruit region. The average annual rainfall is approximately 1000mm and it varies widely throughout the season. The main controversy is that, highest rainfalls occur in winter months when trees are dormant and there is no real need for water in the orchards (Christopher, 1982). Fruit growers have seen the need to preserve this rain water and storage dams have been built. Storage dams like Eikenhof dam has assisted in water storage capacity increase by approximately 50 percent so that water requirements are provided when needed in the area (Christopher, 1982). Figure 2.2 shows South Africa's major deciduous fruit producing areas.

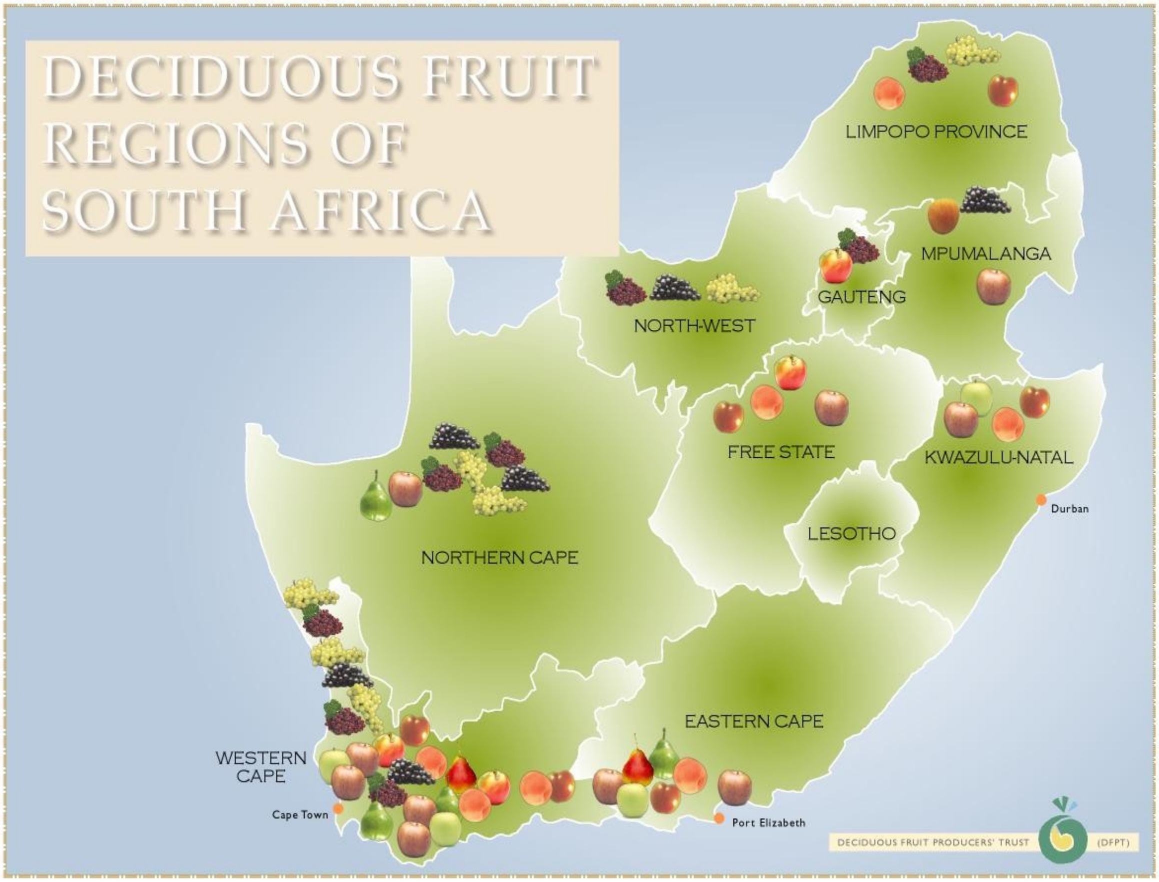

Figure 2.2 South Africa's Major Deciduous Fruit Producing Areas

Source: DFPT, 2008

2.4.1 Deciduous Fruit Production and Consumption

The fruit industry was started by the Dutch East India Company in the 17th century (Deciduous Fruit Growers Association (DFPT), 2009). The major developments on fruit industry occurred with the initiation of fruit exports to England in 1892 (DFPT, 2009). Special railway line connecting areas such as Langkloof and others with exporting ports were constructed (DFPT, 2009). In 1892 Cecil John Rhodes started the Rhodes Fruit Farms in the Franschhoek Valley using expertise imported from California, and these Rhodes Fruit Farms specialised in exporting fruits to England (Christopher, 1982). The export market under the Deciduous Fruit Board was established in 1939 being organised by producer cooperatives (DFPT, 2009).

Deciduous fruit supplies have increased more rapidly than demand in recent years (SAAPPA, 2008). O'Rouke (2001) suggested that aging total population, decline of traditional family household and increasing trend of eating out away from home have all created sluggish demand growth and over supply of deciduous fruits like apples and pears. The sticky demand for deciduous fruits prompt supplies of these fruits to compete fiercely in the product markets. Facing stiff competition among each other, rival export countries have sought for exploitation of new opportunities in developing markets (for example, the Middle East and Far East) instead of concentrating in traditional European markets (DFPT, 2008). South Africa is one of the producer countries that have established market ties with Eastern countries.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

The review of related literature discusses cross sectional and time series studies documenting relationships between farmland values, fundamental factors, and some other factors affecting farmland values in South Africa and abroad. South African historical farmland prices as well as world and domestic agricultural commodity prices are also discussed. The concept of neoclassical general equilibrium theory postulating a long run relationship between and/or among certain variables is also a subject of discussion in this chapter. The last section of the chapter sums up the literature reviewed.

3.2 International Studies on Land Prices

Past studies on farmland markets in the U.S.A. had been conducted on a time series basis or as a cross-sectional analysis. The investigations had different specific interpretations on land markets.

3.2.1 Cross-Sectional Studies

Investigation based on individual farm studies was conducted by Haas (1920) as quoted by Murray (1969). The aim of the study was to examine the relationship between the sale price and the factors influencing land prices of 160 farms sold in 1916 to 1919 in the Blue Earth County, Minnesota. The factors included in the study were crop yields, distance from the market, and value of buildings per acre, type of land, size of the adjacent city or village to the farm, and type of road passing through or near the farm. The coefficient of determination (R^2) in Haas's findings was 0.81; meaning that 81 percent of the variations in sale price was explained by the factors within the model.

Land without buildings for 99 counties in Iowa was correlated to four factors by Wallace (1926). The four factors were average corn yield per acre, percent of land not tilled, percent of land in corn and percent of land in small grain. Results of the study proved that 91.7 percent of total sample variation in land values was due to the independent variables ($R^2 = 0.917$). The variables, especially, the average yield per acre demonstrate that demand and supply of agricultural commodity prices have an influence on land values via net farm income. High average yields per acre indicate increased supply of crops or commodities and low average yields indicate low supply. Low supply results to higher demand for commodities that causes surge in crop prices.

Ahmed and Parcher (1964) developed a methodology of estimating the price per acre of land using the real farmland market values of recently sold tracts of land. The authors used four independent variables, namely, number of acres, productivity, population of the closest town and the distance to the major city or town measured in miles. Eighty one percent **(**$R^2 = 0.81$) of the variations in the model was explained by the variations in the independent variables. Ahmed and Parcher also conducted a further study on farm assessments. The study was based on farm tracts near the city of Tulsa, Oklahoma. The variables included in the study were number of acres, productivity, distance from Tulsa, and distance to tarred road, road type and mineral rights transferred. The results of the studies were $R^2 = 0.89$ and $R^2 = 0.85$ for two areas respectively.

Fluctuations in cotton farmland prices in the Mississippi River Delta were studied by Pen et al (1968) as quoted by Murray (1969). The model consisted of three independent variables, namely conditions of open land, wood land, and acres of cotton allotment. The proportion of total sample variation in the cotton farmland prices due to sample variations in all independent variables was 95 percent ($R^2 = 0.95$) for the study. Some of the explanatory variables in Pen's study (conditions of open land and acres of cotton allotment) are consistent with the study being pursued, but the study explains little about profitability of these open land conditions since these conditions can influence production prospects. Theory suggest that high productive land commands higher rent; the authors should have explained briefly how these conditions relate to profitability of land (their fertility rate) and hence, the rent prospects associated with them.

Pasour (1973) conducted a study on the value of farm real estate on a county basis for North Carolina from 1969 to 1970. The explanatory variables employed in the model were population density per square mile by county, crop land as a percentage of total farmland, the rate of tax, average market value of crops and forestry per acre, average size of farm and dummy variables for counties located in Western North Carolina and counties in North Carolina respectively. An R^2 of 0.74 was obtained

Reis and Kensil (1979) conducted a study to investigate the cause of variations on farmland prices from property to property. The study was a cross-sectional price analysis of farmland markets in the counties of Western Illinois for 1975. The model was conducted on all tracts of land greater than or equal to 12 acres (approximately 5 hectares). The model yielded an R^2 of 0.526. The average size of farms in which the study was conducted suggests that the farming practised in these farms was very intensive in nature. Price of agricultural commodities farmed under intensive methods is usually high, resulting in high revenues and land values.

3.2.2 Time Series Studies

Trends in land prices and farm returns were studied by Montgomery and Tarbet (1968). Increase in expected returns to farmlands due to improved yields was documented as the main driver of farmland prices in the wheat-pea region of the pacific North West. A study conducted by Iden (1964) on cash grain farms in Illinois from 1934 to 1950 proved that land values were highly related to returns per acre.

Johnson (1971) studied trends in rural land prices in New Zealand from 1954-1969 in order to relate the estimated market value of rural freehold land to net income. Johnson found that farmland prices before 1954 showed a tendency to fluctuate with net farm income. His final inference was that high land prices were associated with temporary increase in export prices.

Phipps (1984) studied theoretical and empirical relationships between farmland based residual returns, rents and farmland prices. A farmland price determination model was used to link residual farmland returns and market price of land. The validity of the linkage depended primarily on the opportunity cost of farmland reflected by present and future development of income potentials. The theoretical model combined with expectations process enabled the formulation of a partial hypothesis of determination of primary sources of farmland price movements.

Tegene and Kuchler (1990) used cointegration methods to examine the determinants of farmland prices in the three US regions, namely; the Corn Belt, the Northen Plains, and the Lake States. They found little or no evidence to reject the hypothesis that farmland prices are a function of market fundamentals.

3.3 South African Farmland Price Studies

Historical studies on land prices reveal that farmland prices in South Africa are closely related to expected returns to farmland (Waldeck, 1943; van Wyk, 1967; Behrmann and Collett, 1970; Nieuwoudt, 1980; Janse van Rensburg, 1984).

Waldeck (1943) studied trends in farmland prices in South Africa from 1927-1939. He analysed the links between land values, arability of land in maize, wheat and wool production, irrigation as well as rainfall. His findings were that land prices in general declined during this period. However, this was not surprising since this period includes the period of global recession. The area of land and the number of farms sold remained constant throughout the study period (Waldeck, 1943). Waldeck believed that the decrease in price trend was due to low demand in relation to supply of land.

Studies conducted by Tomlinson (1945 and 1946) on price trends of commodities related to agriculture observed a steady increase in land prices as commodity prices increase. Tomlinson did not use the residual return to assets to estimate returns to farmland. This led to his unpopular claim that farmland prices were high in relation to farmland returns.

Van Wyk (1967) made a suggestion that the various purposes for which land values are determined is important in land price analysis. He found that improved farming techniques resulted in increased land prices in Bethel area whereas in Vryburg district, the introduction of summer crops probably caused an increase in land prices. These findings are consistent with the hypothesis of the study being conducted in a sense that improved farming techniques increase the quality of products; high quality products command higher prices in the market. Higher prices, *ceteris paribus,* result in increased farm income that impact positively on farmland values.

Behrmann and Collett (1970) reported in their article that the price of South African farmland had risen considerably from 1939 to 1960. Three land price models were used in this study. A Nerlove-type distributed lag model was employed to estimate the models. The models applied in this analysis proved that increases in net farm income were capitalised into higher land values. Nominal land values were negatively related to interest rates. The model developed by Behrmann and Collett was able to explain changes in land values over time.

Ortman (1987) found that land rents serve as a reliable measure of farm profitability.

Collett (1969) used data from 1939-1966 in his analysis of factors affecting farmland values in South Africa. He found that real land price was positively related to lag real land price, the total population, and the agricultural price index ratio, but negatively related to the agricultural producer price index ratio.

Hatting and Herzberg (1980) conducted a study of land prices in South Africa from 1959 to 1979. The results of the study proved that land prices had increased at an annual rate of 7.15 percent per annum, and at the same period the net income accruing to farmers increased at a rate of 11.42 percent per annum. In their study, Hatting and Herzberg noticed that net farm income accruing to farmers increased by 7.94 percent per annum while land values increased by 11.34 percent per annum during the period 1973 to 1979.

Nieuwoudt (1980) studied the rate of return on farmland based on a comprehensive survey of land rent in South Africa. The study was based on cross-sectional data of 843 rented farms in South Africa, grouped into 106 areas. The correlation coefficient between farm earnings and farmland value was 72 percent. Nieuwoudt further conducted a study of land values using time series data for the period 1948 to 1980. The correlation coefficient between profits and land values in this study was 93 percent. This indicated a good or close relationship between farm earnings over time and farmland values (real estate values). Nieuwoudt (1980) also studied the rate of return on farmland in response to concern by credit institutions and some market stake holders about "high" land prices in relation to farmland returns that farmers earned during that period. Economists using the concept of Productivity Value (PV) of a farm concluded that farmland was over priced. The equation they used is given as:

$$PVI = \frac{RO}{i}$$

Where Ro = real annual rates of return

i = farm mortgage rate

The model was criticised by Nieuwoudt saying that it does not consider the role of the inflation rate on rents and it also assures zero rate of increase in real profits.

A study of factors explaining changes in South African land prices from 1959 to 1979 was conducted by Janse van Rensburg (1984). Using time series Janse van Rensburg found that nominal land prices were positively related to inflation rate but negatively related to interest rate on credit financing facilities. Janse van Rensburg further pointed out that the supply of land in South Africa is very limited; therefore improved management and technology would be critical factors in improving production and this would result in improved net farm income.

Van Schalkwyk (1995) conducted a study analysing the relative significance of factors determining farmland prices. The study comprised of a multidimensional effect of inflation on capital erosion, savings-return erosion, real debt reduction, and the effect of variations in the capitalisation rate. The results proved that returns to farming were the only one of the major factors explaining land prices movements. Interest rate and inflation were important factors in explaining land price movements.

The reviewed literature on historical studies on farmland values revealed that significant proportions of variations in the dependent variables were explained by factors within the models. The review of literature also revealed that market forces that determine commodity prices (for example, average yields per acre determine whether there is excess supply or excess demand) play a major role in determining farmland values. The other factors that appear consistently in most models discussed are the distance from the major city or town and population size of the village adjacent to the farm. Distance to the main centre minimises transport costs and this results to increased revenues. Population size is a proxy variable to estimate the buying power of consumers. The next section examines specifically the role of agricultural commodity prices on farmland values.

3.4 The Interaction of Price Determinant Factors

The interaction of the South African agricultural sector with other economic sectors, especially the monetary sector may affect the agricultural sector positively or negatively. It is assumed that the relationships between farmland markets and macroeconomic indicators can be modeled through time series to give current and future directions for investors and policy makers regarding farmland price formations. But studies on farmland price determination using forecasting error variance decomposition are not common in South Africa. In this section, literature reviewed examined studies conducted on agricultural and other economic sectors based on vector autoregression forecasting error variance decomposition estimated to capture the future impacts of shocks among variables in the system.

Using a vector autoregression model (VAR) Olomolo and Adejumo (2006) estimated the effects of crude oil price shocks on the Nigerian macroeconomic progression. The forecasting error variance decomposition technique was used to examine the movements of oil price impulses in the Nigerian economy. The magnitude of variations contributed by oil price shocks to variations in other variables in the system was also assessed. Findings from this study revealed that crude oil price shocks significantly impacts oil revenues; contributing a maximum of 38 percent of revenue variations in the short run (first year) and this contribution declining to 25 percent in the long run (fifth year). The contribution of oil price shocks to money supply variations accounted for 4.62 percent in the long run while the short run impacts of oil price impulses are not significant at 0.22 percent in the first year. The authors concluded that the Nigerian monetary policy had limited influence in driving the economy due to fiscal policy dominance.

Awonkuse and Duke (2006) identified the casual effects of different variables on the observed variations in Canadian farmland values. The authors used the combination of cointegrated vector autoregression model and the direct acyclic graphs (DAG) model in their eight-variable study. Inflation and interest rate were found to have an indirect impact on farmland prices. This meant that farmland prices and farmer wealth “appeared to be sensitive to macroeconomic factors” (Awonkuse and Duke, 2006:241). The authors also concluded from the forecasting error variance decomposition (FEVD) results that farmland price expectations, net farm income, opportunity cost of capital and interest rate were key drivers of farmland prices.

Alami (2001) used variance decomposition analysis to estimate the Egyptian local demand for money. Results for his study revealed that expected rate of return shocks on foreign money differ from expected rate of return shocks on domestic money. The difference between these two types of expected rate of return shocks proved to be the main driver of variability in local real balances compared to quarterly expected accounting depreciation.

3.5 Factors affecting Agricultural Commodity Prices in South Africa

3.5.1 Population

Statistical records show that the population of South Africa increased from 40.5 million in 1996 to 44.8million in 2001. Recent community survey returned an estimated population of 48.5 million, an overall increase of 8.2 percent since 2001. Petty (1662) in Hull (1966) outlined population growth rate as one of the factors affecting farmland values; he pointed out that increase in the number of people dependent on food from a fixed supply of land causes demand for food to increase. The increase in commodity prices translates to increases in farmland values via net farm income.

Increasing population growth rate is not a problem facing South Africa alone. Most countries in the Southern African Development Community (SADC) region are experiencing a population explosion. Population growth rate in most SADC countries exceeds both production rate and cereal availability (Nichola, 1998:95). The SADC countries, including South Africa are now dependent upon imports to meet their domestic food requirements. Findings by Nichola (1998) postulate that the region is facing a critical situation of transitory food insecurity, which Nichola defines as short term decrease in food occurring as a result of drought, variability in income and variability of prices.

The coefficient of variation which Nichola used to measure the temporary food insecurity shows that cereal availability in the region is less than what should be produced. This indicates an existence of high demand for cereals in the region. High demand pressure for commodities influences price increases that could impact on the prices of land that is used to produce such commodities. The SADC, including South Africa is faced with volatile cereal production growth rate and rapid increase in prices. These are definite indications of "diminishing entitlements to food and hence transitory food insecurity" (Nichola, 1998:94).

It is therefore argued that population growth increases demand for food. The increased demand for food pushes agricultural commodity prices up. Increased commodity prices result in increases in net farm income which could translates to increased farmland values.

3.5.2 Technology

Technological adoption is one of the factors affecting commodity prices. Increased technological progress results in increased outputs and thus, the increase in commodity prices is mitigated. In South Africa technology has improved the amount of produce that is obtained from commercial farms. Past South African agricultural policies discouraged technological adoption such as the use of hybrid seed and fertilizers by African farmers in their areas. Smallholder farmers in South Africa are relatively slow to adopt new technology. Past studies (Chirwa, 2005) reveal that technological adoption is positively related to higher levels of education, market based tenure reform; but negatively related to distance from input markets and poor credit facilities. Most South African smallholder farmers were denied access to higher levels of education by the apartheid system. Tenure security is not well defined in African areas and farmers are generally far from the inputs markets. All these factors suggest the slow adoption of technology by African farmers; meaning that smallholder African farmers cannot produce enough food for themselves and their families (Cooper, 1988). The whole population of South Africa then depends on the limited number of commercial farms for supply of food. This causes the demand for food to be high and thus producer prices to be also high.

3.5.3 Exchange Rate

The high South African fruit prices and export boom in the early 1990's created puzzles whether the Rand devaluation or consumer tastes and preferences had caused such commodity price booms. The South African rand devaluated in 1991 and in 2002 against the US dollar and the British Pound; these Rand devaluations were followed by a large increase in aggregate volume of deciduous fruit exports. High fruit prices and farm income during these periods were recorded (Agricultural Research Council, 2003). The rapid economic growth and increases in real per capita income in the US and in Europe where deciduous fruits are mainly exported contributed to an upward shift in the foreign demand schedule for South African fruit exports. The over valuation of the South African Rand in the mid to late 1990's artificially depressed South African fruit prices.

These occurrences prove that if the export demand is elastic, foreign exchange earnings will decline with an over valuation of currency and increase with devaluation in currency. In general, a devaluation of exchange rate will shift the domestic terms of trade in favour of local producers against importers. Devaluation of currency makes exported goods cheaper at foreign markets, this creates excess demand for these goods and their prices increase accordingly. Over valuation on the other hand reduces demand for exported goods as they become expensive due to over valuation.

3.5.4 Input Costs

The recent findings of fertilizer price fixing by Sasol have raised concerns over how the input costs have changed farmer wealth and consumer surplus. It can thus be argued that input pricing; particularly inputs for agricultural production have major implications for food prices, farmland values and food security. In 2009 Sasol South Africa was convicted for price fixing in the fertilizer and phosphoric acid regimes (Reuters, 19 May 2009). Reuters reported that Sasol formed cartels with its competitors Omnia and Yara warranting Sasol the monopoly status of supplying fertilizer products like ammonium nitrate and limestone. Apart from these deals with Omnia and Yara, Sasol also colluded with Foskor (a phosphate and phosphoric acid producer) and this deal gave Foskor a monopoly power of being the only phosphoric acid supplier in South Africa. According to Reuters, fertilizer prices in South Africa were 38 percent higher than average world fertilizer prices due to collusion acts by fertilizer suppliers.

3.6 Commodity Prices and Farmland Price Trends in USA

The period 1910 to 1914 is recognised as the "Golden age of The American Agriculture" and the period between 1921 and 1933 is regarded as the "Economic Hell" of The American Agriculture (Cochrane, 2003). Cochrane describe these two contrasting periods as follows:

Farm commodity prices rose steadily between 1900 and 1915. Due to increase in farm commodity prices, farmland prices followed the same upward trend. Farmland prices doubled between 1900 and 1910 (Cochrane, 2003).

Farm commodity prices fell sharply in the period 1920/21. There was a slight recovery of farm commodity prices in the mid 1920's. Prices plummeted again between 1929 and 1933. The value of farmland prices followed commodity price trends once again. The average per acre price for the whole of USA fell more than 50 percent. In Iowa, the average per acre farmland dropped from US $227 in 1920 to US $60 in 1933.

Henderson (2008) studied agricultural land price trends and analysed the factors underlying the current surge in US farmland markets. He compared the current trend in farmland values to past agricultural booms. Agricultural land prices soared in 2007, posting record gains in most regions of the US Corn Belt. Henderson postulated that thin crop production, strong bio-fuel demand, weaker dollar and robust export demand led to an increase in crop prices. The increase of crop prices up until the first quarter of 2008 provoked a surge in farmland values.

Historical evidence suggests that strong demand and low supplies of agricultural commodities had created previous booms in farmland values (Moss, 2003). Moss argues that high prices stemming from strong demand and tight supplies are associated with the 1970's and mid 1990's booms. During the 1970's agriculture was forcefully driven by global food demand. Historical records postulate that the world economic growth was expanding by 4.5 percent annually during that decade. This economic growth increased food consumption in most developing countries.

The weakening of the US dollar made US food products very competitive in world food markets. The Russian grain deal of 1972 together with weaker US dollar contributed towards the increase in agricultural export (Henderson, 2008). Corn prices rose from US $1.11 per bushel in the 1960's to US $2.10 per bushel. Increased net returns to crop production soon translated into high farmland values.

The 1980's global recession coupled with inflation fighting campaigns slashed world food and other commodities demand. The US dollar strengthened and the Russian grain deal was suspended. This restricted the US agricultural export demand. Expected high crop prices vanished, the value of farmlands declined by 5.2 percent in the period 1980 to 1987 (Henderson, 2008).

The poor economic performance of the 1980's was followed by another short agricultural prosperity in the mid 1990's (Cochrane, 2003). The Asian economic growth together with low world grain supplies boosted the demand for agricultural supplies. Farmland values rose as low supplies pushed up crop prices to new records in 1996. The Asian financial crisis in the late 1990's crippled the world economic growth. World food demand saw a decline and the US agricultural exports dropped by 14 percent between 1996 and 1998 (Henderson, 2008). The average annual corn price per bushel also dropped from US $3.24 in 1995 to US $1.94 in 1998.

US government subsidies supplemented farm income during the late 1990's down turn. Government payments accounted for 38.2 percent of US net farm income (Moss, 2003). Aid from the government helped farmland prices not to fall as low as the 1980's records.

3.7 Farmland Price Trends in South Africa

South Africa has experienced farmland price booms and recessions in its history. These periods of high and low price levels had affected prices of agricultural land differently depending agricultural regions and types of crops grown in those regions. The best known booms were during the periods of 1945- 1969, 1970-1979 and 2003-2006. The boom of 1945-1969 was due to rising price trends in agricultural commodity prices as a result of vibrant demand created by the Second World War. Prosperity results of World War II and post War gains to farmers rewarded farmers with net farm income increase that was significantly greater than other previous years in history. The world demand for agricultural product was robust and world economies were reshaping after the War. Farmers capitalised the increased net farm income into farmland values; farmland values then soared during the period 1945-1969. The second great boom was also brought by the increase in commodity prices and relative low interest rates. Interest rate by Land Bank to farmers fell to its lowest and was reported negative in 1977 (Darroch, 1995). The fall in interest rates prompted the appreciation in farmland prices. By 2003, inflation rate was well under control in South Africa. This prompted the South African Reserve Bank to cut or leave the interest rates constant for consecutive quarters. Demand for farmland then became robust during the period 2003-2006. Agricultural commodity prices were also on a rise following the certainty of the farmers that the industry deregulation did not have a significant negative impact on the agricultural sector.

Turning to the recession part of farmland values; great recessions were experienced in the South African farmland markets during the periods 1929-1939, 1982-1983, and 1991-1998. The collapse of the entire world economy into severe depression (Great Depression) during the period 1929-1933 also affected the South African economy and agricultural sector. World and local demand was slashed by the Great Depression. Agricultural commodity prices dropped and returns to farmland slumped. As a result, a huge drop in farmland prices from 1929-1939 was experienced in South African farmland markets. Farmland prices recovered after this period and farmland price booms that had been discussed earlier were experienced.

South African farmland markets also experienced the dips in 1982 and 1983 (Darroch, 1995). Severe drought that hit the country during these years caused severe damages to the agricultural industry. Net farm income for farming sector dropped as a result of drought. The rising trend in farmland values was also reversed by an increase in interest rate. Interest rate increased from 7 percent in 1981 to 17 percent in 1991 and as a result, land values dropped.

3.8 World and South African Agricultural Commodity Prices Review

World grain prices rose sharply in 2007/2008 because of thin supplies and vibrant demand for food use and production of bio-fuels. Production of biofuel from food crops has been identified as one of the main drivers of sharp increase in food prices (Henderson, 2008; Bureau for Food and Agricultural Policy, 2008). The rapid hikes in food prices raised serious concerns about food security in terms of food affordability and accessibility by the poor in many regions of the world (FAO, 2008).

World maize prices are expected to maintain a rising trend until 2009 because of lean supplies of maize (FAPRI, 2008). The shifting of some production areas from maize production to wheat and soybean production has reduced maize supplies while the world demand for maize has grown slightly. Due to this shift in production pattern maize prices have risen and are expected to rise in 2009 (FAPRI, 2008).

The year 2006 was regarded as a good year for the sugar industry. FAO (2008) reported an increase of approximately 57 percent in world sugar prices in 2006. The strong supply response to high 2006 prices increased sugar production and this triggered a decline of 27 percent in world sugar prices in 2007. World sugar surpluses were still reported in 2008 but production was declining as prices droped. FAO reported an average of 13 percent decline in world sugar prices during 2008. The demand for sugarcane for ethanol production as well as the demand from world consumption could set a rise in sugar prices in 2009.

South African agricultural sector has experienced a significant growth during the years 2006 and 2007. Producer prices for field crops and horticultural crops increased considerably over the years 2006-2008. For the livestock industry, strong economic growth as well as competitive feed prices had caused increases in meat and dairy product prices (BFAP, 2008). But profit margins in the entire agricultural sector have been continuously checked by high input costs; hence the industry's growth prospects are not significant.

South African maize producers have followed the world pattern in maize production. Growth in net farm income for wheat and oilseeds has shifted the farmers focus towards the production of wheat and sunflower (BFAP, 2008). But maize production did not decline in 2008 and it is anticipated that it will remain constant or increase in 2009. Maize exports increased considerably in 2008 as the levels of production in other SADC countries were not good (NDA, 2008). The reduction in maize planting will lower maize stocks in future and current (2008) prices of R2000 per ton might increase in response to decrease in area planted, production could also decrease as a result.

Sugar cane production in terms of area planted and yields per hectare experienced positive growth in 2006 and 2007 seasons (SACGA, 2008). The bio-fuel industry is expected to compete fiercely with sugar for sugar cane as feed stock. This might cause a surge in (recoverable value) RV price for sugar cane.

The DFPT describes the 2008 season as an excellent season in terms of production, volume of exports, prices and returns to growers for both apples and pears. For 2009, quality and quantity of fruit produced are expected to be good because climatic and weather conditions experienced up to the beginning of the second quarter of 2009 were good. On average, the amount of volume of exports for pears is expected to be higher than previous years (2006-2008) averages. Predictions for pears reveal that Southern Hemisphere growers will receive an increase of 11.09 percent in 2009 compared to 2008. Countries expecting higher pear crops are Argentina (20.5%) and South Africa (7%). Other Southern Hemisphere producers are expected to experience a decline in crops (Australia (-1.1%); Chile (-7%), and New Zealand (-21%)) (SAAPPA, 2009). SAAPPA predicted that overall world export figures will be lower by 9.7 percent in 2009 compared to 2008. South Africa and Argentina stand a good chance of making substantial profits out of pear crops. Volume of exports for apples is expected to be slightly less than the average of 2006-2008. But exports are expected to be boosted by exchange rate that has depreciated considerably against the Euro and the U.S. Dollar since 2007. The impact of collapsing of world financial markets that has plunged world economies into great recession since 2008 could reduce the world export demand.

3.9 Government Payments and Farmland Values

The future role of government in agriculture is an important factor and is regarded by many as one of the major sources of uncertainty affecting agricultural production and farmland markets. In the Canadian provinces of Quebec and Ontario supply management of commodities (including dairy and poultry) have dominated the agricultural industry. Land values are the highest in Ontario, particularly because of government involvement. Net farm income is less variable in Ontario and Quebec provinces as compared to other Canadian provinces like Saskatchewan. The influence of government payments to farmers increases cash that is available to farmers. Farmers may use this cash for the purchase of additional farmland and this might influence land values. In the US, land values have risen significantly from 1985 as net farm income that includes government payments has risen constantly (Alston, 1986).

Agricultural subsidies have deep roots in South Africa. Cooper (1988) argues that subsidies were designed to help poor farmers to survive since the 1930's. The main objective of giving subsidies was to keep or to maximise the number of farmers on the land. Farmers were offered cheap credit, loans or grants to carry on their farming activities. Subsidies continued to increase despite the government's stated aim of decreasing agricultural support (Cooper, 1988). The political and economic penalties of withdrawing agricultural support seemed to be a burden too huge for the government to bear. Increased agricultural subsidy from R174.6 million in 1980 to R500.1 million in 1985 showed the government's commitment to agricultural subsidies.

An additional R262 million was set aside in 1986 to subsidise farmers' loans from the Land Bank and the Agricultural Credit Board. A further R134 million subsidy was added in 1987 to boost maize prices.

The Marketing Act of 1936 (revised in 1968) postulated the setting of marketing boards that were set to promote the sale of agricultural commodities and protect farmers from massive price variations. During the 1960's and 1970's expectations of increased future earnings from land were raised by reduced risk of farming through government support measures. Results of these expectations were increased land prices. Farmers reacted to increased capital gains by increasing debt use; buying additional farmland and investing more on farm improvements and larger machines. The government reviewed its policies in the 1990's; farmers' privileges were reduced and this led to a dramatic change in the agricultural industry as far as earnings and land values are concerned (van Schalkwyk, 1995).

CHAPTER FOUR

SOUTH AFRICAN HISTORY OF LAND OWNERSHIP AND LAND REFORMS

4.1 Land Reform Issues

4.1.1 Experiences from Other Developing Countries

In East Asia, land reform has played an important role as far as equity is concerned; especially in the Republic of Korea and Taiwan where productivity gains were immense (World Bank, 1993). In Taiwan, land from landlords was confiscated by the government. Land lords were compensated with shares in the state enterprises (Faruqee, 1995). Land was sold to farmers at competitive prices on favourable credit terms. The government also provided technological assistance to new beneficiaries. On the other hand, a long history of failing land reform is evident in the Philippines. Poor implementation and poor enforcement procedures resulted in the reforms lacking the speed and finality of success (Faruqee, 1995). In this sense, land reform in the Philippines has been similar to that of South Africa (where land reform procedures lack appropriate delivery pace and proper implementation measures). The other least successful countries with land reform are counted as Brazil, Colombia, and Guatemala. These countries are characterised by highly skewed pattern of land ownership. A substantial amount of funds are invested in large scale farms. These large scale farms are economically inefficient as far as land use and labour are concerned. The results are rapid out-migration of labour from the agricultural sector into urban and rural slums. Hall (2007) substantiates that focusing too much on large scale farming by these countries fuelled rural and urban poverty.

It is revealed from historical findings of many redistribution programmes that once people are given good farmland, they can lift themselves out of poverty permanently. In Africa, this has been the case of both Kenya and Zimbabwe. Van den Brink et al (2007) argue that after ten years of land reform implementation, Zimbabwe’s land reform programme on small scale was deemed a success. Land reform beneficiaries cultivated nearly 50 percent more land than non-beneficiaries; obtained four times as much in crop revenue, and had expenditures that were higher by 50 percent (van den Brink et al, 2007:158). But Zimbabwe’s overall land reform has turned out to be unsuccessful. The country has moved from food secure to one highly insecure over the past decade. These contradicting land reform policy results for Zimbabwe emphasise the need for review of land reform policies in countries like South Africa. The next section discusses the South African history of agriculture and land reform programmes that are currently in progress.

4.2 South African Agricultural History and Land Reforms

South Africa has a long history of land since the passing of the Native Land Act of 1913. Vink (2003) argued that the notorious Land Act divided the land between blacks and whites. The act decreed that: no whites could own land in African areas, no African could own land in white areas (except in the Cape). Africans who lived on white owned land had to work for the owner; black farmers were no longer allowed to rent land from a white land owner. As a result, whites regarded land as a private property whereas the Africans regarded land as an input factor in South Africa. Land ownership discrepancies in South Africa are discussed below.

In the mid nineteenth century the South African agricultural sector consisted of large-scale farms operated by white farmers, white owned estates with peasant tenant farmers as well as peasant farming on black-owned land (Mbongwa *et al*, 2000). It is argued that two geographical regions of agriculture existed during the nineteenth century in South Africa. One of these regions was the coastal farming region that was made up of Western Cape and its interior parts as well as other coastal parts stretching towards Port Elizabeth. The coastal farming region enjoyed access to export markets and was thus prosperous throughout the nineteenth century. Agricultural products such as wool, wine and fruit were exported to Europe. Products such as crops, horticulture and livestock were produced for domestic markets (Christopher, 1982).

The second agricultural region of the nineteenth century in South Africa was the inland region. The main farming activities in the region were livestock and crops. Most of the agricultural production of the interior region was consumed locally. The major turning point in the region was the discovery of diamonds in 1867 and gold in the 1880's. Vink (2003) argue that the discovery of these mineral deposits created a large domestic agricultural market in the interior of the country.

It is argued that African farmers were able to exploit the opportunities in the agricultural markets that emerged as a result of growth in urban centres and as well as growth in urban population. African farmers supplied most of the agricultural products needed in the major towns and exported the surplus to the Cape. They accumulated wealth and capital; as a result the Native Affairs

Commission pointed out that "Africans were becoming wealthy, independent and difficult to govern" (Mbongwa *et al*, 2000: 8).

African farmers were then marginalised. This resulted in a decline in agricultural production towards the end of the nineteenth century. Funnell (1991) argued that the decline was engineered by the whites; the statement is supported by Vink (2003) who argued that white farmers complained to the government about the tough competition they get from black farmers. African farmers had accumulated technology, equipment, farming skills and were not willing to offer their labour to white farmers for wages. White farmers then sought government intervention to limit African competition in the markets. Commentators suggest that the intervention was successful in creating land shortages for African farmers and forcing them to seek work on white farms.

The South African Native Affairs Commission (1903 – 1905) was set to conduct the task of rationalising the native land rights across the country (Funnell, 1991). The Land Act of 1913, as discussed in the first paragraph of this section postulated racial discrimination of access to land. After the 1913 Land Act, 67 per cent of the total population (the Africans) were provided with 7.3 per cent of legal rights to land. This percentage was however increased to 13.8 per cent (6.2 million hectares) in 1936. The table below shows land allocation by the government of South Africa at that time.

Table: 4.1 Land Areas by tenure system, 1916

Tenure System	Area Hectares	Percentage
Native Reserves	9538300	7.8
Mission Reserves	460000	0.4
Native owned lands	856100	0.7
Crown lands occupied	805100	0.6
EOL occupied by Europeans	90314000	73.7
EOL occupied by Africans	3550900	2.9
Vacant Crown lands and other reserves	17002400	13.9
Total	122526800	100

EOL = European-Owned Land

Source: Report of the Beaumont Commission, 1916, pp. 3 and 4

At this stage the South African agricultural sector was characterised by a dualistic policy. White farmers were subsidised with mechanisation and capital to reduce their dependence on black farm workers. The dualistic agricultural economy consisted of a small group of "capital intensive technologically advanced commercial farmers and a large group of technologically backward and resource poor farmers" (Mbongwa et al, 200:67). Cooper (1988) saw the pattern of agriculture as consisting of three sections: the core system in the highly productive commercial sector, the less developed sector still owned by whites, and the subsistence sector in the homelands or reserves. The core sector supplied about 75 per cent of the country's agricultural output. The less developed sector is characterised by poor cropping and low-value livestock. The owners of less developed farms are seldom found on the farms and African managers keep the farms running with inadequate supplies of resources and production inputs. These managers are remunerated by land to live on and /or land to cultivate.

Despite the support enjoyed by white farmers, the South African farm productivity was lower compared to other countries with similar investment level on agriculture. This is because South African soil structure and rainfall are poor compared to European, Asian and South American countries (Funnell, 1991). This means that technological investment in South African farmers did not justify the costs incurred. Protection of the South African farmers from foreign competition increased the prices of agricultural commodities and fuelled South Africa's inflation.

The land in the homelands was held under common property rights regime. Chiefs and headmen played a role in land distribution. The land was distributed on the basis of one family one plot and the plots were small because land was to be divided among many people. Cooper (1988) noted that the land was not divided equally as larger plots were allocated to chiefs, headmen and their supporters. This further worsened the skewed pattern of land ownership among blacks themselves.

A study conducted by Funnell (1991) revealed that most residents in the homelands (reserves) were not able to provide for their subsistence needs from their own agricultural production. Funnell (1991) also postulated that a fall in per capita agricultural production in homelands was due to population pressure on land. He further stated that lack of state support also contributed to the fall in per capita production in homelands. Further application of new farming methods which might increase land use and management were not pursued. Reports proved that conditions were deteriorating in the homelands. The government decided to embark on plans to rehabilitate the reserves.

The Tomlinson Commission (1955) was established to conduct a revised rationale for development in the reserves. One of the proposals of the Tomlinson Commission was that changes in the tribal tenure system were needed. The Commission also emphasised more on the creation of full time farmers on title deed land. In 1972, a committee was set to look into the possibility of introducing title deeds and renting holdings based upon the valuation of land in KwaZulu (Funell, 1991). The idea was strongly opposed by the chiefs who had the right to allocate land and whose power and patronage depended upon land to some extent. This can be regarded as the first signs of the creation of inefficient land markets in communal areas.

Allowing privately owned land in the reserves was suggested as a solution to the deteriorating land. Communal land tenure puts breaks in the investment on land among rural communities. The argument is that, a person derives no incentive to make permanent improvements on the land he does not own. Stock farming was and is still the most common type of agricultural practice in communal areas. Cooper (1988) argued that much land in communal areas is marginal and inappropriately used. Land degradation is a serious problem but tillers continue to cultivate under deteriorating conditions. Lack of capital in the form of cash and oxen result in under utilisation of the scarce fertile land. The next section will discuss the land reform programmes that were suggested and undertaken to correct past injustices.

4.3 Land Reform

After 1994 the African National Congress (ANC) led government saw the need to address past injustices in land ownership. The policy on land reform was drawn. There are different land reform policy programmes that fall under the umbrella of the South African Land Reform Policy. The South African interim constitution specified three land reform policies when it was launched. Van Zyl et al (2000) specify these land reform policies as follows:

- Restitution of land lost as a result of racial discrimination
- Redistribution of farmland to historically disadvantaged people
- The improvement of tenure security in former homelands

4.4 Modes of Redistribution in South Africa

4.4.1 The Settlement/Land Acquisition Grant

From 1994 onwards the settlement/land acquisition grant (SLAG) had been the main tool used by government to redistribute land. The objective of the programme was to provide poor landless people with a R15000 cash grant for the purpose of purchasing and improving farmland. The main obstacle for this programme was that the R15000 grant was too little to purchase a meaningful farmland in the market. Commercial farms were not easily sub divisible due to the Subdivision of Agricultural Land Act 70 of 1970, and because of high transaction costs involved in sub division of farm units. Beneficiaries opted to pool their meagre grants in order to buy a farm from a willing seller.

The number of beneficiaries who can pool their grants in order to purchase a farm usually became too large for an affordable farm to carry them. Suggestions from the Department of Land Affairs encouraged farmers to use their grants for loan finance acquisitions to buy land. However, the opinion was constrained by means test applied to potential beneficiaries. The means test precludes beneficiaries with a monthly household income of more than R1500; thereby excluding credit worthy farmers from the scheme (AFRA, 2004).

4.4.2 The Land Redistribution for Agricultural Development

The most relevant policy instrument for this study is the land redistribution for agricultural development programme (LRAD). The main objective of the (LRAD) is to redistribute 30% of the country's agricultural land from White farmers to Black farmers by the year 2014 (DLA, 2003). The objective is in line with the South African Land Reform policy to achieve social justice and promote greater productivity in agriculture. Beneficiaries qualify for LRAD grants according to the amount they have contributed. Land Redistribution for Agricultural Development (LRAD) was launched in 2001 with the objective of establishing a class of African commercial farmers (Hall, 2007). LRAD superseded the SLAG programme which did very little to address the problem of land ownership. The DLA results show that by 1999, less than 1 percent of agricultural land had been transferred through all aspects of land reform (including SLAG). Approximately four percent of agricultural land (3.5 million hectares) had been transferred through all land reform programmes by February 2005 (MALA 2005a:8). The market-led approach based on "willing buyer-willing seller" is blamed for delays in land reform delivery. The other main culprit causing delays in the delivery of land reform is the DLA itself. The department had allocated insufficient funds to carry the mandate of land reform (Walker, 2007).

4.5 The Bargaining Process and the "Willing buyer-Willing seller" Approach

The dynamics of farmland transactions often involve high levels of psychological and emotional energy. A seller's emotions stem from his or her emotional attachment to the land he or she has farmed for years. A buyer might be attracted to the farm because he/she has seen its beautiful scenery for years before it is offered in the market for sale. The buyer might be driven by profit prospects to buy a farm. Buyers and sellers interact directly or indirectly and bargain with each other in farmland markets. If buyers and sellers reach agreement on a selling price, the transaction is completed, otherwise bargaining parties start searching again for new bargaining partners. Issues that need to be considered when conducting a bargaining process are stipulated by King and Siden (1994:38) as follows:

- Relative influence of buyer, seller and market characteristics on the sale price
- Differential values that buyers and sellers separately place on farmland
- The influence of the bargaining process itself

Cross (1965), cited by King and Siden (1994) introduced a notion of concession rate as the rate at which the bargainers change their positions in response to demands of the other party. During the bargaining process, each party learns about the other party's concession rate and adjust his or her expectations. The learning process leads to convergence of needs and expectations. However, Cross pointed out that strategic behaviour impedes the learning process and timely adjustments to market conditions.

King and Siden (1994) empirically found that bargaining strengths affect outcomes. Equal bargaining strengths tend to yield equal split of payoffs. The study also revealed that bargaining personalities influence outcomes.

In the South African context, the "willing buyer-willing seller" bargaining system allows the eligible LRAD beneficiaries to bargain the price of land with sellers. Vink (2003) argues that the principle of "willing buyer-willing seller" promotes a free market but not necessarily land reform. The "willing buyer, willing seller approach" makes land reform conditional on the willingness of the seller to sell at the prices that grant applicants can afford or cannot afford. Although South

Africa has an active land market, acquiring land through LRAD grant is not easily achieved (Hall, 2007). Land prices offered at the market price are too high for LRAD beneficiaries. Beneficiaries cannot exercise the benefit of pooling grants. Restrictions on pooling grants have been set because group projects are problematic and are being discouraged. Other pit falls and limitations of the market-led approach to land reform are discussed below.

4.6 Large Farm Lobby against Reforms

Large land owners usually represent a powerful force in many countries including South Africa. Lobbies of large farmers in South Africa are generally opposed to substantial restructuring and down sizing of commercial farms. Other reasons for large farmer opposition include the reluctance to integrate poor African farmers into racially integrated farm communities. Most South African white farming communities view the integrated community as a threat to their security. The price of land in a market reflects the value of income stream from farm profits plus its value as an asset, for example, hedge against inflation. Conversion into residential, lodge, bed and breakfast (B&B) of farm properties can alter the price and value of a farm completely. Poor farmers will only afford to pay the agricultural value of the farm only. Contesting rich farmers will out perform the poor farmers in the land markets. Policy reforms need to be undertaken to counteract this disadvantage.

4.7 Experiences of Market led Land Reform in South Africa

Mercia Andrews (2007) drew a balance sheet of problems and constraints experienced by landless people when trying to access land. The Trust for Community Outreach and Education (TCOE) under Mercia Andrews organised a tribunal on landlessness in December 2003. Hundreds of people came to testify about the hardships they come across when trying to acquire land in the open market. Two cases from the TCOE tribunal will be drawn to give examples on experiences of market led land reform in South Africa.

The case of Ellen Malose from derby, North West province is one of the exemplary cases. Malose legally bought a farm from an auction. The sale was withdrawn immediately after Malose had paid her deposit. Her claims on this regard were that white commercial farmers in the district urged for withdrawal of the sale as soon as they realised that an African woman has successfully bid for the sale. Investigations undertaken by the local municipality and a legal team revealed that the owner of a farm decided to withdrew the farm. The farm was later sold to ‘someone else’ (TCOE 2003a: 93-94).

In another case, the Muldersdrift rural community in Gauteng followed a "willing buyer-will seller" market approach to buy land from a white willing seller. The community and the seller agreed on price and half of the price had been paid to the seller when the process was halted. The landowners in the area persuaded the seller to sell the land to white landowners in the area in order to keep land ownership exclusively under white control (Andrews, 2007). The white landowners were successful on their bid.

These TCOE examples are consistent with the statement made by Marius Nel of ABSA agribusiness risk manager (Media 24, 9 September, 2007). Nel argued that land is an extremely emotional and controversial issue in South Africa. He pointed out that mechanisms for price formulation and distorted pattern of ownership vary widely and they influence land markets.

4.8 Overall Performance of Land Reform Programmes

Land prices for the land redistribution programme rose sharply between 1994 and 1996. A number of factors contributed to this increase in land prices. The period between 1995 and 1996 was the experimental period for land and agrarian reforms. Piloting projects were implemented in selected areas of the country and there is great possibility that the land quality and value offered to these projects were high. Land prices paid for land redistribution during the period 1994 and 1996 were above the prevailing market prices (MALA, 2004). During the years 1997 to 2004, land prices paid for land redistribution were on average 33 percent below the market value. Poor quality of land offered by white commercial farmers is regarded as the main reason for the low prices.

The average price per hectare of land offered to land restitution programme was approximately R1500 in the year 2000. In 2004 the average per hectare land prices was approximately R4500. The sharp increase in land prices can be associated with the immense pressure the DLA was facing in finalising the land restitution claims. Land markets soon capitalised on the urgent need to settle the filed claims. In this regard, government was held as a "captive buyer" and could not walk away from the negotiations while land prices escalated in the market.

There is a strong link between poor quality of land and redistribution of land to land reform beneficiaries who are poor and not credit worthy. In the Northern Cape Province, commercial farm units are estimated to be 6000 units and form approximately 30 million hectares. This is the largest block of commercial farmland in South Africa. But, it is the least valuable from farming and livelihood perspective (Walker, 2007). As far as land redistribution and tenure reforms are concerned, Northern Cape is the leading province in redistributing agricultural land to previously disadvantage people. As at July 2005 more than 500 000 hectares of land had been redistributed in the Northern Cape. This justifies the claim that poor quality of land is easily redistributed to previously disadvantage people because white farmers are keen to get rid of this type of land.

CHAPTER FIVE

THEORY OF LAND PRICE DETERMINATION

5.1 Introduction

Agricultural land prices are determined by the supply of and demand for land. Land differs from other input factors or commodities in that its supply is limited or rather fixed; hence, the supply curve of land is vertical. Since the supply of land is fixed, increases in the demand for land might only result in higher land values. Land prices and the demand for land are largely determined by the expected returns from the land. Expected returns can also be referred to as expected rent.

In economic theory, the term rent applies to payments made for factors of production that have an imperfect elasticity of supply, with land as the main example. An economic rent is sometimes described as a surplus because it does not originate from any effort or activity of the land owners. Adam Smith commented in the 1800's that 'the landlord, like all other men love to reap where they never sowed'. The Classical or Ricardian rent theory considers land rent to be merely a surplus. Product prices determine rent (Clark, 1973). Land rent is residual, the amount of revenue expected to be left over after all other costs are paid. Koutsoyiannis (1979) defines economic rent as a payment to a factor (land) in excess of its opportunity cost.

Rent has been regarded very as important in the early 1800's. In some European countries, rent increased massively during the 1800's because of population pressure on land and the Napoleonic wars (Clark, 1973). Food prices rose considerably in line with rent, scarcity of food prevailed and it was perceived that landlords were profiting from the less fortunate. It appears that Ricardo developed his theory of rent as an attack on the landed aristocracy.

The end of the 19th century and the beginning of the 20th century were highlighted by a controversy over the theory of rent. The dispute was over a question of whether rent is price-determining or price determined. This question was hotly debated in the economic journals of the time. Two distinct groups emerged from this debate, the classical or Ricardian camp and the non-Ricardian camp. Ricardians' philosophical framework begins with the concept that land is a gift of nature (Clark, 1973); and its supply is fixed. The supply curve of land is vertical. When demand increases, rents increase, but not the physical supply of land. Ricardo's claim that rent is determined by prices can be further explained in the following argument:

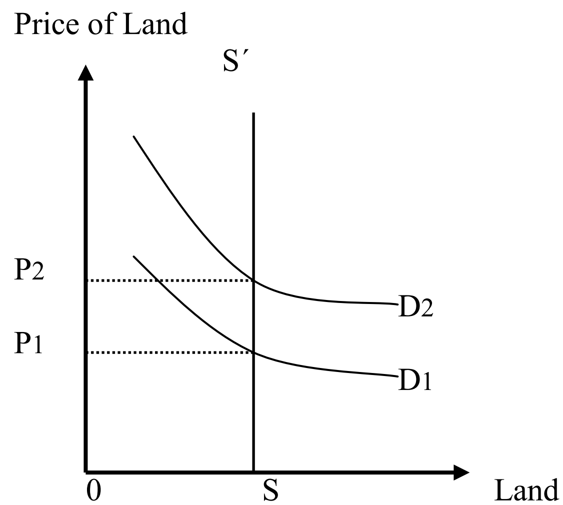

Figure 5.1 Land Price Determinations

Prices of inputs whose supply is fixed are determined by demand conditions only. For example, assume that the land is suitable for production of sugar cane. In figure 5.1 if the demand for sugar cane is set to the demand curve D1; for the cane–producing land, the price of land per hectare is P1. An increase in the demand for sugar cane induces a shift in the demand for land to D2. Given the perfectly fixed supply of land S'S, the price of land rises to P2. In this regard the forces of demand have solely caused the change in demand for land and, hence price increase.

In 1652 Sir William Petty noted that the price of land depends on the capitalized value of rent that the land would yield. The idea is supported by (Cochrane, 1958) who argued that rents accruing to agricultural land are determined by the surplus value of production incurred in that commodity. Clark (1973) argued that land rents vary directly with population density which depends on food from that land. As population increases, the demand for food increases. This drives the prices of food up. The increased price for produce increases the surplus income generated on agricultural land, thereby increasing its rents. Clark (1973) treated population together with wage growth as exogenous factors that could indirectly influence land values. He further argues that commodity prices and productivity directly affect income and, hence farmland values.

According to Petty the price of land depends on the capitalised value of the rent that the land would yield. Rent accruing to agricultural land is a result of the surplus value of production incurred on a particular commodity. Both Ricardo and Petty regarded land rent as a differential rent reflecting differences in the soil fertility of various land parcels. The best land is given priority first and then cultivation expands down to poor soil.

Apart from diminishing returns and soil fertility Petty outlined three other factors influencing the demand for land. The three factors are:

1. Transportation costs – these are inversely related to land rent, increase in transportation costs reduces land rent.
2. The distance from the market- land closer to the market earns higher rent than land further away from the market.
3. Technological progress which influences land rent

The non-Ricardian camp insisted that rent assist in price determination and postulated two types of rents to land: price determined surplus and marginal rent. The non-Ricardian economists argued that land possessing advantages in certain crop production earn surplus rent. They further argued that differential rents are different on each grade of soil and are not included in production costs. Marginal rent accrues to land that has alternate uses of land to users. Since land can be used in different industries for various purposes, rent can be regarded as an income that determines price. An example of this can be stated as follows: land for industrial purpose command higher rent than farming land, therefore land prices for industrial land are higher than agricultural land prices. The study examines the factors that primarily affect the demand for farmland. It is thus assumed that supply of farmland the study areas is price inelastic. Changes in farmland prices are attributed to changes in the demand for farmland.

5.2 Capitalisation Theory

Farms are bought or possessed for multiple purposes. The primary motive for owning a farm is to make a living out of it or earn income. Earning income or rent out of an asset is the major origin of value. Income is capitalised into value of the farm and thereby enhancing the value of a farm. Income is derived from the sale of farm commodities (livestock, crops and so on). Darroch (1995) perceived residual income and rent earned as two yardsticks for estimating annual returns to land. Residual income is given by gross revenue less productions costs (excluding interest on loan), less taxes and returns to management. He defined net rent as gross rent less any property taxes.

Since land is an input in agricultural production, it is likely that the demand for land is derived from demands that determine farm income. Future expectations in farm income could lead to changes in land values. Hattingh and Herzburg (1980) showed that since 1973/74 land values have increased more than agricultural earnings per hectare in South Africa. The likely reason for this phenomenon is that mortgage rates were low while inflation rates were high during this period. Nieuwoudt (1980) supported Hattingh and Herzberg's findings by proving that various factors such as technological advances, discount and inflation rates could affect future rent streams and hence, land values.

The concept of "productivity value" of a farm is derived by dividing profits per hectare by the mortgage bond interest rate. It is the most commonly used approach by valuers in South Africa and abroad. The approach depicts that the value of an asset, such as land can be expressed as the present value of the future rent streams generated by the asset and can be specified as follows:

$$\mathbf{PVI} = \frac{RO}{i}$$

Where R0 = current/real return on land

PV = present value of land

i = real capitalisation rate (nominal discount rate minus anticipated inflation rate)

When the income stream is expected to continue, a simple capitalisation rate can be used to capitalise income in perpetuity.

Further studies have put a great emphasis on the importance of land appreciation. The first productivity value equation assumes that land has an infinite life and recognises no real growth in returns. If returns are expected to grow over time in response to grow in inflation rate, the growth rate can be estimated as the difference between the nominal and the inflation rate. Hoover and Passour (1976) argued that capitalistion rate consist of three components, namely, the return on farmland, the capitalisation rate and the appreciation or growth rate. The mathematical formula for capitalisation approach then becomes:

$$\mathbf{PVI} = \frac{RO}{i - g}$$

Where i >g and g is the growth in real income. The improved capitalisation approach formula is the asset value model that was used by Melichar (1979) and Nieuwoudt (1980) in their studies.
The capitalisation theoretical models described in this study shows how important variables interact to influence land values. Barry et al (1988) anticipated that these models serve as a guide in evaluating the potential response to expected changes in variables. The study being conducted examines factors that primarily affect the demand for farmland. It is thus assumed that the supply of land in relative study areas is price inelastic. Changes in farmland prices are attributed to changes in the demand for farmland only. An upward trend for both farmland values and returns to farmland is thus assumed to be present in this study. The next section of the theory relevant to this study examines the long run equilibrium relationship of variables, including those discussed in this study.

5.3 Methods of Farm valuations

5.3.1Valuation of Orchards

Orchards are special agricultural units consisting of permanent crops. Orchards are characterised by high initial establishment costs; trees require several years to reach maturity with little or no income in early years (White, 1995). Production reach climax and continue giving profits to owners for a period of 25-30 years or even more before declining (White, 1995). Two valuation approaches are suggested by the South African Council of Professional Valuers for valuation of orchards: the cost approach and the income capitalisation approach. The cost approach is most applicable in the early stages before the crop comes into full production. The value consists of total establishment costs and the value of land is added to these establishment costs. White pointed out that cost does not necessarily equals to values. It is therefore advisable to check if the costs will be recovered when the property is in full production. The income approach reflects the range of profitability at different levels of net farm income per hectare that the orchards will yield.

5.3.2 Valuation of Sugarcane Farms

Sugarcane farms are normally sold as "going concerns" which includes land, buildings, crop, sucrose quota and movables (tractors and equipments) (Edwards, 1995). Edwards listed guideline methods for valuation of sugarcane farms as follows:

1. Price/Value per Tons of Cane- the method is based on average production of cane crop over several years. This method gives an excellent guide to production and income capabilities if the property has been established for a long time.
2. Price/Value per Hectare- the method is appropriate if the property is in main cane growing areas and the majority of hectares are under cane (+/- 90%)
3. Price/Value per Tone of Sucrose (Quota) - care must be exercised when using this method because sucrose is tradable. Additional sucrose can be bought, or conversely, a property may have a low sucrose in relation to its production.

The methods described above are recommended by the South African Institute of Valuers as well as SACGA as the primary guidelines for valuing sugarcane farms.

5.4 The Long Run Equilibrium

Long run equilibrium approach stems from the belief that economic forces of supply and demand through time, operate on variables such that some combinations of the time series will not drift apart significantly in the long run (Koop, 2000). Such variables can be given as commodity prices, interest rates, government income and expenditure, market shares, and so on. Hence, Granger (1983) argued that cointegration of an economic time series corresponds to the theoretical notion of a long-run dynamic equilibrium. Engle and Granger (1987) prove that if two variables are integrated of order one [I (1)] and are cointegrated, a generating process which has an error term exists. The resulting equilibrium error in the model permits for the impact of long run equilibrium theory to be introduced. Cointegration is thus a new method for specifying, estimating and testing dynamic models. It can be used for testing the validity of underlying economic theories, for example, the long run equilibrium theory. Cointegration analysis technique is discussed in details in the methodology section. The concept of equilibrium is introduced for discussion at this stage.

It has been argued that the neoclassical general equilibrium theory is applicable to this study. The concept of market equilibrium was defined as a condition that is determined at the market price at which quantities offered for sale equal the quantities demanded by consumers. The general equilibrium approach considers the interdependence among all sectors of the economy. The agricultural sector is greatly influenced by the financial sector and by the manufacturing sector; it is therefore argued that backward and forward linkages exist between the agricultural sector and these two sectors. Since general equilibrium analysis considers the interdependence among the sectors of the economy, it is regarded as the relevant equilibrium analysis to start with this study.

There are three questions that need to be considered when adopting any form of equilibrium analysis. The questions are:
Does the equilibrium exist?
If it exists, is its solution unique?
If it exists, is the equilibrium solution stable?

If, after some shock, market forces induce movements further away from the equilibrium point, the equilibrium solution is said to be not stable. If the market is not in equilibrium or is in disequilibrium, it means that market transactions are not conducted at market clearing prices. Disequilibrium may occur because the determining forces (demand and supply) are volatile. Correction forces may tend to bring the market to equilibrium, but prices may usually be far from their equilibrium level. It is usually noted that prices of some agricultural commodities are highly volatile in the short run. The price instability may induce income instability that may discourage investment. Over the long run, agricultural prices may decline relative to other product prices. Disequilibrium can also prevail in markets in which the economic agents lack information about the market mechanism.

5.4.1 Comparative Static Analysis

It has been argued that equilibrium in agricultural commodity markets is determined by the interaction of demand and supply curves drawn under the assumption of *ceteris paribus*. This is to say, other product prices, income, population, technology, input prices, and so on were not taken into consideration. It must also be noted that the concepts of demand and supply can be used to analyse the effects of changes in one or more of these exogenous variables. The assumption in this regard is that the market is in equilibrium before the change in the exogenous variable and the market will also be in equilibrium after the change. This method of comparing price and quantity between the initial and final equilibriums is called comparative statics (Koutsoyiannis, 1979).

Comparative static can be useful in explaining policies that reduce instability in agricultural commodity prices. It can also be useful in explaining the long term trends in commodity prices. A buffer stock scheme will be used as an example of how comparative static can be used to reduce instability in commodity prices.

5.5 Dynamic Equilibrium Models

Dynamic equilibrium models involve time variable and explicitly focus on the time-path of economic variables. A cob-web model is a dynamic model that has gained reputation among agricultural economists. Colman and Young (1989) argue that the time paths of prices and output exhibit regular fluctuations in some agricultural product markets. Their argument is based on the premise that production plans are built on current prices and that a one period lag exists in production response. The expected price P* for output sold in period t is equal to the actual price in the previous period.

Conclusions on equilibrium discussion can be drawn on the basis that disequilibrium is a consequence of the fact that economic conditions are not observed correctly. Participating agents adjust to conditions different from those that actually turn out to be. Cumulative deviations from equilibrium are usually corrected at some stage. From the above argument, it can be concluded that farmland prices and fundamental factors, especially commodity prices fluctuates around equilibrium. The reason that they are not always in equilibrium is that continuously changing economic conditions are imperfectly observed.

CHAPTER SIX

METHODOLOGY

6.1 Introduction

Data sources, the methodology and methods of analysing data are presented and discussed in this chapter. The model that is perceived as appropriate for this study is the vector autoregressive model if variables in the study are stationary; the vector error-correction model will be used if variables in the model are nonstationary. SHAZM, SPSS, and Eviews are the computer packages that were used to analyse the data.

6.1.2 Hypothesis and Objectives

The study seeks to investigate the relationships that might exist between farmland values and fundamental factors (interest rates and net farm income or returns to farmland). Secondly, it is assumed that monetary variables like money supply and exchange rate affect farmland values indirectly through agricultural commodity prices and input costs. Linkages between the agricultural sector and the monetary sector will be examined in order to estimate the relationships between the variables in the system (agricultural commodity prices, input costs, money supply (M3), interest rate, and exchange rate). The impact of land reform on land values will also be studied as land reform programmes might alter the demand for farmland in South Africa. Agricultural commodity prices via net farm income are expected to positively affect farmland values while interest rates are expected to have a negative impact on farmland values. Money supply is also expected to positively affect farmland values while exchange rate's influence on farmland values is expected to be negative.

6.2 Data Sources and Model Framework

6.2.1 Sugar Cane Data Sources

Land value per hectare data collected incorporates values for land and buildings reported together. Included are all bona fide sales of tracts of land that were made from (1978 to 2008). Sucrose quota values are reflected in the land value data as sugar cane farms are normally sold with their allocated quotas. Information on land transactions supplied to South African Cane Growers Association by the Deeds Offices in KZN formed the basic source of information. Interest rates are the average mortgage rates charged by the Land bank and commercial banks.

6.2.2 Maize, Deciduous and Average South African Studies Data Sources

Land value per hectare data for average South African, sugar cane, maize, and deciduous fruit studies from 1978 to 2008 were obtained form the following sources: Statistics South Africa: Transfers of Rural Immovable Properties; Reports from 1978-1998. The remaining per hectare farmland values data from 1999-2008 was obtained from the Abstract of Agricultural Statistics (2008), ABSA (2008), and from the Human Science Research Council: South African Farmland Price Trends Report. For deciduous fruits farmland value data were also obtained from Elsenburg Agricultural College, Western Cape department of Agriculture. Returns to farmland data were derived from the Abstract of Agricultural Statistics, SAGIS, Elsenburg and DFPT. Averaged South African interest rate data from 1978-2008 were obtained from the Abstract of Agricultural Statistics (2008). Data for historical and current South African inflation were obtained from the South African Reserve Bank and the Western Cape Department of Agriculture. The next section states what kind of a model will be used conceptually to implement the model.

Schmitz (1995) empirically analysed the tendency of U.S. farmland values to deviate from long run equilibrium in response to changes in fundamental factors in U.S. agricultural and financial sectors. Schmitz used a multivariate stochastic trend model with Kalman Filter specification to examine transitory versus permanent changes in factors affecting farmland values. The general method we follow in this study parallels that of Schmitz; however, the empirical specification to be used departs from his specification in several respects which ensures the model's applicability to the pursued study. The first step in our model building explains the derivation of cash flows that will be used to estimate net farm income or returns to farmland.

6.3 Cash Flow Estimation

When conducting an investment analysis (farm purchasing), returns from the perspective farm are estimated. Some valuators prefer accounting earnings to cash flow earnings, others prefer cash flow earnings. Accounting earnings differ significantly from cash flow earnings because accounting earnings takes into account non-cash expenses such as depreciation and amortization. Economic returns or cash flow earnings add back these non-cash expenses because they do not result in any cash inflow or out flow. Operating cash flow can then be depicted as follows:

OCF = PBIT + Depreciation – taxes

Where OCF = Operating cash flow

PBIT = Profit before interest and taxes

Ross *et al* (2001: 247) define relevant cash flow for any particular investment as “a change in the firm’s (farm) overall future cash flow that comes about as a direct consequence of a decision to take part in that investment”. Following the Modigliani-Miller theory, the choice of financing an asset (farm) either using debt or equity does not affect the value of an asset, thus interest payment is ignored in the calculation of relevant cash flow. Discounted cash flows are normally used when valuing an asset. The benefit of using discounted cash flows is that discounted cash flows explicitly consider the time value of money. In this study cash flows are discounted to their present value by using capitalisation rate which is the mortgage interest rate.

When working with investments that generate cash flows over multiple periods it is important to consider the effects of inflation on these cash flows. A link that exists between inflation and interest rate becomes clear when we distinguish between nominal interest rate and real interest rate. Nominal interest rate can be described as the interest rate that has not been adjusted for inflation. Real interest rate is the interest rate that has been adjusted for inflation. The CPI (Consumer Price Index) that is used as an inflation indicator in South Africa will be used as an inflation adjustment factor. Therefore, real interest rate can be expressed as follows:

$$\text{ir} = \frac{1 + i}{1 + h}$$

Where *ir* = real interest rate, and *h* is inflation rate or CPI

Nominal cash flows include expected inflation; in contrast, real cash flow is an attempt to accommodate the loss of purchasing power created by inflation. Real cash flows can be depicted as follows:

$$Real\ cash\ Flow_t = \sum_{t=1}^{p} \left(Nominal\ Cash\ Flow_t\ \text{X} \frac{1}{1 + h} \right)$$

The last term in the equation is the deflation factor.

6.4.1 The Present Value Model

The model builds on Schmitz (1995) present value model; Schmitz's present value model can be represented as follows:

$$\Delta Vt = ECFt + \frac{rt}{1+rt}Vt + \varepsilon t \ldots\ldots\ldots\ldots.6.1$$

ΔV_t = the observed change in farmland values, $\Delta Vt = (Vt - Vt - 1)$

E_tCF_t = the xpected return on farmland in period t

r = the discount rate for agricultural sector in period t

Observed cashflows are substituted for expected cash flows and the equation yields

$$\Delta Vt = (CFt + vt) + \frac{rt}{1+rt}Vt + \gamma t \ldots\ldots\ldots\ldots\ldots\ldots\ldots.6.2$$

vt is the difference between observed cash flows and expected cash flows. This substitution yields an error term

$$\Delta Vt = (CFt + vt) + \frac{rt}{1+rt}Vt + (\gamma t - vt) \ldots\ldots\ldots\ldots\ldots\ldots\ldots.6.3$$

The empirical findings by Schmitz (1995) revealed that changes in asset values over time are consistent with equation (6.3), but the error term ((γ_t - v_t) displays autocorrelation in the short run (Featherstone and Moss, 2003:165). This correlation is regarded as boom-bust cycles in farmland prices (Schmitz, 1995). Featherstone and Moss (2003:159) defines a boom as a period of time in which farmland values are above its intrinsic value and the bust as the period of time in which the intrinsic value of farmlands is below its market value.

Given that farmland prices may be nonstationary, error correction models will be used to estimate farmland values with unit roots. Gujarati (1999) argues that error correction models eliminate the spurious regression problem associated with nonstaionarity in the time-series data. Engle and Granger (1987) argued that if a system of variables is cointegrated, economic forces interact to bind these variables together in a long run equilibrium relationship. They proved that two or more series are cointegrated of order one [I(1)] if and only if an error correction mechanism (ECM) exists.

The economic interpretation of cointegration is that cointegration exists if two or more series are linked to form an equilibrium relationship spanning the long run (Koop, 2000). The series may be nonstationary but their movements tend to be closely together over time. The long run relationship is the equilibrium to which the system converges over time. The error term in the series can be interpreted as the distance the system is away from equilibrium at time t.

6.5 Stationarity and Unit Root Tests

Before estimating cointegrating regressions, it is conventional to test the order of integration for the variables used. The Dickey-Fuller tests (1979) for the null hypothesis of nonstationarity are often used in literature to test for the possible existence of unit roots. Stationarity tests of a time series normally begins with the estimation of the following equation:

$$\Delta Xt = \beta 0 + \beta 1 Xt - 1 + \sum_{j=1}^{p} \gamma j \Delta Xt - j + \varepsilon t \ldots\ldots\ldots\ldots\ldots\ldots 6.4.$$

Equation 6.4 considers no linear trend; if a linear trend and a parameter for drift are considered, equation 6.5 is used.

$$\Delta Xt = \beta 0 + \beta 1 Xt - 1 + \beta 2 t + \sum_{j=1}^{p} \gamma j \Delta Xt - j + \varepsilon t \ldots\ldots\ldots\ldots\ldots\ldots 6.5$$

In the above equation (6.4) and (6.5); Δ represents first differences unless otherwise stated, β0 is the intercept, β1 allows for the testing for a unit root and β2 verifies the presence of trend. If the hypothesis β1=0 cannot be rejected, the series possesses a unit root and is nonstationary. If the hypothesis β1=0 is rejected we conclude that the series does not contain a unit root and is stationary. Due to the low power of Dickey-Fuller tests in determination of unit root test, other unit root test methods were employed. Elliot, Rothenberg and Stock (1996) proposed a modified Dickey-Fuller test based on generalised least squares (GLS) detrending series. The test is widely known as DF-GLS; it was used jointly with the Im, Pesaran, Shin (IPS) and the Augmented Dickey-Fuller Fisher tests to test for stationarity and non-stationarity of variables. The tests specification is almost the same as specified in equations (6.4) and (6.5).

The Im, Pesaran, Shin (2003) herein referred to as IPS utilises a panel version of Dickey-Fuller model and it estimates the t-test for unit root in number of different panels. The advantage of the IPS is that it allows tests for individual, common and grouped effects. The test assumes that all series are non-stationary under the null hypothesis against the alternative of stationarity in variables. The ADF-Fisher test is the extended version of the Dickey-Fuller test and its t-statistic is also normally distributed under the null hypothesis of unit root. In both these unit root tests (IPS and ADF-Fisher) lags of the dependent variable may be introduced to allow for serial correlation in errors. In the model(s) conducted to estimate the interaction of monetary variables and agricultural sector in determining farmland prices, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test was conducted to strengthen the unit root tests results. The "failure to reject the null hypothesis could occur because the null was correct, or because there was insufficient information to unable rejection" (Brooks, 2002:382). Brooks suggests the use of stationary tests like KPSS jointly with the specified unit root test(s) if there is uncertainty about the existence of unit root. Stationarity tests postulate stationarity under the null hypothesis. The results of the stationarity test are then compared with ADF or other similar test. The KPSS test specification follows the general unit root test specification presented in equations (6.4) and (6.5).

6.6 The Vector Autoregressive Model

The vector autoregressive model (VAR) is a natural extension of the univariate autoregression model to dynamic multivariate time series model (Enders, 2004). The VAR has proven to be useful for describing dynamic behaviour of economic, financial and other time series for forecasting (Enders, 2004). Forecasts from VAR models are quite flexible because they can be made conditional on the potential future paths of the specified model variables. Causal impacts of unexpected shocks to specific variables on other variables in the model are identified. The causal impacts are then summarised with impulse response functions and forecast error variance decompositions (Enders, 2004). The Akaike information criterion (AIC) and the Schwartz Bayesian criterion (SBC) are used to decide on the choice of lag lengths. Both the AIC and SBC are criteria developed for maximum likelihood estimation techniques. The AIC and SBC formulae for calculating optimal lag lengths can be given as follows:

$$\text{AIC} = \ln\sigma^2 + \frac{2k}{T}$$

$$\text{SBIC} = \ln\sigma^2 + \frac{k}{T}\ln T,$$

Where σ^2 the residuals variance, k is the total number of parameters estimated and T is the sample size. When using the criterion based on estimated standard errors (for example, AIC and SBIC), the model with the lowest value of AIC or SBIC should be chosen. Some researchers would use the formula $T^{1/3}$ to identify the optimal lag length. If $T^{1/3}$ does not yield the optimal lag length, the researcher can add few lags on $T^{1/3}$ number of lags obtained so that the optimal results are obtained.

6.6.1 Structural and Reduced Form VAR

The VAR system can be in a traditional form or in a reduced form. The difference between these forms of VAR and the advantage of using a reduced form is discussed as follows: Let LVt = yt and NRRt =zt so that we have two series yt and zt. Let the path of yt be affected by current and past realizations of zt and let zt be affected by the past and current realizations of yt; the two equations representing these series are:

$y_t = b_{10} - b_{12}z_t + \gamma_{21}y_t - 1 + \gamma_{12}z_t - 1 + \varepsilon z_t$ 6.6

$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon z_t$ 6.7

Where $b10, b20, \gamma 11, \gamma 12, \gamma 21, \gamma 22$ are estimated parameters, εyt and εzt are white noise disturbances with standard deviations σy and σz respectively; the system incorporates feedback because yt and zt are allowed to affect each other. Equations (6.6) and (6.7) constitute a first order VAR because the largest lag is one. The equations are not in a reduced form since yt has a contemporaneous effect on zt and vice versa. Feed back on equations cannot be easily estimated because of variables correlations with error terms. In order to impose restrictions on equations so that the equations are identified and are in a reduced form, a recursive system proposed by Sims (1980) is used. We first use matrix algebra to transform the system into a more usable system.

$$\begin{pmatrix} 1 & b12 \\ b21 & 1 \end{pmatrix}\begin{pmatrix} yt \\ zt \end{pmatrix} = \begin{pmatrix} b10 \\ b20 \end{pmatrix} + \begin{pmatrix} \gamma 11 & \gamma 12 \\ \gamma 21 & \gamma 22 \end{pmatrix}\begin{pmatrix} yt-1 \\ zt-1 \end{pmatrix} + \begin{pmatrix} \varepsilon yt \\ \varepsilon xt \end{pmatrix}$$

Similarly, $\mathbf{Bxt = \Gamma 0 + \Gamma 1 xt - 1 + \varepsilon t}$

$$b = \begin{pmatrix} 1 & b12 \\ b21 & 1 \end{pmatrix}, xt = \begin{pmatrix} yt \\ zt \end{pmatrix}, \Gamma 0 = \begin{pmatrix} b10 \\ b20 \end{pmatrix}, \Gamma 1 = \begin{pmatrix} \gamma 11 & \gamma 12 \\ \gamma 21 & \gamma 22 \end{pmatrix}, \varepsilon t = \begin{pmatrix} \varepsilon yt \\ \varepsilon xt \end{pmatrix}$$

Pre-multiplying by B^{-1} leads to a VAR in standard form

$xt = A0 + A1xt - 1 + et$

A0=$B^{-1}\Gamma 0$, $\mathbf{A1} = B^{-1}\Gamma\mathbf{1}$, $\mathbf{et} = B^{-1}\varepsilon t$

Alternatively, imposing restrictions on equations yields the following VAR system in a reduced form:

$y_t = b_{10} - b_{12}z_t + \gamma_{21}y_t - 1 + \gamma_{12}z_t - 1 + \varepsilon z_t$ 6.8

$z_t = b_{20} - b_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}z_{t-1} + \varepsilon z_t$ 6.9

Forcing $b21 = 0$ means that zt has no contemporaneous effect on yt but yt can affect zt sequence with one period lag. However, this is not a relevant case to happen in this study because farmland values do not determine income but income determines farmland values.

Forcing $b21 = 0$ is the same as:

$e1t = \varepsilon yt - b12\varepsilon zt$

$e2t = \varepsilon zt$

6.6.2 Stability and Staionarity in VAR

A VAR is stable and stationary if the impacts of shocks to innovations in some equations eventually die out as we get further away in time from date of shock. Stability and stationarity are considered and the importance of calculating eigenvalues (known as the companion matrix) is emphasised in VAR (Patterson, 2000:600). For simple illustration of eigenvalues, unit roots and stability in VAR, let us consider a first order VAR without a drift:

$wt = \Pi wt - 1 + at$

That is $A(L)wt + at$

$A(L) = I - \Pi L$ is the auto regressive polynomial.

The eigenvalues of $\prod$ of characteristic polynomial $|\prod - \lambda I|$ can be obtained by solving the equation $|\prod - \lambda I| = 0$; the condition for stability of the VAR can be stated in terms of the roots of the characteristics polynomial (Patterson, 2000:605).

6.7 The Vector Error-Correction Model

Using Johansen's vector error-correction model in this study allows for exploration of the dynamic relations between price determined incomes, interest rate and farmland values in South Africa. The Engle and Granger (1987) two step error-correction model is also applicable to multivariate analysis but the VECM yields efficient results than the Engle and Granger method. This is because the VECM is full information maximum likelihood estimation that allows for testing for cointegration in a whole system of equations in a single step with no normalization of certain variables required. Carrying over of errors from the first step that could result if using the standard Engle and Granger method is avoided by using the VECM (Verbeek, 2004). Patterson (2000) also suggested that the apriori assumptions of exogenity or endogenity of variables is not required when using the VECM.

Johansen and Juselius (1990) modelled time series as reduced rank regression. They computed the maximum likelihood estimates in a VAR cointegration model with Gaussian distribution errors. The maximum likelihood representation of the error correction model is:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \cdots \Gamma_k - 1\Delta X_{t-1} + \Pi X_{t-1} + \mu + \Psi D_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots 6.10$$

Where Xt = vector of prices

ΔX_t = change in X_t

Dt = vector of exogenous variables, deterministic terms such as constant, linear trend and seasonal dummies

$\Gamma_1, \Gamma_{k-1}, \Pi, \Psi$ are estimated parameters, and

ε_t is an error term

The Δ symbol represents differences (first differences unless otherwise stated), ∏ allows testing for a unit root, and ΔX_{t-k+1} represents the error correcting mechanism in the model.

To estimate the model, Johansen and Juselius (1990) recommended that ΔX_t matrix should be regressed against the lagged differences of ΔXt and Y_{t-k}; the rank of a matrix $\Pi=\alpha'\beta$ is then determined. The rank Π is first determined by finding the eigenvalues that are estimated from canonical correlation of residuals set from the regression equations. Suitable trace test and maximum eigenvalue test are then undertaken to determine the number of cointegrating vectors in the model. The key feature to note in this regard is the rank of a matrix (Π). The rank of a matrix is equal to the number of cointegrating vectors. If rank (Π) = 0, the matrix is not valid; if Π is of rank n (n = number of system of equations) the vector process is stationary. If Π = 1, then there is a single cointegrating vector of matrix.

If $1 < \Pi < n$, this means that there is a multiple cointegrating vectors.

The two tests statistics that will be used to identify the number of cointegrating vectors (trace test and maximum eigenvalue test) can be specified as follows:

$$\Lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \lambda i) \ldots\ldots\ldots\ldots\ldots\ldots 6.11$$

$$\lambda_{max}(r, r+1) = -T\ln(1 - \lambda_{r+1}) \ldots\ldots\ldots\ldots\ldots\ldots 6.12$$

Where λ = the estimated values of the characteristic root (eigenvalues) obtained from the estimated matrix (Π)

T = the number of usable observations

In models that have full rank Π=0, we normally do not fail to reject the null hypothesis of no cointegrating vectors because Xt in this regard has no unit root and is stationary. This suggests the non existence of error-correction mechanism in the model.

6.8 The Model to be Estimated and Variables

The most important control variables are those that directly affect land values. These variables include past prices on land (LV_{t-1}), real net farm income (NRR_{t-1}), real interest rate (IR_{t-1}). The variables are lagged because it is important to account for past conditions so that current circumstances can be evaluated on what has been observed. The general model to be estimated can be specified as follows:

$lnLV_t = \beta_0 + \beta_1 lnLV_{t-1} + \beta_2 lnNRR_{t-1} - \beta_3 RI_{t-1} + \varepsilon_t$ 6.13

In this study the output of the South African deciduous fruits is dichotomised into two categories: internationally tradable fruits which are exported and local tradable fruits which are consumed locally and canned in the fruit processing market. This classification is important and necessary in the analysis because the impact of export demand of apples and pears might influence export fruit prices differently to local traded fruit prices. This in turn might influence land prices differently.

In order to examine the relative role of exports in income determination and, hence land values over time; net farm income (NRR_{t-1}) is divided into two components. Land value per hectare (LV_t) is then estimated as a function of lagged real export return (NXR_{t-1}), lagged real aggregate net income (NRR_{t-1}), lagged real per hectare, and lagged real interest rate. The equations for apples and pears deciduous fruits are then given as follows:

$lnLV_t = \beta_0 + \beta_1 lnLV_{t-1} + \beta_2 lnNRR_{t-1} - \beta_3 RI_{t-1} + \varepsilon_t$ 6.14

$lnLV_t = \beta_0 + \beta_1 lnLV_{t-1} + \beta_2 lnNXR_{t-1} - \beta_3 RI_{t-1} + \varepsilon_t$ 6.15

The sugar cane study comprises of two subsections: the quota land value (since 1997 quotas have fallen away, now area under cane (AUC) per hectare transferable is used instead of quotas) but this transferable AUC works almost the same as quota. The main reason for splitting the study is that quotas restrict production to quota holders, thereby increasing product prices. This leads to increase in revenue as demand for product is price inelastic. The market price for transferable quota would be the capitalised income stream accruing to land owners, thus quota land prices are higher (Nieuwoudt, 1976). According to Ortman (1987) quota land values were approximately 60 percent higher of land value per hectare during the period 1986-1987.

The dependent variables in the sugar cane farmland value model are real land value per hectare and real per hectare area under cane (AUC). These dependent variables are each a function of their lagged real per hectare values, lagged real per hectare net farm income and lagged real interest rate. Sugar cane models can be given as follows:

$$lnVPH_t = \beta_0 + \beta_1 lnVPH_{t-1} + \beta_2 lnAUC_{t-1} + \beta_2 lnNRR_{t-1} - \beta_4 RI_{t-1} + \varepsilon_t \quad \text{................6.16}$$

Where VPH is value per hectare, NRR is net real return, and RI real interest rate; εt is the error term. The area under cane per hectare farmland value or AUC equation is specified as:

$$lnAUC_t = \beta_0 + \beta_1 lnAUC_{t-1} + \beta_2 lnNRR_{t-1} - \beta_3 RI_{t-1} + \varepsilon_t \quad \text{...........................6.17}$$

Where AUC is the area under cane per hectare farmland value, NRR is real return per hectare, RI is interest rate and εt is the error term. Variables for VPH and AUC are specified for period t and in past values for period t-1 (the t subscripts at each and every variable).

6.9 The Macroeconomic-Agricultural Sector Model

The model(s) estimated costs, product prices and monetary sector effects on South African farmland markets. The macroeconomic-agricultural sector model is the extension of the models specified in equations (6.13; 6.14, and 6.15) but it differs from these models in that they all use the present value discount rate model (PVDRM). The present value model is normally used in empirical estimation of farmland (asset) price determination. The present value discount rate model suggests that farmland prices are a function of capitalized future farm earnings. The net farm income used in the these models is calculated as operating cash flows and is hence cash flows accruing to the entity. The net farm income also considers factors like yield per hectare. The yields that the farmer expects are subjected to weather changes and the systematic risk associated with weather changes cannot be minimised by diversification. On the other hand, prices and costs do not reflect output produced by the farm in a particular time. Prices and costs are also subjected to systematic risk but their degree of systematic risk differs from that of net farm income and hence, valuation results based on these two approaches (PVDRM and Price-Cost approaches) do not contain the same meaning. Using input costs separately in the model also gives insight into how the pricing of input factors affect farmer wealth and consumer surplus. It is perceived that consumer surplus and farmer wealth are affected because changes in input prices are transferred into final product prices. There are two models to be estimated in this section, the maize and the apple models. Specification of the models is as follows:

$$lnLV_t = \beta_0 + \beta_1 lnLV_{t-1} + \beta_2 lnP_{t-1} - \beta_3 RI_{t-1} + \beta_4 lnC_{t-1} + \beta_5 m3_{t-1} + \varepsilon_t \quad \text{................6.18}$$

$$lnLV_t = \beta_0 + \beta_1 lnLV_{t-1} + \beta_2 lnP_{t-1} - \beta_3 RI_{t-1} + \beta_4 lnC_{t-1} + \beta_5 m3_{t-1} + \beta_6 lnEx_{t-1} + \varepsilon_t \quad \text{..6.19}$$

Where $lnLV_{t-1}$ is the log of per hectare farmland price, $\ln P_{t-1}$ is the log of lagged product prices, lnC_{t-1}, is the log of lagged input costs, Ex_{t-1}, is the log of lagged exchange rate (Rand/US$), $\ln M3_{t-1}$, and RI_{t-1}, are lagged money supply and lagged interest rate respective; ε_t is the error term.

6.10 Structural Changes Tests

Structural change is also known as structural instability. It normally happens that the relationship between the dependent variable and the control variables undergo structural change from one period to another due to know or unknown occurrences. A fine example of this situation is the deregulation of the South African agricultural industry in 1997. The impact of deregulation of the South African agricultural sector could have resulted to changes in agricultural elements such as commodity prices, farmland values, and so on. The statistical test used to determine whether there was a break or structural change in a certain period is known as the Chow test. The Chow test assumes that coefficients β_1, β_2 and so on are stable or constant for the whole sampled period and for future period. The Chow test proceeds as follows: The data is split into two sub-periods (1978-1997) and (1998-2008) for the South African agricultural sector. The second stage involves estimation of the regression model over the whole sampled period; the two sub-periods are then estimated independently. The entire period estimated regression is known as the restricted regression and the two sub-period regressions are known as the unrestricted regressions. The sum of squared residuals (RSS) for each regression should be obtained. The F-test is then conducted based on the (RSS) for all regressed models. The Chow break test can be specified as follows:

$$\text{F}-\text{statistic} = \frac{RSS-(RSS_1+RSS_2)}{RSS_1+RSS_2} * \frac{T-2k}{k} \quad \text{...6.20}$$

Where RSS_1, RSS_2, k, and T are sum of squared residuals for sample period one, sum of squared residuals for sample period two, number of estimated parameters and number of observations respectively. The restriction imposed is that all â parameters are equal across the sub samples. The hypothesis is rejected if the estimated parameters are not found to be stable over time. This can be presented as follows: $F_{statistic} > F_{critical}$, where $F_{critical} = F_{k,T-2k}$. If the occurred break impacted significantly on sampled data, the model conducted using that data cannot adequately predict the model results.

However, there are problems associated with the Chow test; for the desired situation to hold, there must be enough data to conduct regression on sub-samples (that is $T_1 \gg k, T_2 \gg \text{k}$) (Brooks, 2002). Brooks also stipulates that using smaller number of observations for sampling purpose may not yield the desired situation of $T_1 \gg k, T_2 \gg \text{k}$. A predictive failure test can be used instead of Chow test if sample sizes are small. The mechanism of the predictive failure test is to estimate the regression over a long sub-period (Brooks, 2002). The obtained coefficients are used to predict the values of the dependent variable for the remaining period of time. There are two types of predictive failure tests: the forward test and the backward test. In this study a forward predictive failure test will be used to forecast the values of farmland prices. In the forward predictive failure test the last few observations are held back for forecast testing. For example, suppose we have data for 1977-2008; the forward predictive test entails estimating the model over 1977 to 2005 or from 1977-2007 and the remaining data for other years is forecasted. Specification of the predictive failure test is as follows:

$$\text{F}-\text{statistic} = \frac{RSS-RSS_1}{RSS_1} * \frac{T-k}{T_2} \quad \text{..6.21}$$

Where T_2 is the of observations the model is trying to predict, RSS_1 is the sum of squared residuals for large sampled sub-period and RSS is the sum of squared residuals for the whole period.

6.11 Land Reform Model

Different modes of land reform and their performances were discussed in the literature review section. The census survey of all farmland transactions involving transfer of ownership in five South African provinces during 2006 and 2007 was conducted to determine the rate of land redistribution in South Africa. The main purpose for conducting the survey was to estimate the demand for land in South Africa where land reform measures are employed in farmland transactions. Fifty observations from five provinces were drawn from the DLA provincial lists of properties financed with grant and loans. The provinces were selected randomly and they are KZN, Mpumalanga, Free State, North West and Limpopo. The logit model described below is used to estimate the impact of land reform grant on the demand for land.

6.11.1 The Logit Model

The logit model is a non-linear probability model based on a logistic curve designed to estimate the conditional probability of a positive response or presence of characteristic (Hill et al, 1997). Parameter estimates and their variances give information for investigation of statistical association among variables. The other two equally important purposes of empirical research in logit models are selection and prediction (Cramer, 2003). In application of discrete probability for selection, the estimates of β serve to calculate predicted probabilities for individuals or items with covariates. The probabilities are then used for classification, identification or segmentation of target groups (Cramer, 2003:27-28).

Examples of target groups as listed by Cramer are prospective customers who are interested in a particular product or item and potential borrowers who are likely to default; these examples are consistent with the logit study pursued because previously disadvantaged grant applicants and/or recipients are prospective customers who are interested in a particular product (farmland), and are also potential borrowers who are likely to default, hence, have to be assessed for selection purpose.

D = f(Debt/Equity Ratio)

D = 1 if D/E ratio is ≥ 1.5, 0 otherwise

Where: D/E is the ratio of loan to LRAD grant used to finance property

As theory suggests, the greater the collateral a household possesses, the greater is the credit worthiness of that household. Putting a greater amount of deposit on purchases enhances the transaction deal. The likelihood for the financial provider that the borrower will not default is also increased. Hill et al (1997: 203) argue that banks, prior to approving loans predict the probability that an applicant will default. If the probability of default is high, the loan is not approved or additional conditions such as extra collateral is imposed.

In this study, at least 40 percent of LRAD grant is perceived as a good deposit to secure a loan. It is thus argued that a positive relationship is expected between the demand for land and the increase in LRAD grant obtained. A second implication is that a meaningful grant plus the loan secured increase the willingness and the ability of a household to purchase farmland. It is therefore argued that a positive relationship holds for reasonable solvency ratio and chance to purchase farmland. In the study the logistic function can be specified as:

$$f(z) = \frac{1}{(1 + e^{-z})};$$

Where the variable (z) can be regarded as an input and f(z) as an output. The control variable (z) can be of any value from negative to positive, (Cramer, 2003). The control or independent variable (z) measures the aggregate contribution of all control variables (if they are many) used in the model. The final outcome f(z) is confined to any values between zero and one.

The control variable (z) is normally specified as:

$$(z) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \dots\dots.\beta_j x_j,$$

Where β_0 is the intercept; $\beta_1, \beta_2 \dots.\beta_j$ are the regression coefficients of $x_1, x_2 \dots.x_j$ respectively. If the contribution control variables equals zero, the intercept β_0 is the value of control variables. An increase in the probability of the outcome is explained by a positive coefficient ($\beta_1, \beta_2 \dots.\beta_j$) whereas a negative coefficient implies that the probability of outcome is reduced by the control variable whose coefficient is negative. The logit model describes the potential relationship between one or more control variables (for example, success, failure, live, dead, age, sex, and so on) and an outcome that is expressed as a probability with alternatives such as success or failure. The model analyses binomial distribution of data in the form:

$$Y \backsim B(n_1, p_1) \text{ for } i = 1 \dots\dots..k,$$

Where the numbers of Bernoulli trials n_1 are known and the probabilities of outcome p_1 are not known. In this study, the binomial distribution is the fraction of LRAD grant holders that are successful in farmland markets after combining their LRAD grants and mortgage loans. The natural logs of the log of odds of the unknown probabilities are then modelled as a linear function of the (X_i.) depicted below:

$$\textbf{Logit} = \ln\left[\frac{Pi}{(1 - Pi)}\right] = \beta 1 + \frac{\beta 2 D}{E}$$

Pi is the probability of competing fairly well in the property market and (1 – Pi) is the probability of no strong competition offered by the previously disadvantage grant holders in farmland market. The ratio $\left[\frac{Pi}{(1 - Pi)}\right]$ is the odds ratio or the odds in favour of successful biding by grant holders, and therefore increasing the demand for land. The natural log of this odds ratio is called the logit and the model is called the logit model (Gujarati, 1999: 449).

The logit model informs us that the log of odds ratio is a linear function of explanatory variable D/E in the present case. In this model, for example, the slope coefficient β2 estimates the change in the log of odds ratio per unit change in the amount of credit obtained by grant holders.

6.11.2 Special features of the logit model

Probabilities estimated from the model will always lie within the logical bounds of 0 and 1. The probability of competing fairly strong does not increase linearly or by a constant amount with a unit change in the value of any explanatory variable (Gujarati, 1999:449).

Since data on individual observation was collected, the method of maximum likelihood (ML) will be used to estimate the model. The logit ML estimation routine of the SHAZAM computer programme will be used to estimate the model. For the logit model, the usual R^2 is not meaningful. Alternatives such as Maddala and McFadden R^2s are used for validation.

CHAPTER SEVEN

EMPIRICAL RESULTS

7.1 Introduction

Chapter six identified the general hypothesis for the study, data sources, and the methodologies that were selected to empirically investigate the research propositions. The research problem is to investigate the relationship that might exist between agricultural commodity prices, interest rate and farmland values. This chapter presents and discusses the empirical results.

The central hypothesis is that a significant proportion of variation in farmland values is determined or explained by the variability in agricultural commodity prices that causes fluctuations in net farm income. The interest rate (capitalization rate) and net farm income jointly are expected to have a great influence on farmland values. Land reform issues might alter the demand for farmland and are expected to have a significant impact on farmland values. The notion of “significant proportion” recognizes the fact that fundamental factors discussed in this study could play a prominent role in the determination of farmland values although some other factors may also affect farmland values.

Identifying the price dynamics in agricultural land, and linkages between farmland values and fundamental factors provides an insight into the opportunities agricultural land offers to investors. The nature of the underlying data used in the study need to be accounted for in order to examine the existing linkages if any, between the dependent and independent variables. Non normality and autocorrelation problems in farmland time series studies have been found (Moss and Featherstone, 2003; Tegene and Kuchler, 1990). Standard statistical procedures in the presence of non stationarity may yield misleading results. The presence of non-stationarity in time series warrants the use of cointegrating methods to prevent spurious regression results.

The model was estimated using annual data for the period 1978 to 2008. Real per hectare farmland value is the dependent variable; it is differently specified in some sub-studies (for example, it is given as AUC to capture the effects on area under cane farmland value measure, and VPH which is value per hectare in sugar cane studies). Real returns per hectare were measured by net farm income after deducting all expenses except depreciation and interest on loans. Interest rate was measured by average interest rates from Land Bank and other commercial banks. For deciduous fruits, real net income from export is also included. All the variables are deflated by the CPI obtained from the South African Reserve Bank. All the other data were drawn from the Abstract of Agricultural Statistics, 2002-2008; South African cane Growers Association, Transfers of Rural Immovable Properties, 1977-1998; SAGIS; and from Elsenburg (Western Cape Department of Agriculture). Data for the land reform model were drawn from the Department of Land Affairs Provincial Report on Land Reform for Agricultural Development.

We first evaluated the stationarity of the variables using the annual time series data for all studies conducted. DF-GLS (Dickey-Fuller-Generalized Least Squares) test statistics were used to test for stationarity of variables. Two other tests were used to assist in the assessment of the presence of unit roots. The Im, Pesaran, Shin (IPS) test and the Augmented Dickey-Fuller Fisher test (ADF-Fisher) were also conducted. These tests are more powerful and reliable than the traditional Dickey-Fuller test since they are modified and have been recently tested. Results of these tests are presented in table 7.1. Once the unit root tests are completed the test for the number of cointegrated series was carried out. This part of the analysis uses the methodology developed by Johansen (1988); Johansen and Juselius (1990; 1991). Details of these tests were discussed in the methodology section. Testing for unit root and for the number of cointegrating vectors in the model determines what method to use in estimating the model (VAR if the series is stationary and VECM if the series is not stationary).

Computer software packages that were used to estimate the model are as follows:
SHAZAM was used to conduct the traditional Dickey-Fuller tests, estimate the model sub-studies using a single equation technique and to estimate the Logit model of land reforms. SPSS package was used to transform data and for comparison of results; Eviews package was used to conduct the other forms of unit root test (Im, Pesaran, Shin test; the Dickey-Fuller-GLS test, and the Augmented Dickey-Fuller-Fisher test). The Eviews package was also used to conduct the Johansen cointegration tests and to estimate the sub-studies models in VAR and VECM techniques. Results of the model sub-studies are given and interpreted in the coming sections.

Table: 7.1 Unit Root Test Results

Variable	Test	Prob	t-stat	Test	Prob	t-(crit)	Test	t-Stat	T-crit	Study
Values	IPS	0.999	2.08	ADF-F	0.998	-1.45	DF-GLS	1.05	-1.95	Maize
Returns	IPS	0.73	0.31	ADF-F	0.73	-1.52	DF-GLS	-1.5	-1.95	Maize
Interest	IPS	0.24	0.787	ADF-F	0.24	-1.52	DF-GLS	-1.83	-1.95	Maize
VPH	IPS	0.98	0.45	ADF-F	0.98	-1.52	DF-GLS	0.61	-1.95	Sugar Cane
AUC	IPS	0.98	0.40	ADF-F	0.98	-1.52	DF-GLS	0.03	-1.95	Sugar Cane
Returns	IPS	0.73	-0.93	ADF-F	0.76	-1.52	DF-GLS	-1.8	-1.95	Sugar Cane
Interest	IPS	0.24	-2.11	ADF-F	0.24	-1.52	DF-GLS	-1.3	-1.95	Sugar Cane
Values	IPS	1.00	5.3	ADF-F	1.00	-1.52	DF-GLS	0.27	-1.95	(ASA)
Returns	IPS	0.99	0.717	ADF-F	0.99	-1.52	DF-GLS	-0.01	-1.95	(ASA)
Interest	IPS	0.24	-2.11	ADF-F	0.24	-1.52	DF-GLS	-1.82	-1.95	(ASA)
Values	IPS	0.992	0.78	ADF-F	0.99	-1.52	DF-GLS	0.64	-1.95	Apples
Returns	IPS	0.85	-0.62	ADF-F	0.85	-1.52	DF-GLS	-1.65	-1.95	Apples
Interest	IPS	0.24	-2.11	ADF-F	0.24	-1.52	DF-GLS	-1.83	-1.95	Apples
Export	IPS	0.73	-0.16	ADF-F	0.73	-1.52	DF-GLS	-0.63	-1.95	Apples
Values	IPS	0.99	0.77	ADF-F	0.99	-1.52	DF-GLS	-0.63	-1.95	Pears
Returns	IPS	0.03*	-0.315	ADF-F	0.03	-1.52	DF-GLS	-1.51	-1.95	Pears
Interest	IPS	0.24	-2.11	ADF-F	0.24	-1.52	DF-GLS	-1.82	-1.95	Pears
Export	IPS	0.93	-0.16	ADF-F	0.93	-1.52	DF-GLS	0.21	-1.95	Pears

The symbol* denotes rejection of the hypothesis of unit root existence at the 5% level

Table 7.1 above shows results of the IPS, DF-GLS, and ADF-Fisher unit root tests. In all the studies conducted, the null hypothesis of unit root existence cannot be rejected at 5% level because all the probabilities are greater than 0.05 except the probability for returns in the pears study which is 0.03 and is less that 0.05; this implies that returns in pears study are stationary at 5%. The first differences of all variables under these unit root tests give probabilities that are far less than 0.05 implying that variables are stationary at first differences. More interpretation of these results is presented in the sub studies concerned.

Table7.2 Maximum Eigenvalue and Trace-Statistic Tests Results at 5% Critical value

Hyothesised No. of CE(s)	Eigenvalue	Trce-test	Trace C Value	LMax-test	Max-Eig C Value	Study
None*	0.6421	38.25	29.79	25.41	21.13	Maize
At most 1	0.3774	12.83	15.49	12.31	14.26	
At most 2	0.0197	0.518	3.84	0.518	3.84	

Hyothesised No. of CE(s)	Eigenvalue	Trce-test	Trace C Value	LMax-test	Max-Eig C Value	Study
None*	0.6390	36.99	29.79	25.00	21.13	Cane
At most 1	0.2631	11.99	15.49	8.24	14.26	
At most 2	0.1295	3.74	3.84	3.74	3.84	

Hyothesised No. of CE(s)	Eigenvalue	Trce-test	Trace C Value	LMax-test	Max-Eig C Value	Study
None*	0.5343	32.44	29.79	21.39	21.13	A (S.A)
At most 1	0.3051	11.04	15.49	10.18	14.26	
At most 2	0.0314	0.855	3.84	0.855	3.84	

Hyothesised No. of CE(s)	Eigenvalue	Trce-test	Trace C Value	LMax-test	Max-Eig C Value	Study
None*	0.9365	96.17	47.85	74.45	27.58	Apples
At most 1	0.3511	21.17	29.71	11.76	21.13	
At most 2	0.2958	9.95	15.49	9.47	14.26	
At most 3	0.0175	0.47	3.84	0.47	3.84	

Hyothesised No. of CE(s)	Eigenvalue	Trce-test	Trace C Value	LMax-test	Max-Eig C Value	Study
None*	0.7364	60.92	47.85	37.33	27.58	Pears
At most 1	0.4044	23.58	29.71	14.51	21.13	
At most 2	0.2653	9.07	15.49	8.63	14.26	
At most 3	0.0156	0.44	3.84	0.44	3.84	

The symbol* denotes rejection of the hypothesis of no cointegrating equations at the 5% level.

The Johansen cointegration tests results are presented in Table 7.2. Selecting the optimal lag length is vital for the Johansen cointegration tests since the tests are sensitive to lag lengths employed in the vector autoregression error correction model (VECM). Results of the Johansen cointegration tests (trace and maximum eigenvalue tests) fail to reject the null hypothesis of existence of cointegrating equations at 5% and 10% levels. These results are in line with unit root tests results obtained. The study thus opted to use a VECM to estimate the time series models. Results of the trace and maximum eigenvalue tests fail to reject the hypothesis of existence of cointegrating equations at 5% and 10% levels. The results prove that there is at least one cointegrating equation at five percent significant level for all studies conducted. Since the variables used are in log form, convergence to a long term solution should spell alpha parameters (speed of adjustment coefficients) falling within the range of minus one and zero (-1; 0). Speed of adjustment coefficients with values lower than negative two (-2) or higher than zero indicate explosive behaviour. Values closer to minus one (-1) indicate that a large percentage of disequilibrium is corrected, while values that are closer to zero indicate that correction or adjustment is low. For the long run results presented in Table 7.4 and 7.12, the results are presented in the form of normalized coefficients with respect to the coefficient of the dependent variable (farmland values) in all sub-studies. Normalization on farmland values (LV_t) involves transforming the equation $\beta_1 LV_t = \beta_2 NRR_t - \beta_3 RI_t + \varepsilon_t$ into normalized equation with respect to LV_t by dividing through by β_1, and transferring NRR_t and RI_t to the other side of the equation. A coefficient of one is obtained on LV_t and the coefficient signs of the transferred variables are reversed or changed (see Appendix A, section 1.3 for further explanation on normalization of coefficients) (Rossiter, 2002). However, this reversal of signs does not alter the impact of the control variable on the dependent variable.

It was also considered useful to test if the known structural changes of full deregulation of the South African agricultural sector had caused significant changes between the dependent variable and the independent variables. The Chow structural break test and the predictive forecasting failure tests were used to test the impact of structural changes on South African agricultural commodity prices and farmland values. All the models conducted in the study survived both the Chow break test and the predictive failure test. The models survived these tests with a known structural change (full deregulation) of 1997 as well as the state of uncertainty of the year 2000 (when 2000 was approaching, there was great uncertainty what will happen to the world should technology fail to adjust to digital changes-from the 20th century to 21st century. Chow test results in Table 7.3 reveal that the hypothesis of stable or constant parameters over time cannot be rejected at five percent significance level. F-statistic values at five percent significance level are much smaller than F-critical values. This implies that sample data should be pooled and analysed together in a single regression.

Table 7.3 Chow Break and Predictive Failure Tests Results								
Test	Period	F-statistic	F-critical	Test	Period	F-statistic	F-critical	Study
Chow-B	1997	0.701	3.32	Forecast	1997	0.487	2.35	Apples
Chow-B	2000	0.485	3.32	Forecast	2000	0.26	2.74	Apples
Chow-B	1997	0.703	3.32	Forecast	1997	0.487	2.35	Pears
Chow-B	2000	3.01	3.32	Forecast	2000	0.20	2.74	Pears
Chow-B	1997	2.11	3.32	Forecast	1997	2.13	2.51	Maize
Chow-B	2000	1.32	3.32	Forecast	2000	1.49	2.74	Maize
Chow-B	1997	1.96	3.32	Forecast	1997	1.00	2.39	Cane
Chow-B	2000	0.485	3.32	Forecast	2000	0.08	2.76	Cane
Chow-B	1997	1.96	3.32	Forecast	1997	2.19	2.33	A (SA)
Chow-B	2000	1.14	3.28	Forecast	2000	0.431	2.60	A (SA)

7.2 Sugar Cane

Dickey-Fuller generalized Least Squares (DF-GLS) test results for series with constant without trend, and for series with both constant and trend indicate that each of the series, are integrated of order one [I (1)]. The first differences of variables are stationary and are integrated of order zero [I (0)]. The tδ test for values per hectare, returns, and interest rates are 0.61, -1.33, and -1.83 respectively and are larger than t-critcal values at one percent and five percent levels. The test statistics (tδ) for differenced series for value per hectare (VPH), returns, and interest rates are much smaller than t-critical values at one percent and five percent levels, hence, the series are stationary after first differences. Given these results, each series satisfies the requirements to be included in the long run cointegration analysis. Johansen cointegration tests results are consistent with the Im, Pesaran, Shin (IPS), and the ADF-Fisher unit root test results presented in table 7.1.

Table 7.4:Normalized Vector Error-Correction Model Long Run and Short Run Results					
Variable	Normalized value (β)	(β) standard error	Alpha (α)coefficient	(α) Standard Error	Study
VPH	1	0.00	-0.032	0.09	Cane (VPH)
AUC	-0.0139	0.29	-0.085	0.07	Cane (VPH)
Net Income	-0.148	0.03	3.59	1.17	Cane (VPH)
Interest	0.325	0.059	-1.44	0.61	Cane (VPH)
AUC	1	0.00	-0.200	0.17	Cane (AUC)
Net Income	-0.158	0.02	0.0059	0.014	Cane (AUC
Interest	0.157	0.06	-0.559	1.50	Cane (AUC
Land Value	1	0.00	0.051	0.080	Maize
Net Income	-1.22	0.839	-0.09	0.181	Maize
Interest	0.4	0.11	-0.998	0.304	Maize
Land Value	1	0.00	-0.097	0.48	Aggregate(SA)
Net Income	-0.964	0.09	-0.119	0.008	Aggregate(SA)
Interest	-0.147	0.029	5.12	1.20	Aggregate(SA)
Land Value	1	0.00	-0.05	0.21	Apples (NRR)
Net Income	-0.00043	0.0013	0.000005	0.00004	Apples (NRR)
Interest	0.64	0.28	0.00003	0.016	Apples (NRR)
Land Value	1	0.00	-0.84	0.38	Apples (NXR)
Export Income	-0.52	0.055	0.67	0.45	Apples ((NXR)
Interest	0.0065	0.019	2.27	2.95	Apples (NXR)
Land Value	1	0.00	-0.184	0.0012	Pears (NRR)
Net Income	-0.00117	0.07	0.000006	0.000004	Pears (NRR
Interest	0.0468	0.02	0.00035	0.002	Pears (NRR
Land Value	1	0.00	-0.17	0.27	Pears (NXR)
Exp Income	-0.67	0.0.07	0.029	0.136	Pears (NXR)
Interest	0.14	0.022	-0.015	0.022	Pears (NXR)

Long run cointegration results after normalisation with respect to value per hectare are presented in table 7.4. The long run vector autoregressive error correction results reveal that per hectare real net farm income has the expected positive sign, while real interest rate coefficient has the expected negative sign (note that signs are reversed by normalization, in reality net farm income is positive and interest rate is negative). Both coefficients are found to be significantly different from zero with very low standard errors. The positive signs for lagged real per hectare net farm income and lagged real per hectare farmland value show that past information on farmland values and on returns to farmland impacts positively on current farmland prices as individuals form their expectations based on past information. In this value per hectare sugar cane model, a ten percent change in lagged real per hectare net farm income could induce a 1.48 percent change in current per hectare farmland value; whereas a one percent change in lagged real interest rate could induce a -0.325 percent change in current farmland values.

The short run dynamics of the model are also presented in Table 7.4. The speeds of adjustment coefficients (α values) for real per hectare farmland values and net farm income have the expected negative signs. The speed of adjustment coefficient for real per hectare farmland value has a value of -0.032. This means that the deviation from equilibrium are adjusted or corrected each period.

Coming to the area under cane (AUC) per hectare farmland values; estimation of VECM proceeds under the assumption of nonstationarity and cointegration in variables. Results of the model are presented after normalization with respect to area under cane per hectare land value variable. Real per hectare net farm income has an expected positive sign. A ten percent change in lagged real per hectare net farm income could induce a proportionate 1.5 percent change in current per hectare farmland value. The sign of real interest rate is negative; implying a negative relationship between farmland values and interest rate. A one percent change in real interest rate could induce a -0.157 percent change in current per hectare area under cane farmland value. The speed of adjustment coefficient signs for area under cane per hectare farmland value and interest rate are negative, meaning that deviations from the long run equilibrium for these variables are corrected each and every period the system is away from equilibrium. Real per hectare net farm income has a large positive coefficient value, meaning that returns to farmland are explosive and their deviations from long run equilibrium are not easily corrected. This shows the volatility of commodity prices that determines net farm income.

The effects of interaction among variables are best captured in a vector autoregression error correction model. A combined estimation of variables using VECM proved that a link exists between area under cane (AUC) per hectare, net income and value per hectare (VPH) although the link is not very strong. Area under cane per hectare has a positive externality on both net income and value per hectare. Area under cane (AUC) per hectare influences the value per hectare (VPH) land prices with a margin of 0.014 percent and a very low standard error. This means that area under cane per hectare induces increases in value per hectare indirectly.

7.3 Maize Results

Unit root test statistics indicated a unit root in all the series in the maize model (that is, real per hectare farmland values, real per hectare returns to farmland and real interest rates). Nonstationarity exist among variables as indicted by t-statistics that are greater than t-critical values at 5% and 10% for not differenced series. When series are differenced once, t-tests values are much smaller than t-critical values, indicating nonstationarity of the series. Results of the IPS and ADF-Fuller tests in Table 7.1 are consistent with Dickey-Fuller- GLS test results. Test statistics that are specially designed to detect the number of cointegrating equations in the model were used. Results of trace and maximum-eigenvalue tests indicated that at least one cointegrating equation exists in the model. A vector autoregressive error correction model was used to analyse the data series.

For the long run results presented in Table 7.4 (after normalization with respect to farmland values); the sign on the coefficient of real returns to farmland is positive as expected apriori; indicating a positive impact of lagged real net farm income on farmland values. A ten percent change in lagged real net farm income could result in a proportionate 12.1 percent change in farmland values. Interest rate is negatively related to real per hectare farmland value, and the empirical results indicate that a 1% change in lagged real interest rate could inversely affect farmland values by 0.4% percent. Short run dynamics of variables as represented by the speed of adjustment coefficients reveal that returns to farmland has a negative value of (-0.098) indicating that 0.098 percent of net farm income deviations from the equilibrium path are corrected each period. The speed of adjustment coefficient for per hectare farmland value is very small (close to zero) but is positive. Its standard error is also very small at 0.008. This means that the distortion corrections are slow to adjust.

7.4 Aggregate South African Farmland Value Results

Cointegration test results for aggregate South African farmland value study are presented after all unit root tests were conducted. The results give evidence of the existence of nonstationarity among the variables tested. Consistent with all unit root tests conducted, the Johansen tests used to determine the number of cointegrating vectors accepted the null hypothesis of existence of at least one cointegrating equation. Trace and Maximum Eigenvalue tests statistics are 32.44 and 21.39 respectively and are greater than t-critical values at five (5) percent and ten (10) percent levels of significance. This indicates and suggests that the aggregate South African farmland value study should be estimated with a VECM (vector autoregression error correction method) since the trace and maximum eigenvalue tests indicated the presence of at least one cointegrating equation at 5% level. The results for vector autoregression error correction long run dynamics are presented in Table 7.4:

Table 7.4 presents normalized (with respect to farmland values) long run equilibrium and short run dynamic results for aggregate South African farmland value study. The coefficient for real net farm income is positive, significantly different form zero and is very close to one. The results suggest that a 10% change in real per hectare net farm income could induce a direct proportionate 9.7 percent change in real per hectare farmland values. A negative relationship between real per hectare farmland value and lagged real interest rate was expected. It was surprising that interest rate appeared positive. However, the coefficient sign for interest has no significant impact on the dependent variable in the long run as it is far less than one.

The speeds of adjustment coefficients for real per hectare farmland values and net farm income have expected negative signs. The value of the speed of adjustment coefficient for real per hectare farmland is -0.373 whereas that for net farm income is -0.195. This means that deviations from equilibrium are adjusted or corrected each period for both these variables once they are out of the equilibrium path.

7.5 Deciduous Fruit Results

Dickey-Fuller-GLS, Im, Paseran, Shin (IPS) and ADF-Fisher test statistics, indicated a presence of unit root in all deciduous fruit series in the model (that is, real per hectare farmland values, real per hectare returns to farmland, real per hectare export income, and real interest rates are said to possess unit root). This meant that nonstionarity exists among variables in the models as indicated by the t-statistics that are greater than t-critical values at 1% and 5% significance levels the for series at levels. When the series are differenced once, t-tests values are much smaller than t-critical values, indicating that the series become stationary at first differences. Also, the probabilities for variables in IPS and ADF-Fisher tests results allows for non-rejection of the null hypothesis of unit root. The Johansen trace and maximum-eigenvalues tests were conducted to support the unit root tests results and to indentify the number of cointegrated series in the models. Results of trace and maximum-eigenvalue tests did not fail to reject the null hypothesis of no cointegration among variables at 5% significance level for series with a constant in cointegrating space and trend in data. A vector autoregressive error correction method was employed to estimate both apples and pears models. Since apples and pears net farm income consist of export net income as one of the income components; it was perceived necessary to model net farm income separately from export income. This reduced the problem of multicollinearity among variables in the models estimated.

7.5.1 Apples

As stated above, unit root tests conducted on variables under this study suggested that variables are non stationary; these were supported by the Johansen cointegration tests that depicted a one cointegrating equation in each apples sub-study. The normalized (with respect to farmland value) long run cointegration results for export income model indicated that a positive relationship exists between export income and apple farmland values. A ten percent change in per hectare export income could induce a 3.39 percent change in apple per hectare farmland value. Per hectare net farm income also has a positive sign; a ten percent change in this aggregate net income could induce a 0.0004 percent change in apple farmland values. The results prove that export demand for deciduous fruit contributes significantly to changes in deciduous fruit farmland values. Interest rates under these studies induce changes of 0.0065 percent and 0.64 percent for export income and aggregate net farm income respectively for a one percent change in interest rate. The coefficient signs of interest rate in both these models are as expected. This is consistent with economic theory suggesting that interest rate is negatively related to investments. The speed of adjustment coefficient for per hectare farmland value is negative at -0.84, implying that 0.84 percent of farmland price deviations from equilibrium are corrected each year under the export income sub-study. The alpha coefficient for aggregate net farm income is also negative at -0.05. This indicates that apple farmland values respond slowly to shocks and deviations from long run path under net farm income compared to export income.

7.5.2 Pears

Given existence of at least one cointegrating vector among variables, the pears study will be modelled using vector autoregressive error correction model. Results of the VECM long-run equation after normalization with respect to per hectare land value are then presented as follows: The VECM normalized long-run results indicate that the long-run elasticity of per hectare net farm income is approximately 0.66 percent. Alternatively, this can be interpreted in the manner that real per hectare farmland value changes by 6.6 percent with a ten percent change in per hectare net export income in the long run. From interest rate perspective, per hectare farmland value is negatively affected by real interest rate. A percentage change in interest rate could induce a negative 0.158 percent change in farmland values in the long run. The model strongly suggests that pears export prices are prominent drivers of changes in pear net farm income. A substantial amount of income in pears industry is derived from exported pears. Each speed of adjustment after normalization measures the degree to which the variable in question (for example, values, and so on) responds to the deviation from the long run equilibrium relationship. The speed of adjustment for real per hectare farmland value is -0.167. The significantly different from zero speed of adjustment coefficient for per hectare farmland value indicates that per hectare farmland values respond moderately to deviations from equilibrium path.

7.6 Contemporaneous Relationships among Variables

Impulse response analyses are regarded as a common tool for investigating interrelationships among variables in dynamic models. In this study, the Choleski forecasting error variance decomposition is used to examine contemporaneous relationships between variables in the sub-studies. Variance decomposition gives the proportion of the movements in the dependent variable that are due to its own shocks against the shocks of other variables. Specification of the Choleski method is the same as imposing restrictions on a structural VAR so that it is transformed into a reduced form VAR. The restrictions imposed in particular equation manifest themselves such that farmland value (y_t) and returns (z_t) shocks contemporaneously affect farmland values but only returns shocks contemporaneously affect returns (farmland values do not contemporaneously affect returns). Residuals decomposed in such a triangular fashion are decomposed using Choleski decomposition. The related equations are:

$e1t = \varepsilon yt - b12\varepsilon zt$

$e2t = \varepsilon zt$

Setting equations similar to the ones above is referred to as ordering of variables (Enders, 2004). The importance of ordering depends on the magnitude of the correlation coefficient between e_{1t} and e_{2t};. According to Enders (2004) if the estimated variance-covariance model yields a value of:

$$\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix}$$

Where (σ_{11} andσ_{22}) are variances of e_{1t} and e_{2t} respectively, and (σ_{12} ,σ_{21}) are covariances of the two composite errors e_{1t} ande_{2t}; such that the correlation coefficient (ρ) is found to be zero; the ordering in this case is zero since there is no correlation across equations. The residuals from y_t and z_t equations are equivalent to εyt and εzt shocks. Variable inter relationship results for maize, average South Africa and sugar cane studies and their interpretation are given below:

Table 7.5a: Sugar Cane Value per Hectare Variance Decomposition

Period	S.E.	VPH	AUC	RETURNS	INTEREST
1	0.248491	100.0000	0.000000	0.000000	0.000000
2	0.278202	89.37100	0.274603	4.089116	6.265284
3	0.311136	84.48763	0.793893	4.760990	9.957486
4	0.331075	83.31578	1.021914	6.845171	8.817138
5	0.341596	83.11415	0.993751	7.202757	8.689345

The variance decomposition analysis of value per hectare (VPH) variable (Table 7.5a) reveals that value per hectare's contribution to its own shock accounts for 100 percent in the first year, 89.37 percent in the second year and remains stable from the third year up to the fifth year with a value of 83 percent contribution to its own shock. Interest rate is the second major contributor of variation in value per hectare with a significant short run contribution of 6.26 percent in the second year and 9.95 percent in the third year. The other variable which picks up a significant part of variation in the value per hectare is per hectare net farm income. In the long run (5th year) about 7.2 percent in variance in farmland value per hectare is explained by variations in per hectare net farm income whereas, in the short run per hectare net farm income accounts for 4.09 to 4.76 percent.

Table 7.5b: Area under Cane (AUC) Variance Decomposition

Period	S.E.	VPH	AUC	RETURNS	INTEREST
1	0.216940	3.694719	96.30528	0.000000	0.000000
2	0.311752	1.872718	93.89653	4.203239	0.027511
3	0.330398	1.952428	90.94674	6.993463	0.107370
4	0.348494	3.683679	88.57478	7.105167	0.636378
5	0.375779	4.982580	85.66230	6.251614	3.103510

Table 7.5b shows results of the variance decomposition of area under cane (AUC) per hectare farmland value. The variable contributes 96.31 percent to its own shock in period one (1st year); the shocks then stabilises from year four through year five. Returns to farmland (per hectare net farm income) accounts for the largest contribution of shocks to area under cane variable apart from area under cane's own shocks. Net farm income significantly accounts for 7.1 percent of long run variations in area under cane farmland value in the fourth year; the contribution gradually declines to 6.25 percent in fifth year to about 5.64 percent in the 8th year (5.64 not shown in Table 7.5). Meanwhile, the contribution of interest rate is insignificant and accounts for 0.027 percent in the short run (2nd period) but increases to 3.1 percent in the long run (5th year). It is surprising but interesting to note the value per hectare's (VPH) 4.98 percent long run total contribution to area under cane's (AUC) variations. Variations in per hectare farmland value for maize are discussed in the next section.

Table 7.6: Maize Value per Hectare Variance Decomposition

Period	S.E.	VALUES	RETURNS	INTEREST
1	0.290330	100.0000	0.000000	0.000000
2	0.308274	97.67124	0.023226	2.305532
3	0.356679	82.77041	13.00862	4.220962
4	0.387260	81.83080	12.02519	6.144008
5	0.428253	83.08688	11.33470	5.578413

Real per hectare maize farmland value variance decomposition results (Table 7.6) reveals that the variable per hectare farmland value is exogenous and contributes 100 percent of its own shock in year one. A return to farmland (per hectare net farm income) substantially contributes 13 percent of variation in per hectare farmland value in period three. This amount gradually reduces to 11.33 percent in the long run (period five). Interest rate takes its pick contribution to variations in per hectare farmland value in period four with a reasonable share of 6.14 percent contribution. The variable interest tare's contribution in the short run is however fairly small (2.3 percent in first year and 4.22 percent in period three respectively).

For the aggregate South African farmland value study (Table 7.7), variance decomposition results show that real per hectare farmland value is exogenous and contributes 100 percent of its variations in the short run (first year) but this contribution gradually declines to 78.76 percent in the fifth year. Real per hectare net farm income's contribution to farmland value shocks is significant but stable in the short run with a contribution of approximately 11 percent in the second and third years.

Table 7.7: Aggregate (SA) Value per Hectare Variance Decomposition

Period	S.E.	VALUES	RETURNS	INTEREST
1	0.595486	100.0000	0.000000	0.000000
2	0.647964	84.76418	11.12493	4.110894
3	0.682452	84.46611	10.82089	4.713006
4	0.698267	83.58697	11.82833	4.584699
5	0.726808	78.76713	16.78322	4.449647

Net farm income's contribution to variations in per hectare farmland value become robust in the long run as per hectare net farm income contributes 16.78 percent of shocks to per hectare farmland value. Like per hectare net farm income, interest rate's impact on per hectare farmland value has a delayed effect as it does not contribute at first year. Interest rate's innovations to per hectare farmland value shocks account for 4.11 percent in the second year and remain stable around 4.58 to 4.44 percent in the long run. Deciduous fruit farmland value variance decompositions are discussed in the next section.

Table 7.8: Pears Value per Hectare Variance Decomposition

Period	S.E.	VALUES	RETURNS	EXPORT	INTEREST
1	0.138788	100.0000	0.000000	0.000000	0.000000
2	0.173185	91.80946	0.718861	2.119351	5.352331
3	0.194481	86.84890	5.819165	2.406574	4.925358
4	0.275995	61.76737	6.682644	8.627409	22.92257
5	0.330505	57.80463	5.205016	9.246248	27.74411

The effect of export income on pears per hectare farmland value appears to be long run and persistent over time. Per hectare export income explains up to 9.24 percent of variability in per hectare farmland values in the fifth year while in the short run per hectare export income accounts for 2.11 percent and 2.406 percent of the shocks in per hectare farmland value in the second and third year respectively. Another significant determinant of the variations in pears per hectare farmland value is per hectare net farm income which accounts for 6.68 percent in the fourth year. Both per hectare export income and local per hectare net farm income affect per hectare farmland values with a lag of one year. Innovations in interest rate explain a large proportion of variations in per hectare farmland value as this variable contributes 22.92 percent to 27.74 percent of variations in per hectare farmland value in the long run. Variance decomposition for apple farmland value study is presented in the next section.

Table 7.9a: Apples Value per Hectare Variance Decomposition

Period	S.E.	VALUES	EXPORT	INTEREST
1	0.166559	100.0000	0.000000	0.000000
2	0.228476	94.37027	5.150108	0.479618
3	0.290844	90.57640	3.780105	5.643492
4	0.327583	91.76366	3.529045	4.707292
5	0.378835	88.17082	8.309074	3.520107

Table 7.9b: Apples Value per Hectare Variance Decomposition

Period	S.E.	VALUES	RETURNS	INTEREST
1	0.147857	100.0000	0.000000	0.000000
2	0.230988	92.53097	6.372512	1.096517
3	0.306812	91.24113	3.928186	4.830686
4	0.364339	88.74918	7.822641	3.428178
5	0.425818	89.77413	7.705551	2.520319

The apple her hectare farmland value study also demonstrates that per hectare export income has a substantial impact on apple farmland values. Export income accounts for 5.15 percent of variations in apple per hectare farmland values in the short run (second year) and this contribution increases to 8.3 percent in the long run. Returns to apple farmland also have a significant impact on apple farmland values as this variable contributes 6.37 percent of variations in apple per hectare farmland values in the second year (short run). The contribution by returns to farmland increases to 7.71 percent in the long run. Interest rate also affects apple farmland values with a delayed impact. In the second year, interest rate accounts for 0.47 and 1.09 percent of the variations in the apple per hectare farmland value under export income and returns to farmland respectively. The variable interest rate takes its pick contribution to variations in apples per hectare farmland value in third year with a contribution of approximately five percent.

7.7 The Macroeconomic-Agricultural Sector Model

7.7.1 Unit Root and Cointegration Tests Results

Three unit root tests were employed to test for the stationarity or non-stationarity of variables in the models. These unit root tests are Dickey-Fuller-GLS, augmented Dickey-Fuller test, and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The results for the two unit root test revealed that all variables used in the two models are non-stationary and are integrated of order one. The KPSS results reveal that all variables are stationary and integrated of order zero [I (0)]. This suggested the need for error correction methods in estimating the models. Cointegration tests were conducted after the unit root tests.

Table 7.10 Maize and Apple Unit Root Test Results					
	Apples				
Variable	**DF-GLS**	**ADF**	**Results**	**KPSS**	**Results**
Values	0.64	-0.13	Ho ~I(1)	0.712	Ho ~I(0)
Price	-0.05	-1.27	Ho ~I(1)	0.692	Ho ~I(0)
Costs	0.069	-2.57	Ho ~I(1)	0.74	Ho ~I(0)
Interest rate	-1.83	-2.007	Ho ~I(1)	0.196	Ho ~I(0)
M3	-1.175	-3.44	Ho ~I(1)	0.119	Ho ~I(0)
Exchange rate	-0.11	-0.95	Ho ~I(1)	0.71	Ho ~I(0)
	Maize				
Variable	**DF-GLS**	**ADF**	**Results**	**KPSS**	**Results**
Values	-1.05	0.58	Ho ~I(1)	0.71	Ho ~I(0)
Price	0.633	-0.45	Ho ~I(1)	0.42	Ho ~I(0)
Costs	-3.17	-4.71	Ho ~I(1)	0.34	Ho ~I(0)
Interest rate	-1.83	-2.007	Ho ~I(1)	0.196	Ho ~I(0)
M3	-0.119	-3.44	Ho ~I(1)	0.119	Ho ~I(0)

Trace and Maximum eigenvalue cointegration tests were carried out to determine the existence of the number of cointegrating equations in the systems. The results of these two cointegration tests revealed that at least two cointegrating relationships exist at five percent significance level for both maize and apple models (Table7.10). This means that the first and second eigenvalues are statistically significant at five percent level.

7.7.2 Maize and Apple Long Run and Short Run Results

Given the existence of two cointegrating equations, error correction models were estimated based on eigenvectors in relation to eigenvalues of equations (6.11) and (6.12). We first present maize long run cointegration results based on Table 7.11. All the long run and their corresponding short run results are given as normalized with respect to the dependent variable (farmland values) (see appendix A section 1.3 for some explanation on normalized coefficients). It must be noted that a negative sign is interpreted as positive and a positive sign as negative when results are given as normalized results. This occurs because interest rate and net farm income are transferred to the other side of the equation and the equation is then divided by the coefficient of the chosen variable (in this case farmland values).

Table 7.11 Maize and Apple Cointegration Tests Results					
	Apples				
Hypothesized No. CE(s)		Trace Statistic	Trace Critical	Maximum Eigenvalue	Maximum Eigenvalue
	Eigenvalue	5%	5%	5% (statistic)	5% critical
None *	0.859642	176.8178	95.75366	56.94328	40.07757
At most 1 *	0.845889	119.8745	69.81889	54.23234	33.87687
At most 2 *	0.735620	65.64214	47.85613	38.58069	27.58434
At most 3	0.457470	27.06145	29.79707	17.73384	21.13162
At most 4	0.263450	9.327609	15.49471	8.867563	14.26460
	Maize				
Hypothesized No. CE(s)		Trace Statistic	Trace Critical	Maximum Eigenvalue	Maximum Eigenvalue
	Eigenvalue	5%	5%	5% (statistic)	5% critical
None *	0.898209	115.8657	69.81889	66.26006	33.87687
At most 1 *	0.600751	49.60567	47.85613	26.62695	27.58434
At most 2	0.377245	22.97871	29.79707	13.73447	21.13162
At most 3	0.249306	9.244241	15.49471	8.315950	14.26460
At most 4	0.031503	0.928291	3.841466	0.928291	3.841466

(*) indicates significance at 5% level

Maize

The normalized long run coefficient of maize price is positive and statistically significant at 1, 5 and 10 percent levels of significance with a t-statistic of 11.59. A 10 percent increase in maize price could induce a 14.1 percent proportionate increase in maize farmland prices in the long run. Money supply has an inflationary impact because its increase may results in increase in prices. The normalized coefficient of money supply is positive and is statistically significant at one percent and five percent significant levels with a t-statistic of 9.61. A 10 percent increase in money supply could induce a 0.61 percent increase in maize farmland prices in the long run. Costs and interest rate normalized coefficients are negative as they were expected. These coefficients are statistically significant at one and five percent significance levels with t-statistics of 5.02 and 17.54 for costs and interest rate respectively. A 10 percent increase in costs could induce a decline of 5.27 percent in maize farmland prices in the long run. A one percent increase in interest rate could induce a long run 0.136 percent decrease in maize farmland prices. The speed of adjustment coefficient for farmland values is negative (-0.74) and close to one. This indicates that farmland values moderately adjust from long run equilibrium deviations.

Table 7.12 Maize and Apple Long Run and Short Run Cointegration Results					
	Apples				
Variable	***β***	***t-stat***	***β(s.e)***	***α***	***α(s.e)***
Values	1	0.00	0.00	-0.08	0.02
Price	-0.07	-0.76	0.09	0.52	0.7
Costs	-1.4	-5.94***	0.23	0.168	0.04
Interest rate	0.069	6.56	0.01	2.17	2.16
M3	-.008	-0.92	0.009	-0.68	5.76
Exchange rate	0.94	5.00***	0.18	-0.27	0.24
	Maize				
Variable	***β***	***t-stat***	***β(s.e)***	***α***	***α(s.e)***
Values	1	0.00	0.00	-0.74	0.275
Price	-1.41	-11.6***	0.12	-0.22	0.42
Costs	0.527	5.02***	0.10	0.162	0.33
Interest	0.136	17.5***	0.007	-6.35	1.4
M3	-0.06	-9.61***	0.006	-10.7	5.76

(***) indicate statistically significant at 1% level

Apples

Long run cointegration results are presented in Table 7.12. Input costs for apple production appear to be the major driver of apple farmland values. The coefficient sign for input costs is not as it was expected. The sign is positive instead of negative and is statistically significant at 1 percent, 5 percent and 10 percent levels with a t-statistic of 5.95. This could happen because input costs are a dominant factor in the early stages of fruit plantations. Orchard values appreciate simultaneously with the increase in the costs of maintaining an orchard. A 10 percent increase in input costs could induce a 14.1 percent increase in farmland values in the long run. Exchange rate has an expected negative sign; appreciation of the South African Rand against the US Dollar makes South African goods expensive in foreign markets and profit margins also decline. Depreciation of the South African Rand makes South African goods cheaper in foreign markets and revenue prospects are revitalised. Exchange rate coefficient is statistically significant at all levels of significance with a t-statistic of 5.00. A 10 percent increase in exchange rate could result in a decrease of 9.4 percent in apple farmland values in the long run. Interest rate coefficient also has an expected negative sign and is statistically significant at 1 percent, 5 percent and 10 percent significance levels. A percentage increase in interest rate could induce a decline of 0.069 percent in apple farmland values in the long run. The coefficient sign of average apple prices is positive but not statistically significant at 5 percent and 10 percent levels. This could be the result of pooling together of export prices, domestic prices and processing prices. Processing prices are the lowest of the three prices and has an adverse impact on averaging the apple prices. A 10 percent increase in average price could induce a 0.7 percent increase in apple farmland values in the long run. Money supply coefficient is positive as it was expected; a 10 percent increase in money supply could result in a 0.08 percent increase in apple farmland prices in the long run. The speed of adjustment coefficient for apple farmland values is -0.08; this indicates that apple farmland values do not quickly adjust to long run equilibrium path after deviating from the path. Money supply and exchange rate speed of adjustment coefficients are -0.68 and -0.27 respectively. These variables moderately adjust to long run equilibrium after deviation from the equilibrium path. Interest rate is the most explosive variable with a speed of adjustment coefficient of 2.17 percent.

7.7.3 Forecasting Error Variance Decomposition (Maize and Apple)

Maize

Maize farmland values are exogenous as 100 percent of its variations in the first year are explained by its own shocks. The farmland value shocks gradually declines from 100 percent in the first year to 62.74 percent in the fifth year. Maize prices contribute approximately 8 percent of maize farmland price variations in the short run. The contribution of maize price shocks to variability in maize farmland values gradually increase to 14.32 percent in the fifth year. Interest rate is another important contributor to maize farmland price variations. A significant 12.37 percent variation in maize farmland prices in the short run is due to interest rate shocks. Money supply contributes approximately 3.64 percent of variations in maize farmland prices in the short run. The long run impact of money supply shocks on maize farmland values is outstanding. Money supply shocks contribute 10.87 percent of variations in maize farmland values. The contribution of input costs shocks to maize farmland values accounts for 4.33 percent in the short run and this contribution steadily declines to 3.22 percent in the long run (fifth year).

Maize prices are an endogenous variable as their own shocks contribute 88.99 percent of its own variations in the first year. Money supply shocks are the second largest contributor to maize price variations. Money supply shocks account for 3.62 percent in maize farm variations in the short run and 4.93 percent in the long run. Input costs shocks contribute 2.31 percent in maize price variations in the short run and 1.73 percent in the long run. Interest rate is not significant in influencing maize prices. Money supply shocks also proved to be a dominant contributor towards maize input costs shocks accounting for 3.67 percent in the short run (2nd year) and 2.3 percent in the long run. Interest rate shocks marginally contributed a 0.64 percent of total variation in maize price in the short run and 1.22 percent in the long run.

Table 7.13 MAIZE FORCASTING ERROR VIRIANCE DECOMPOSITIONS

Values

Period	S.E.	VALUES	PRICE	COST	INTEREST	M3
1	0.200676	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.275250	74.92757	7.604450	4.248374	12.37890	0.840709
3	0.316530	70.26902	11.84570	4.331036	9.910548	3.643692
4	0.355551	61.96372	14.32953	3.566995	10.80731	9.332447
5	0.388463	62.74315	13.53124	3.223698	9.628252	10.87366

Price

Period	S.E.	VALUES	PRICE	COST	INTEREST	M3
1	0.307046	11.00510	88.99490	0.000000	0.000000	0.000000
2	0.384967	13.16525	85.42425	0.904631	0.011994	0.493870
3	0.414579	18.73357	74.94375	2.310061	0.396569	3.616045
4	0.450073	16.89934	75.68383	2.064114	0.422646	4.930070
5	0.494913	15.75286	77.60678	1.726954	0.713417	4.199990

Costs

Period	S.E.	VALUES	PRICE	COST	INTEREST	M3
1	0.240462	3.166419	0.442484	96.39110	0.000000	0.000000
2	0.338258	4.874593	0.714867	90.09719	0.636649	3.676697
3	0.420091	5.452239	0.694007	89.66704	1.612004	2.574707
4	0.492597	7.202052	2.655118	86.45644	1.382566	2.303822
5	0.554665	8.917431	2.189946	85.83471	1.223669	1.834244

TABLE 7.14 APPLE FORECASTING ERROR VARIANCE DECOMPOSITIONS

Values

Period	S.E.	VALUES	INTEREST	COST	AVERAGE_P	M3	EXCHANGE
1	0.174468	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.247970	90.55866	0.046248	4.661484	0.379762	2.068681	2.285164
3	0.303750	85.14832	3.981098	6.681864	0.326945	2.322965	1.538808
4	0.350382	83.84793	4.140849	7.260764	0.249471	2.510792	1.990195
5	0.382274	82.17608	3.488752	7.675716	0.259585	3.063701	3.336167

Price

Period	S.E.	VALUES	INTEREST	COST	AVERAGE_P	M3	EXCHANGE
1	0.602775	1.641805	1.580713	6.630027	90.14745	0.000000	0.000000
2	0.650590	2.926928	5.872533	6.245006	84.40189	0.467385	0.086259
3	0.746768	3.675658	6.949056	4.799216	81.31829	1.920996	1.336785
4	0.847834	3.415130	9.895067	4.786781	79.15520	1.674925	1.072899
5	0.887988	3.395602	13.13682	4.794260	75.98879	1.691889	0.992642

Costs

Period	S.E.	VALUES	INTEREST	COST	AVERAGE_P	M3	EXCHANGE
1	0.034792	56.00823	1.511405	42.48036	0.000000	0.000000	0.000000
2	0.054599	47.42095	0.731036	42.71884	7.832615	0.171747	1.124809
3	0.082751	35.93056	1.914669	24.90600	15.89078	0.080379	21.27762
4	0.113774	22.79374	13.07447	15.56240	9.386086	0.202715	38.98059
5	0.137994	16.74728	22.63437	12.29564	6.446672	0.299190	41.57685

Apples

Apple per hectare farmland value shocks contributes 100 percent of its total variation in the first year and 82.17 percent in the fifth year, indicating that the variable is exogenous. Input costs for apple production proved to be a significant driver of apple farmland values. Input costs shocks contribute 4.71 percent of variations in apple farmland values in the short run and the long run's contributions account for 7.76 percent. The results prove that input costs like fertilizer and fuel have a significant impact on farmland price determination. Money supply and exchange rate shocks contributed approximately 2 percent each to total variations in farmland prices in the short run. Exchange rate shocks' contribution increased to 3.33 percent in the fifth year, and money supply shocks' contributions also increased to 3.06 percent in the fifth year. Interest rate shocks' contribution to farmland price variations account for 4.14 percent in the long run while short run contributions are not significant at 0.05 percent in the second year. It is surprising to note that average apple price shocks contribution to apple farmland price variations is not significant in the short run and in the long run. The variable's shocks contribute 0.379 percent in the short run and 0.25 percent in the long run in farmland price variations. This could be the result of using averaged apple prices in the model.

Input costs are an endogenous variable since they contribute 42.5 percent of its own shocks in the first year. The short run major contributors to input cost shocks are exchange rate and apple prices. A surprising 21.27 percent of total variations in input costs are due to exchange rate shocks while average price shocks contribute 15.89 percent of input cost variations in the short run. Exchange rate also proved to be the dominant contributor to input cost variations in the long run as exchange rate shocks accounts for 41.57 percent of long run input cost shocks. Interest rate shocks' contribution to variations in input costs is marginal in the short run (1.51 percent in the first year) but highly significant in the long run; explaining 22.63 percent of input cost variations. Money supply shocks' contributions to input costs shocks are not significant in the short run and in the long run.

Average apple price are endogenous in that 90 percent of the variables shocks originate from the variable itself. Input costs shocks are a second major contributor to average apple price variations with a 6.63 percent contribution in the short run. Interest rate shocks' follows input costs as another short run contributor to average price variations with interest arte shocks accounting for 5.87 percent in the second year. In the long run, interest rate shocks dominate other variables contribution to average price shocks. A noticeable 13.31 percent of shocks in average prices are due to interest rate shocks in the long run. Money supply and interest rate shocks are not significant in the long run and in the short run. The long run money supply shocks' contribution to average price shocks accounts for only 1.69 percent while exchange rate shocks' contribution remain relatively low at 0.99 percent.

7.8 The Logit Model Results

The model was first estimated with two variables explaining the model. The variables were the number of hectares obtained, and the amount of credit used to finance the transaction. The model suffered multicollinearity problems because the number of hectares obtained and the amount of credit used were highly correlated. The results for the model were unreliable; the coefficients all the variables in the model were statistically not significant at all the levels of probability, standard errors were extremely high and the R^2s were at the region of 1.002 percent explaining the model. Two options were considered: Dropping the variable amount of credit received from the model; this option seemed not good. Given the high farmland prices in South Africa, receiving a grant alone usually cannot afford to buy farmland at going market prices. Pooling of the grants was noted as exacerbating post transfer problems for beneficiaries, and the DALA does not further recommend the pooling of grants. This meant that the amount of loan used to finance farmland purchases is important. Dropping the variable number of hectares obtained was considered the best option since obtaining the number of hectares stem from the two other factors (percentage of grant and amount of credit received).

The model was then estimated with D/E ratio as explanatory variable. The results of the model are given below:

$$\mathbf{D = -2.9550 + \beta 10.000163}$$

$$se = (1.267) \qquad (0.000072)$$

$$t = (-2.33) \qquad (2.250)$$

Durbin-Watson = 1.9009 ρ= 0.01512

Estrella R^2= 0.79646

Maddala R^2= 0.56922

Cragg-Uhler R^2= 0.85232

Mcfadden R^2= 0.76410

$$\textbf{Logit} = \ln\left[\frac{Pi}{(\mathbf{1} - Pi)}\right] = \mathbf{-2.9550 + 0.000163}$$

$$Pi = \frac{1}{[1 + e^{-zi}]} \qquad Pi = \frac{1}{[1 + e^{-2.9550 + 0.000163}]}$$

$$Pi = \frac{1}{[1 + e^{-0.052087}]} \qquad Pi = 0.513$$

The probability that previously disadvantage individuals stand a good chance to compete fairly farmland markets if they have a debt equity ratio of 1.5 (1.5 solvency ratio being 60 percent loan and 40 percent LRAD grant) is fairly explained by the model. Given the fact that goodness-of-fit is fairly low for discrete choice models in most cases (Verbeek, 2004); the model does a good job in explaining the probability. Results of goodness-of-fit of the model as explained by different R^2s (coefficients of determinations) are as follows: The Cragg-Uhler R^2 predicts that 85 percent of the total variations in the dependent variable are explained by the debt-equity ratio of 1.5. The McFadden R^2 gives 76 percent of total variations in the dependent variable, while Estrella and Maddala coefficients of determination are 79.6 percent and 56.9 percent respectively.

The estimated debt-equity coefficient is positive and significant at 1% and 5% levels of significance. The results support the view that increasing collateral input increases the chances of securing a loan; the ability part of the demand concept is accomplished in this regard. The amount of loan received or used is positive; indicating that government's contribution to land reform (in the form of LRAD grants) attracts private capital into land transaction processes and could stimulate the demand for farmland. The probability of using LRAD grants combined with mortgage loans in land acquisitions equals 0.513. This means that there is a 51.3 percent chance that combining LRAD grants and mortgage loans in land purchases would likely increase the demand for land by ensuring a low risk debt-equity ratio.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary and Conclusions

The purpose of the study was to examine the possible relationships that might exist between farmland values, land reform issues, interest rates, and net farm income as determined by agricultural commodity prices. Secondly, the study examined the relative role of export demand on South African deciduous fruit prices and hence, land values. In its second objective, the study also examined the relative role of area under cane (AUC) on sugar cane land prices. In general, it is perceived that fluctuations in agricultural commodity prices cause variations in net farm income; as a result, farmland prices also deviate from their long run equilibrium path, resulting in boom-bust cycles in farmland values.

Using time series data from 1977 to 2008 on South African farmland prices and returns to farmlands, the hypothesis that variables in the model are stationary against the alternative that variables are non-stationary was tested by applying Dickey-Fuller-GLS tests, IPS, and ADF-Fisher tests. The study then set out to employ the Johansen Maximum Likelihood procedure in estimating the long-run and short-run dynamic relationships between farmland values, returns to farmland and interest rates. A reduced form VAR/VECM was used in order to eliminate the correlation problem between the error term and the regressors. In addressing the question of the impact of land reform issues on farmland values in South Africa, the study has reviewed the relevant literature and estimated a logit model. The logit model was used to examine the probability of previously disadvantaged individual grant holders to bid successfully in farmland markets if they combine LRAD grants and mortgage loans in land acquisition.

The initial exploratory tests using unit root tests found that most variables in the study exhibit nonstationarity. All unit root tests that were used failed to reject the null hypothesis of the existence of unit root. It thus seemed logical to adopt cointegrated methods as relevant processes in this study. Identifying lag lengths that minimised the AIC and SC criteria assisted to eliminate the non-decaying autocorrelations in data sets. Variables were selected in accordance with various economic theories explaining farmland price determination. The results supported the underlying

assumption of the Ricardian rent theory and the PVDR (present value discount rate) model of asset pricing.
Results of the Johansen tests for the number of cointegrating vectors suggested a rejection of the no cointegrating vector (r = 0) hypothesis for all sub studies conducted. Johansen coitengration tests found that at least one cointegrating equation exist at five percent level for all the models estimated. Consistent with the large body of previous research (Phipps, 1989; Tegene and Kuchler, 1990; 1993; Featherstone and Moss, 2003; Henderson, 2008), a significant impact of crop prices and capitalisation rate on farmland values between 1977 and 2008 was found. Furthermore, all the models estimated survived both the Chow and predictive failure tests with the known structural break of 1997 South African agricultural industry deregulation. This meant that the models were good in predicting the relationship among variables from 1977 to 2008.

Results in all sub studies conducted proved that commodity prices play a significant role in the determination of farmland prices via net farm income. A positive relationship was found between lagged net farm income and farmland values. It was also revealed in the study that a substantial increase in farmland prices is largely due to past information on farmland prices. For all studies conducted, the rate of growth in farmland prices far exceeds the rate of growth in net farm income. This contradicts the claim made by farmers that selling farm prices are high because of returns investors will reap from buying a farm. High discrepancies between farmland values and returns to farmlands are not consistent with the primary rule of farmland valuations suggesting that market farmland prices should comply with the productive value of a farm. Interest rates were found to be negatively related to farmland values in all sub studies conducted. The adverse impact is largely counteracted by the impact of past information on farmland values.

The area under cane per hectare that is now used instead of a quota system in the sugar cane farming sector, was found to have a significant positive impact on sugar cane farmland values. The effects of interaction among variables are best illustrated in vector autoregression error correction model. The VECM results indicated a link between value per hectare and the area under cane (AUC) per hectare value although the link is not very strong. Area under cane per hectare was found to have a positive externality to value per hectare farmland prices.

Export demand has a significant impact on apple and pear farmland values. Influenced by exchange rate changes, export demand affected apple and pear prices positively; this led to

increases in farmland values for these two products. Past information on farmland values also played a significant role in inflating land prices for these two deciduous fruits.
Forecast error variance decomposition was conducted with an objective of examining the proportion of variation among variables that are explained by their own shocks in relation to shocks from other variables. The variation of each source of impulses to the variance of s-ahead forecast error for each variable over five years was assessed through forecast error variance decomposition (FEVD). Farmland values were the first in the ordering of variables in all the models estimated. All per hectare farmland values were found to be exogenous since they account for 100 percent of their own variation in the first year. The only farmland measure that was found to be endogenous is area under cane (AUC) farmland value. This variable accounts for 86 percent of its own variation in the first year. Returns to farmland and interest rate were found to be a significant contributor to variations in farmland values although they impact farmland values with a delayed effect. Export net farm income was also found to be a significant determinant of deciduous fruit farmland values, especially in the long run. The variable accounts on average, approximately eight to nine percent of variations in deciduous fruit farmland values in the long run.

In the macroeconomic-agricultural sector model, the vector error correction model and the VAR forecasting error variance decomposition model were also used to estimate the interaction of variables in the systems. The VECM was estimated with an aim of assessing how past changes in variables employed in the models affected farmland prices in current period. The forecasting error variance decomposition was used to examine the causality in a vector autoregression system so that future variable interrelationships are identified.

The long run cointegration results for the apple model revealed that input costs are the prominent driver behind apple farmland prices as they contrary affected apple farmland prices positively with a significant effect in the long run. Exchange rate also appeared to be a significant contributor to the long run changes in apple farmland values. Average apple prices were expected to have a significant impact on apple farmland prices but the results proved that average apple prices contribute marginally to apple farmland price changes in the long run. Money supply affects apple farmland values positively but the impact is not significant in the long run. The forecasting error variance decomposition results also revealed that input cost shocks has a statistical significant impact on future apple farmland values. Money supply and exchange rate shocks also proved to

have a significant short run impact on the future farmland prices, while interest rate shocks contributed significantly in the long run future farmland prices.
The long run cointegration results for maize model revealed that farmland values are significantly influenced by maize prices in the long run. Input costs and interest rate are two other variables that are influential to long run maize farmland prices determination. Results of the forecasting error variance decomposition proved that maize price shocks contribute significantly to variability in maize farmland prices in the short run and in the long run. Interest rate shocks also have a significant impact on variability in maize farmland prices, especially in the short run. Money supply shocks proved to have a significant impact on maize farmland prices in the long run while input costs shocks were significant in the short run. The results of the macroeconomic-agricultural sector model revealed that monetary indicators (money supply, exchange rate and interest rate) have a significant influence on farmland values and hence farmer wealth. It was also found that input costs have a significant impact on farmland prices.

The study also examined the possible role of the land reform programmes in addressing the challenge of unequal land ownership in South Africa. Several important lessons emerge from previous research on land reforms. Firstly, land reform in South Africa is market orientated. Sellers possess a bargaining power in the market for land, and could influence the market (indication of an imperfect market). Secondly, most of the land reform measures that were implemented since 1994 have progressed slowly in addressing the skewed pattern of land ownership. An increase in the number of hectares that have been redistributed in marginal areas is noticed. This shows that a remarkable demand for land by previously disadvantaged people exists but access to land is constrained by market imperfection. The study revealed that land reform programmes and programme instruments have a powerful impact on demand for farmland in South Africa. The logit model results proved that land reform beneficiaries stand a 51.3 percent chance of bidding successfully in farmland markets with a debt/equity ratio of 1.5 (60% mortgage loan and 40% equity in the form of LRAD grant). This in turn could influence the demand for farmland and therefore farmland prices.

Fighting poverty and hunger coupled with addressing the skewed pattern of land ownership in South Africa are some of the key objectives of the National Development Agency. The results of the study show that high commodity prices that deny the majority of South Africans access to their food choices also contribute to escalating farmland prices. Given the grant amount that has been offered since 1994 to promote land redistribution, it seems impossible for the DLA to achieve its target of getting 30 percent of agricultural land from the Whites to the previously disadvantaged people by 2014. This means that the problem of food insecurity triggered by high food prices will persist, as a result of scarcity of farmland that is also due to high farmland prices. For potential emerging farmers and Land Reform Policy makers, inflated land values act as a huge barrier to their success. The recent establishment of the Department of Land Reform and Rural Development to improve service delivery on land reform highlights the need for further research in this area and the need to review the LRAD grant.

8.2. Recommendations

8.2.1 Technological Adoption

Improvement of agricultural productivity through technological change is perceived as the key factor to sustained economic viability for farmers, especially small farmers (Nkamleu and Adesina, 2000). According to Nkamleu and Adesina (2000) many African countries, including South Africa are still using low yielding agricultural technology. This leads to low agricultural production. Colman and Young (1989) argue that technological change can cause a production function to shift over some range such that:

1. More output is produced with the same quantity of inputs
2. The same amount of output can be produced with a smaller quantity of inputs.

Economists argue that there some factors that affect the adoption of technology by farmers. One of these factors is an investment in human capital. Human capital is defined as the cumulative knowledge acquired in the form of informal or formal education, and experience (Nkamleu and Adesina, 2000). Farmer education plays an important role in influencing the rate at which technology is adopted. Economists argue that better educated farmers can assimilate and interpret information at a lower cost than less educated farmers. It is therefore perceived that better educated farmers are early adopters of technology and this gives them a competitive edge over less educated farmers. Investment in human capital is greatly needed in South Africa. This will reduce post transfer malfunctioning of most farms acquired through land reform programmes. Since technological progress affects the value of agricultural products, it therefore affects land values indirectly since land values are determined by expected earnings from land. It can be argued that Technological progress can improve South African export competitiveness by lowering the costs of agricultural production. Lower production costs relative to competitors costs imply that South African goods can be sold at lower prices in foreign markets and thus expanding the market share.

A larger market share suggests greater net farm income that would be translated to land values without increasing commodity prices.

8.2.2 Improving Tenure Security

Hayami and Ruttan (1992) emphasise that institutional innovation is necessary to reorganise property rights; the authors suggested that institutional arrangements underpin and influence patterns of resource flow. Lyne et al (1993) support the view by stating that institutions must promote free market system and ensure efficiency in the land rental market by reducing transaction costs. They further postulate that some key institutions in South African rural areas are not adequately aligned to strategies that ensure economic efficiency. Institutions (legal) must offer secure tenure and effective legal contracts that can help to address the problem of landlessness and procrastination caused by delays in land sale.

There is a need for institutional innovations that will accommodate all farmers in South Africa. Legal institutions must provide well defined and enforceable property rights to promote efficient and sustainable land use with reduced transaction costs in the land markets. This will help in the provision of affordable land for purchasing and the creation of land rental markets. Individuals without enough capital to buy land can gain access to land through land rental markets. Clear definition and enforcement of property rights can also promote investment on land improvements. It is thus argued that for land rental markets to develop, tenancy terms and conditions are important.

Land rental system is regarded as an alternative solution to land purchasing with the assistance of LRAD grants. Lyne et al (2003) pointed out the potential advantages of the rental markets for arable lands in KwaZulu-Natal. But their subsequent study revealed that the land rental markets are not functioning properly in KwaZulu-Natal and South Africa as a whole. Lyne (2003: 579) further suggested that “an efficient rental market for arable land would improve allocative efficiency because idle or underutilised land would be leased to more effective farmers”. Land rental markets can help to alleviate the land scarcity problem and increase land usage.

Past experiences from South Africa and abroad prove that land beneficiaries have limited ability to use the acquired land effectively. The South African government must therefore provide well trained and experienced extension officers to assist emerging farmers in their operations. This could contribute favourably to increases in production; this in turn, will lower food prices. High farmland prices that are unaffordable to previously disadvantaged South Africans prohibit these people from producing their own food. This in turn could result to food insecurity among previously disadvantaged people.

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APPENDIX A

1.1 Some Examples of Unit Root Test Results

In this appendix, tables of computer software output are presented in order to give more explanation and analysis of some unit root tests conducted on variables. The DF-GLS unit root test results for apple and pear e studies are presented.

A: Unit Root Test Results for Apples

Null Hypothesis: VALUES has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-0.634955
Test critical values:	1% level	-2.656915
	5% level	-1.954414
	10% level	-1.609329

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 07:55
Sample (adjusted): 7 32
Included observations: 26 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.120423	0.189656	-0.634955	0.5327
D(GLSRESID(-1))	0.043989	0.271017	0.162313	0.8727
D(GLSRESID(-2))	0.121259	0.278856	0.434843	0.6683
D(GLSRESID(-3))	0.367257	0.288321	1.273775	0.2173
D(GLSRESID(-4))	0.285226	0.305873	0.932500	0.3622
D(GLSRESID(-5))	0.098613	0.277452	0.355424	0.7260

R-squared	0.011344	Mean dependent var	0.049649
Adjusted R-squared	-0.235819	S.D. dependent var	0.163837
S.E. of regression	0.182133	Akaike info criterion	-0.368987
Sum squared resid	0.663447	Schwarz criterion	-0.078657
Log likelihood	10.79683	Hannan-Quinn criter.	-0.285382
Durbin-Watson stat	1.987344		

Null Hypothesis: RETURNS has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.651232
Test critical values:	1% level	-2.664853
	5% level	-1.955681
	10% level	-1.608793

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 07:56
Sample (adjusted): 9 32
Included observations: 24 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.310334	0.793549	-1.651232	0.1182
D(GLSRESID(-1))	0.271541	0.731225	0.371351	0.7152
D(GLSRESID(-2))	0.232752	0.666576	0.349176	0.7315
D(GLSRESID(-3))	0.193968	0.598849	0.323902	0.7502
D(GLSRESID(-4))	0.155177	0.526855	0.294534	0.7721
D(GLSRESID(-5))	0.116389	0.448546	0.259481	0.7986
D(GLSRESID(-6))	0.077591	0.359819	0.215638	0.8320
D(GLSRESID(-7))	0.038795	0.249810	0.155299	0.8785

R-squared	0.519397	Mean dependent var	0.081924
Adjusted R-squared	0.309133	S.D. dependent var	15719.62
S.E. of regression	13065.90	Akaike info criterion	22.05460
Sum squared resid	2.73E+09	Schwarz criterion	22.44729
Log likelihood	-256.6552	Hannan-Quinn criter.	22.15878
Durbin-Watson stat	2.003134		

Null Hypothesis: INTEREST has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.827311
Test critical values:	1% level	-2.641672
	5% level	-1.952066
	10% level	-1.610400

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 07:57
Sample (adjusted): 2 32
Included observations: 31 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.191510	0.104805	-1.827311	0.0776

R-squared	0.096891	Mean dependent var	0.106452
Adjusted R-squared	0.096891	S.D. dependent var	1.796689
S.E. of regression	1.707430	Akaike info criterion	3.939583
Sum squared resid	87.45956	Schwarz criterion	3.985840
Log likelihood	-60.06353	Hannan-Quinn criter.	3.954661
Durbin-Watson stat	1.804820		

Null Hypothesis: EXPORT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-0.663579
Test critical values:	1% level	-2.641672
	5% level	-1.952066
	10% level	-1.610400

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 07:57
Sample (adjusted): 2 32
Included observations: 31 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.032317	0.048702	-0.663579	0.5120

R-squared	-0.080721	Mean dependent var	0.076295
Adjusted R-squared	-0.080721	S.D. dependent var	0.249553
S.E. of regression	0.259430	Akaike info criterion	0.171065
Sum squared resid	2.019115	Schwarz criterion	0.217323
Log likelihood	-1.651511	Hannan-Quinn criter.	0.186144
Durbin-Watson stat	2.344786		

B: Unit Root Test Results for Pears

Null Hypothesis: VALUES has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-0.634955
Test critical values:	1% level	-2.656915
	5% level	-1.954414
	10% level	-1.609329

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 08:09
Sample (adjusted): 7 32
Included observations: 26 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.120423	0.189656	-0.634955	0.5327
D(GLSRESID(-1))	0.043989	0.271017	0.162313	0.8727
D(GLSRESID(-2))	0.121259	0.278856	0.434843	0.6683
D(GLSRESID(-3))	0.367257	0.288321	1.273775	0.2173
D(GLSRESID(-4))	0.285226	0.305873	0.932500	0.3622
D(GLSRESID(-5))	0.098613	0.277452	0.355424	0.7260

R-squared	0.011344	Mean dependent var	0.049649
Adjusted R-squared	-0.235819	S.D. dependent var	0.163837
S.E. of regression	0.182133	Akaike info criterion	-0.368987
Sum squared resid	0.663447	Schwarz criterion	-0.078657
Log likelihood	10.79683	Hannan-Quinn criter.	-0.285382
Durbin-Watson stat	1.987344		

Null Hypothesis: RETURNS has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.517587
Test critical values:	1% level	-2.664853
	5% level	-1.955681
	10% level	-1.608793

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 08:10
Sample (adjusted): 9 32
Included observations: 24 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.698635	0.460359	-1.517587	0.1486
D(GLSRESID(-1))	0.132521	0.437082	0.303195	0.7656
D(GLSRESID(-2))	0.035514	0.404129	0.087878	0.9311
D(GLSRESID(-3))	0.266687	0.374806	0.711532	0.4870
D(GLSRESID(-4))	0.087488	0.348647	0.250936	0.8051
D(GLSRESID(-5))	0.092336	0.334742	0.275841	0.7862
D(GLSRESID(-6))	0.016872	0.294510	0.057289	0.9550
D(GLSRESID(-7))	0.038222	0.260254	0.146865	0.8851

R-squared	0.339073	Mean dependent var	0.026324
Adjusted R-squared	0.049917	S.D. dependent var	1502.195
S.E. of regression	1464.222	Akaike info criterion	17.67724
Sum squared resid	34303141	Schwarz criterion	18.06992
Log likelihood	-204.1268	Hannan-Quinn criter.	17.78142
Durbin-Watson stat	2.002516		

Null Hypothesis: INTEREST has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.827311
Test critical values:	1% level	-2.641672
	5% level	-1.952066
	10% level	-1.610400

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 08:11
Sample (adjusted): 2 32
Included observations: 31 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.191510	0.104805	-1.827311	0.0776

R-squared	0.096891	Mean dependent var	0.106452
Adjusted R-squared	0.096891	S.D. dependent var	1.796689
S.E. of regression	1.707430	Akaike info criterion	3.939583
Sum squared resid	87.45956	Schwarz criterion	3.985840
Log likelihood	-60.06353	Hannan-Quinn criter.	3.954661
Durbin-Watson stat	1.804820		

Null Hypothesis: EXPORT has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic based on SIC, MAXLAG=7)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		0.211548
Test critical values:	1% level	-2.656915
	5% level	-1.954414
	10% level	-1.609329

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 09/14/09 Time: 08:11
Sample (adjusted): 7 32
Included observations: 26 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	0.074936	0.354229	0.211548	0.8346
D(GLSRESID(-1))	-0.819992	0.384541	-2.132391	0.0456
D(GLSRESID(-2))	-0.617560	0.371477	-1.662446	0.1120
D(GLSRESID(-3))	-0.548865	0.340390	-1.612461	0.1225
D(GLSRESID(-4))	-0.365353	0.298049	-1.225815	0.2345
D(GLSRESID(-5))	-0.352275	0.217835	-1.617162	0.1215

R-squared	0.441307	Mean dependent var	0.085332
Adjusted R-squared	0.301634	S.D. dependent var	1.132231
S.E. of regression	0.946186	Akaike info criterion	2.926419
Sum squared resid	17.90536	Schwarz criterion	3.216749
Log likelihood	-32.04345	Hannan-Quinn criter.	3.010024
Durbin-Watson stat	1.857506		

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It must be noted that the above unit root test results were produced in order to provide more insight into the analysis of the stationarity and nonstationarity of variables. Not all test results are presented as most information on tests results is presented in tables 7.1 and 7.10 in the text. Further explanation on unit root test and cointegration is given in this appendix. We outlined details of the Cointegration Regression Durbin Watson test (CRDW) as they appear in the DF-GLS results. The null hypothesis for the Durbin Watson test is that test values that are close to two (2) indicate the presence of cointegration and no autocorrelation among the residuals of the series tested, while Durbin Watson test values that are close to zero indicate the absence of cointegration as well as the presence of autocorrelation among the residuals in the series tested. This can be written symbolically as follows:

$H0: d = 2$

$H1: d \neq 2$

The cointegration in variables implies that there is an adjustment process which prevents the errors in the long run from becoming larger and larger (Enders, 2004). In the apple returns variable, the Durbin Watson test statistic is 2.003 which is approximately 2. This indicates that the variable contains a unit root, there is no autocorrelation among the variable's residuals, and the variable is suitable to be used in the cointegration regression.

1.2 Some Variable Graphical Representation

These graphical representations of variables were produced in order to give more insight into the direction of sequential movement of variables. It is anticipated that cointegrated variables should follow the same direction of movement over time (for example, if variables have unit root and are cointegrated, their direction of movement should follow the same pattern over time). All variables are transformed into natural logs and are not differenced (presented at levels).

1.2.1 Maize Graphs

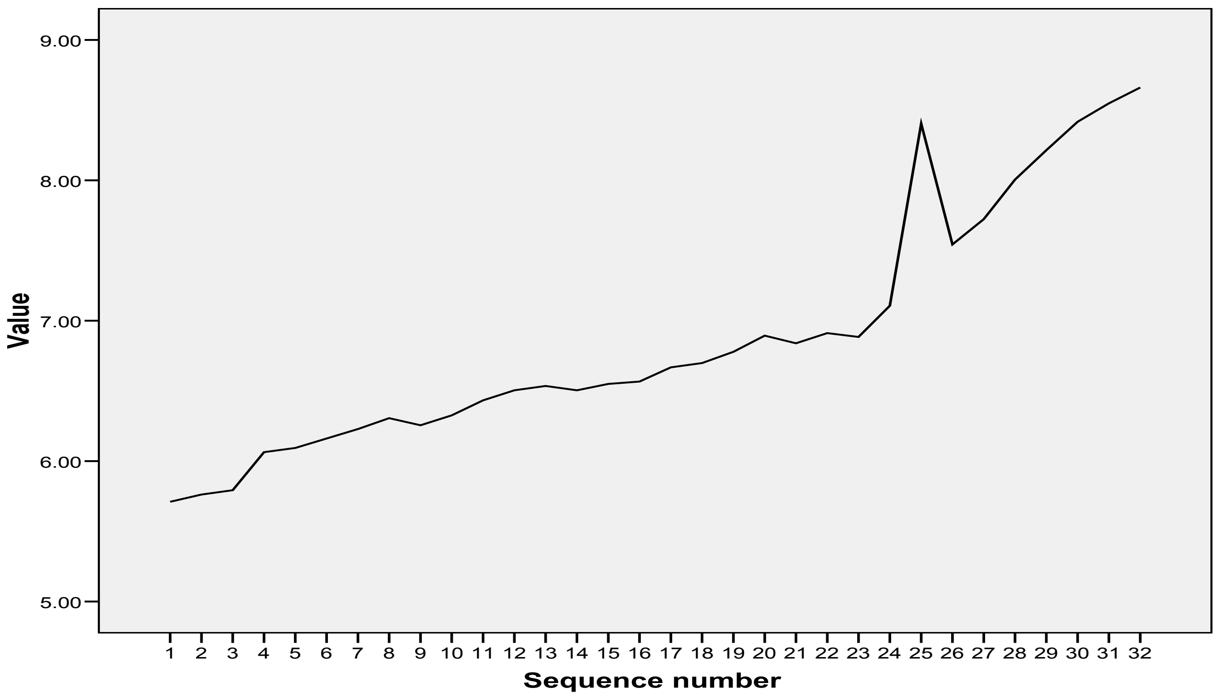

Figure 1.2.1-A. Maize farmland values are less volatile than maize net farm income; farmland values follows an upward trend and are not stationary at levels.

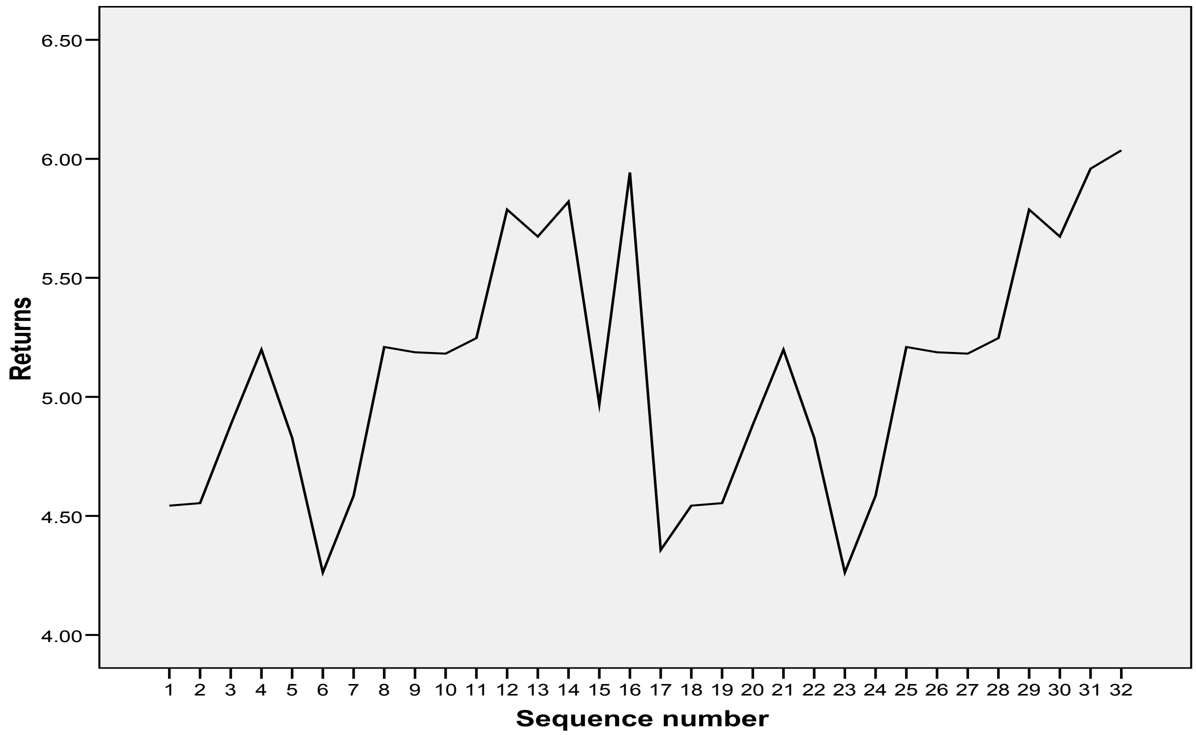

Figure 1.2.1-B. Maize net farm income is volatile and follows an upward trend.

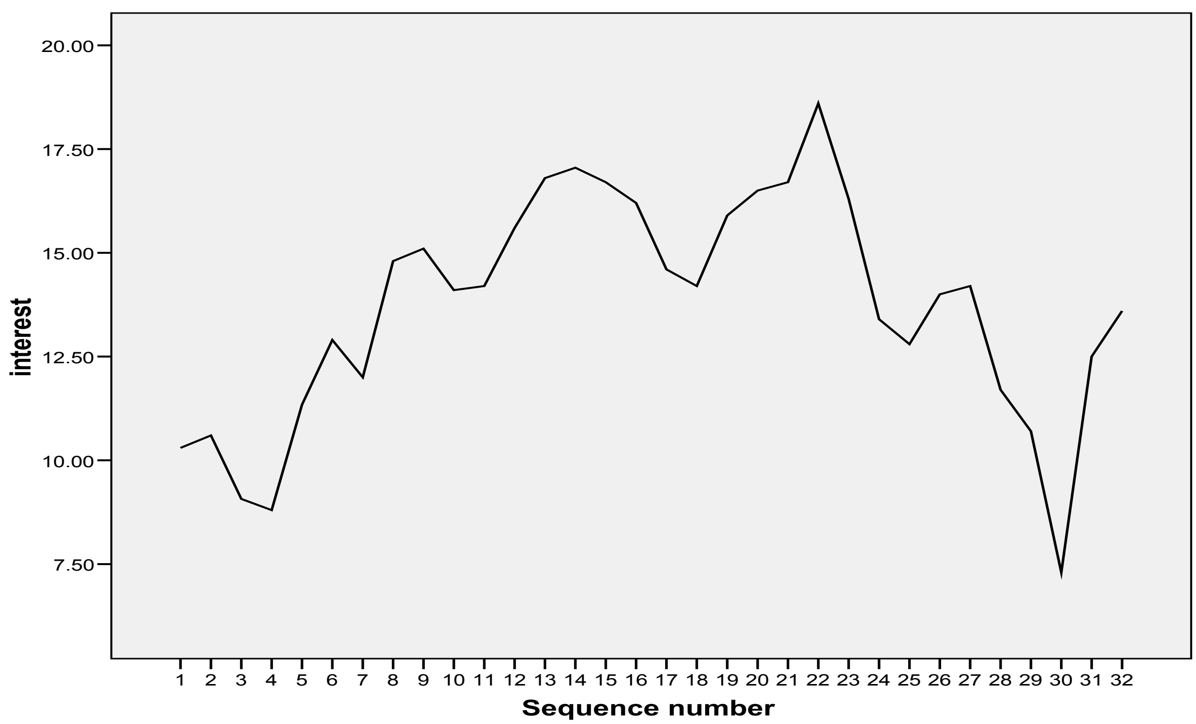

Figure 1.2.1-C shows interest rate which is the common variable for all models estimated. The variable is volatile (mainly because it is not transformed into natural log) and has the tendency of trending upward.

1.2.2 Sugar Cane Graphs

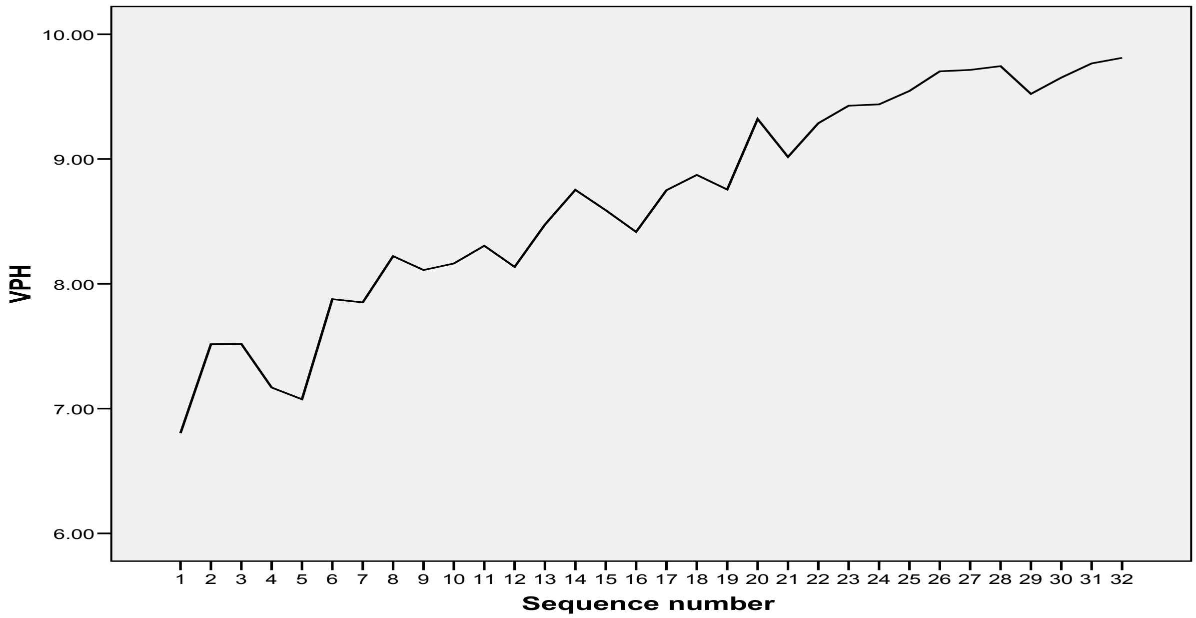

Figure 1.2.2-A.Sugar cane value per hectare (VPH) also follows an upward trend

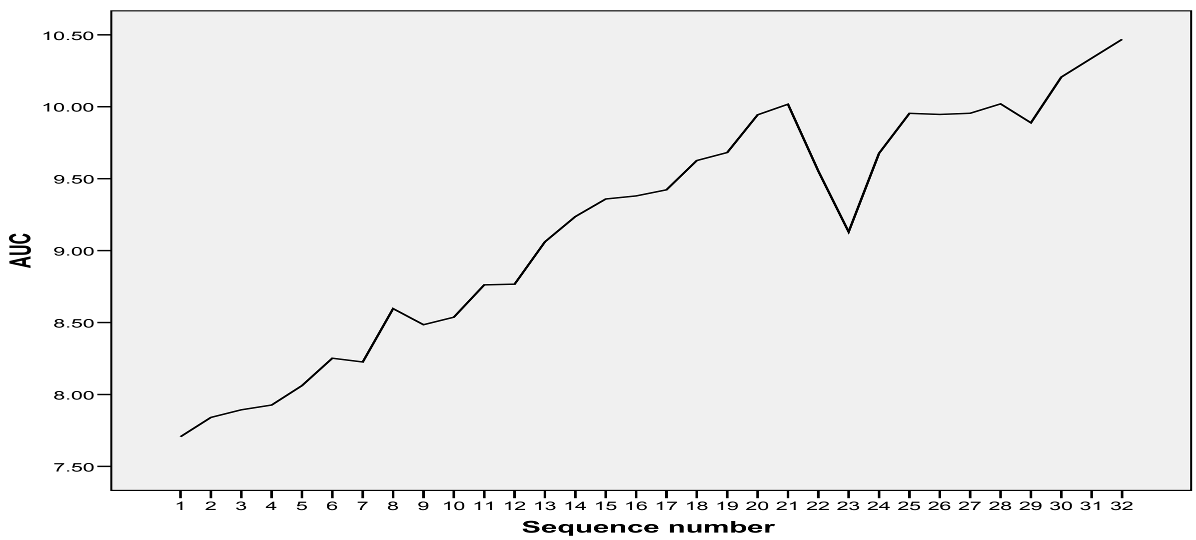

Figure 1.2.2-B.-Area Under Cane (AUC) farmland value trends upward and is not stationary at levels.

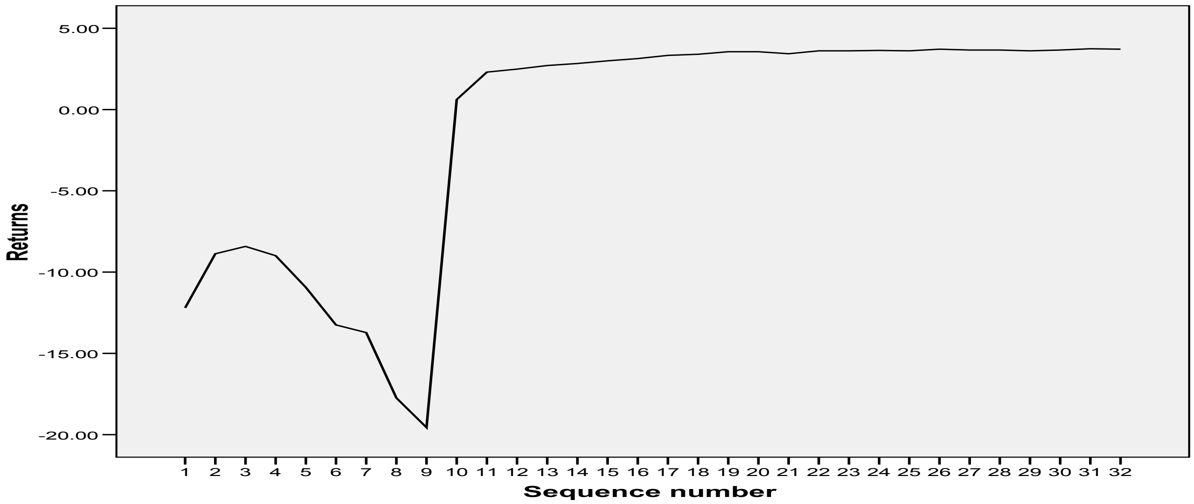

Figure 1.2.2-C Sugar cane's net farm income at levels

1.2.3 Deciduous Fruit Graphs

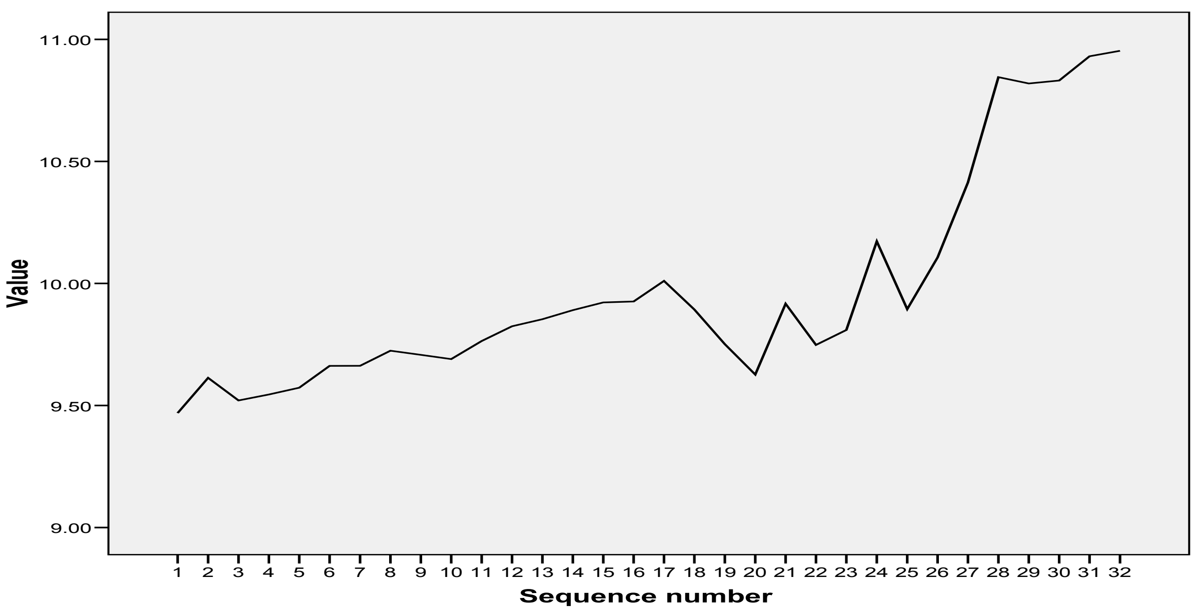

Figure 1.2.3-A.Farmland values for apples and pears trends upward and are volatile as shown in the above graph.

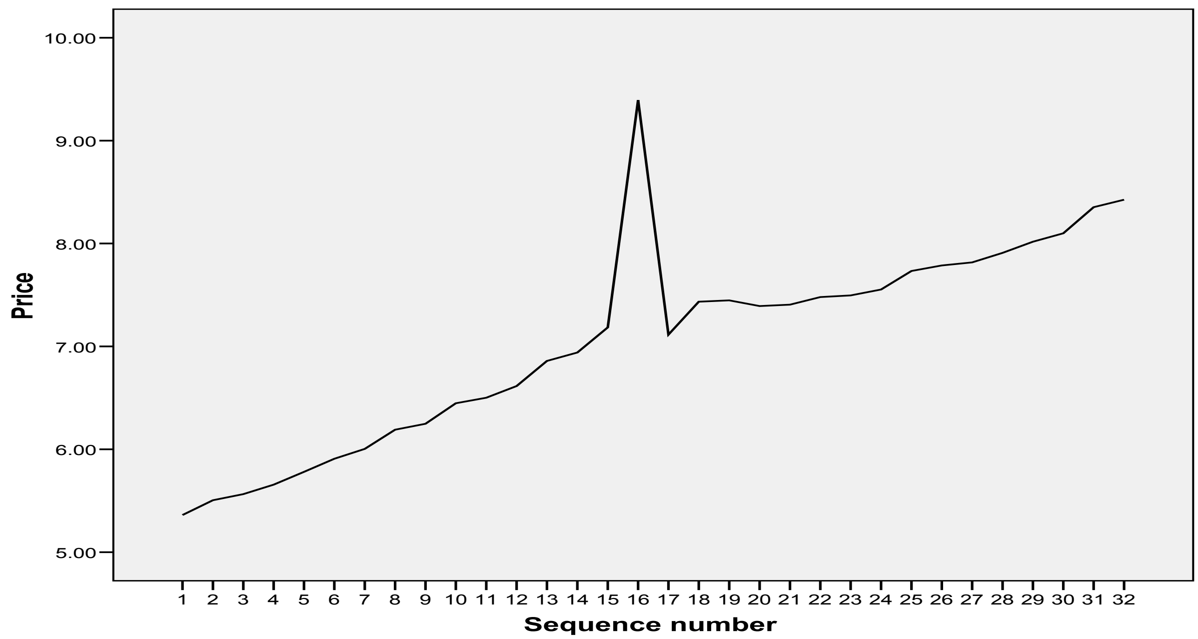

Figure 1.2.3-B. The price dipicted in the above graph is the price for apples. The apple prices drifts upward and are not stationary (at levels) as dipicted by the graph.

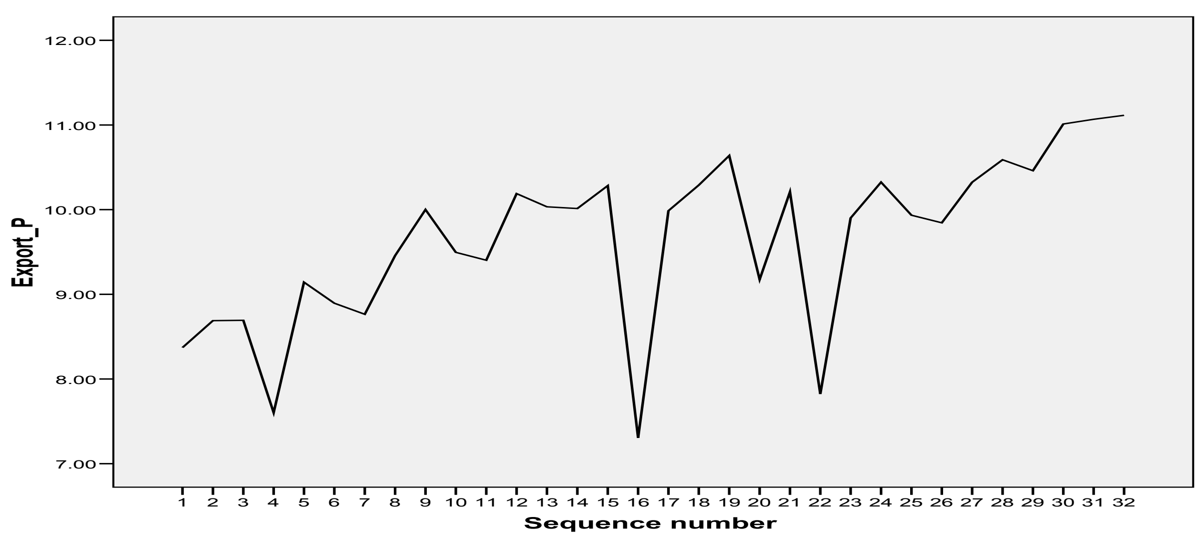

Figure1.2.3-C shows the export income for pears. The variable's sequential movement tends to slope upwards; it is also noted that the variable is not stationary (at levels).

1.3 Notes on Normalized Long Run Results

The results in Table 7.4 in the text are presented in the form of normalized results with respect to the dependent variable (farmland values) in all sub-studies. Normalization on farmland values (LV_t) involves transforming the equation $\beta_1 LV_t = \beta_2 NRR_t - \beta_3 RI_t + \varepsilon_t$ into normalized equation with respect to LV_t by dividing through by β_1, and transferring NRR_t and RI_t to the other side of the equation (Rossiter, 2002). A coefficient of one is obtained on LV_t; the resulting equation can thus be presented as follows:

$$\frac{\beta_1 LV_t}{\beta_1} - \frac{\beta_2 NRR_t}{\beta_1} + \frac{\beta_3 RI_t}{\beta_1} = \frac{\varepsilon_t}{\beta_1}$$

Yielding the coefficient results of: $1 - \frac{\beta_2 NRR_t}{\beta_1} + \frac{\beta_3 RI_t}{\beta_1}$

Normalization assists in the interpretation of the cointegrating combination relative to the normalized variable. There is no presumption in cointegration analysis stating that one variable has a different status from other variables, any variable in the equation may be normalized (Patterson, 2000). E-views give normalized results as identified and /or restricted results. Imposing restrictions on parameters of the vector error correction model render all parameters of the vector error correction model and their corresponding alpha parameters identification with respect to the dependent variable (Enders, 2004). The concept of identification which renders a structural VAR a reduced status is fully discussed in section 6.6.1 of the text.

APPENDIX B

Deciduous Fruit Grower Cost/Income Trends

Source: DFPT (2009)

POME FRUIT

	APPLES			PEARS		
	Establish	Non Bearing	Full Bearing	Establish	Non Bearing	Full Bearing
Yield (ton)	**0**	**0**	**55**	**0**	**0**	**45**
Number of trees per ha	**1,650**	**1,650**	**1,650**	**1,650**	**1,650**	**1,650**
Pre-harvest costs	**113,394**	**16,266**	**44,322**	**110,986**	**15,104**	**38,450**
Plant material	38,775	3,878	0	35,475	3,548	0
Land preparation	12,000	0	0	12,000	0	0
Irrigation	15,000	0	0	15,000	0	0
Drainage	5,140	0	0	5,140	0	0
Trellising	31,032	0	0	31,032	0	0
Fertilizer	7,856	3,740	9,939	7,842	3,720	8,514
Herbicides	416	416	826	416	416	826
Pesticides	103	147	5,409	136	209	4,605
Fungicides	439	627	1,812	303	433	1,833
Rest breaking agents	0	288	2,355	0	87	2,355
Consultants	550	550	550	550	550	550
Seasonal Labour	0	661	11,197	0	661	9,480
Fuel (diesel)	835	1,037	3,698	881	1,210	2,661
Repairs and maintenance	354	440	1,296	309	424	932
Electricity	484	4,366	6,253	1,492	3,731	4,836
General	410	116	116	410	116	116
Pollination	0	0	870	0	0	1,740
Post-harvest	**0**	**0**	**104,543**	**0**	**0**	**87,348**
Transport rental	0	0	11,550	0	0	9,450
Packaging	0	0	82,957	0	0	67,501
Seasonal Labour	0	0	9,035	0	0	9,669
Fuel (diesel)	0	0	741	0	0	539
Repairs and maintenance	0	0	259	0	0	189
Overhead costs	**27,930**	**20,655**	**30,723**	**27,624**	**20,446**	**28,804**
Fixed labour	6,540	6,540	6,540	6,540	6,540	6,540
Water costs	2,150	2,150	2,150	2,150	2,150	2,150
Licenses & Insurance	39	48	171	34	47	103
Other overheads	5,027	5,027	5,027	5,027	5,027	5,027
Interest on loans	8,505	1,220	11,165	8,324	1,133	9,435
Depreciation on orchard	5,670	5,670	5,670	5,549	5,549	5,549
TOTAL COST	**141,324**	**36,921**	**179,587**	**138,610**	**35,550**	**154,601**

* These budgets are only a guideline and should be adapted to your own specific situation.

* Other overheads = admin, bank charges, general repairs, local taxes, postage, phone, auditing, secretarial, etc.

APPENDIX C

Sugar Cane Grower Cost/Income Trends

Source: South African cane Growers Association (2008)

APPENDIX D

Maize Grower Cost/Income Trends

Source: South African Grain Information Services (2008)

APPENDIX E

Ethical Clearance Certificate

ACTUAL COSTS, INCOME AND MARGINS BY MILL: IRRIGATED TOTAL - 1976/77 to 2006/07 (RAND/TONNE)

-1.00

	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90
	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne
Farm Staff	2.61	2.97	3.20	3.55	4.12	4.14	4.93	7.46	5.40	5.87	6.32	6.37	8.62	9.19
Chemicals	0.13	0.22	0.23	0.24	0.35	0.34	0.39	0.68	0.56	0.65	0.86	0.77	1.20	1.49
Fertilizer	0.92	1.19	1.16	1.38	1.90	2.24	2.31	3.39	2.71	3.07	3.12	2.95	4.28	4.69
Fuels and Lubricants	0.55	0.55	0.69	1.05	1.16	1.20	1.28	1.76	1.48	1.69	1.52	1.47	1.58	2.34
Maintenance - Mechanica	0.89	1.19	1.14	1.28	1.59	1.64	1.85	2.83	2.36	2.73	2.81	2.60	3.66	4.73
Maintenance - General	0.25	0.18	0.18	0.18	0.25	0.23	0.20	0.42	0.39	0.35	0.42	0.40	0.68	0.64
Services	0.72	1.03	1.08	1.29	1.36	1.42	1.95	2.91	1.84	3.03	3.96	3.71	4.53	5.00
Administration/Levies	0.26	0.24	0.23	0.26	0.37	0.39	0.51	0.82	0.67	0.71	0.81	0.77	0.88	1.11
Insurance/Licences	0.17	0.18	0.20	0.19	0.28	0.31	0.37	0.62	0.50	0.55	0.63	0.77	1.09	1.25
Irrigation Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sundry	0.37	0.33	0.36	0.44	0.59	0.69	0.32	0.56	0.61	0.79	1.27	1.31	1.33	1.82
Sub Total	***6.86***	***8.09***	***8.47***	***9.85***	***11.96***	***12.60***	***14.11***	***21.46***	***16.54***	***19.43***	***21.71***	***21.11***	***27.85***	***32.26***
Cane Transport	1.19	1.54	1.64	2.12	2.04	1.92	2.42	2.45	3.79	4.19	5.51	5.65	6.59	7.22
TOTAL F & V COSTS	***8.06***	***9.64***	***10.11***	***11.98***	***14.01***	***14.53***	***16.53***	***23.91***	***20.33***	***23.62***	***27.22***	***26.76***	***34.44***	***39.48***
Depreciation	0.55	0.66	0.61	0.72	0.75	0.66	0.62	1.04	1.10	0.93	0.96	1.43	1.37	1.43
Management Allowance	0.64	0.59	0.51	0.58	0.45	0.65	0.55	1.08	0.72	1.04	1.28	1.24	0.97	1.55
ACTUAL COSTS	***9.24***	***10.88***	***11.22***	***13.27***	***15.21***	***15.84***	***17.71***	***26.03***	***22.14***	***25.59***	***29.46***	***29.43***	***36.78***	***42.47***
Gross Income	*	*	*	*	*	*	*	*	*	*	**33.26**	**39.27**	**48.30**	**57.28**
Less: F & V Costs	8.06	9.64	10.11	11.98	14.01	14.53	16.53	23.91	20.33	23.62	27.22	26.76	34.44	39.48
Depreciation	0.55	0.66	0.61	0.72	0.75	0.66	0.62	1.04	1.10	0.93	0.96	1.43	1.37	1.43
NET FARM INCOME	***-8.60***	***-10.30***	***-10.72***	***-12.70***	***-14.76***	***-15.19***	***-17.15***	***-24.94***	***-21.42***	***-24.55***	***5.08***	***11.08***	***12.49***	***16.36***
Less:														
Interest/Rent/Leases	1.28	1.54	1.64	1.13	1.31	1.58	2.11	3.79	2.87	3.88	3.78	4.59	5.29	8.47
Management Allowance	0.64	0.59	0.51	0.58	0.45	0.65	0.55	1.08	0.72	1.04	1.28	1.24	0.97	1.55
MARGIN	***-10.52***	***-12.42***	***-12.87***	***-14.41***	***-16.52***	***-17.42***	***-19.82***	***-29.82***	***-25.01***	***-29.46***	***0.03***	***5.25***	***6.23***	***6.34***

	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04
	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne	R/Tonne
Farm Staff	11.48	11.51	14.72	19.01	18.73	23.98	21.12	20.43	21.13	19.98	19.55	27.03	25.60	26.80
Chemicals	1.72	2.06	2.49	3.09	3.12	3.47	3.39	2.90	4.02	3.21	5.84	5.25	6.64	4.89
Fertilizer	5.51	5.80	6.51	7.63	9.27	9.08	11.98	10.76	12.12	10.32	14.25	19.57	19.59	17.71
Fuels and Lubricants	2.37	2.27	3.14	3.79	3.56	4.31	5.27	5.21	5.06	5.27	6.86	9.46	9.70	10.19
Maintenance - Mechanica	5.13	5.18	7.59	7.67	8.20	9.06	8.95	7.71	9.26	8.28	10.61	13.80	13.88	12.13
Maintenance - General	0.92	1.00	0.93	2.43	1.24	1.50	1.13	1.63	0.85	1.72	2.18	1.25	2.30	1.36
Services	6.23	5.82	8.11	9.73	9.63	11.87	12.22	9.78	11.46	8.96	8.38	12.52	16.18	19.41
Administration/Levies	1.23	1.33	1.84	2.26	2.63	2.96	3.68	2.95	3.57	4.37	4.98	4.40	5.73	7.55
Insurance/Licences	1.26	1.23	2.21	2.48	2.57	8.13	3.14	2.78	3.77	3.48	3.30	3.66	4.37	4.91
Irrigation Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.36	0.76	1.06	3.90	2.90	1.19	0.93
Sundry	1.57	1.68	3.96	3.73	5.35	6.98	5.23	9.27	8.48	7.31	9.90	10.25	11.28	11.27
Sub Total	***37.43***	***37.87***	***51.48***	***61.81***	***64.29***	***81.33***	***76.09***	***76.78***	***80.48***	***73.96***	***89.75***	***110.09***	***116.46***	***117.15***
Cane Transport	7.35	8.49	7.58	11.08	9.01	9.40	11.04	13.21	8.67	8.19	12.54	16.59	20.41	17.31
TOTAL F & V COSTS	***44.77***	***46.36***	***59.06***	***72.89***	***73.30***	***90.73***	***87.13***	***89.99***	***89.15***	***82.15***	***102.29***	***126.68***	***136.87***	***134.46***
Depreciation	1.57	1.97	3.35	2.89	4.45	3.45	4.92	4.53	2.99	2.23	3.07	3.83	3.39	3.34
Management Allowance	2.04	1.82	2.06	4.05	2.29	2.81	3.92	3.68	2.86	2.95	2.86	3.49	3.05	2.97
ACTUAL COSTS	***48.39***	***50.15***	***64.46***	***79.83***	***80.03***	***97.00***	***95.96***	***98.20***	***95.00***	***87.33***	***108.22***	***134.00***	***143.31***	***140.77***
Gross Income	**65.20**	**65.76**	**94.71**	**108.49**	**108.90**	**123.10**	**118.63**	**123.73**	**124.89**	**114.43**	**130.32**	**175.37**	**183.76**	**176.43**
Less: F & V Costs	44.77	46.36	59.06	72.89	73.30	90.73	87.13	89.99	89.15	82.15	102.29	126.68	136.87	134.46
Depreciation	1.57	1.97	3.35	2.89	4.45	3.45	4.92	4.53	2.99	2.23	3.07	3.83	3.39	3.34
NET FARM INCOME	***18.86***	***17.43***	***32.31***	***32.71***	***31.15***	***28.92***	***26.58***	***29.21***	***32.75***	***30.05***	***24.96***	***44.86***	***43.50***	***38.63***
Less:														
Interest/Rent/Leases	8.63	9.95	10.54	8.79	10.21	24.05	19.66	19.14	22.57	24.26	18.00	17.64	16.89	14.27
Management Allowance	2.04	1.82	2.06	4.05	2.29	2.81	3.92	3.68	2.86	2.95	2.86	3.49	3.05	2.97
MARGIN	***8.19***	***5.66***	***19.70***	***19.87***	***18.66***	***2.06***	***3.01***	***6.39***	***7.32***	***2.84***	***4.10***	***23.73***	***23.56***	***21.39***

SOURCE: South African Cane Growers Association

Note: * From 1976/77 to 1985/86 no Gross Income is shown, just expenses

GRAAN SA/GRAIN SA
Beraamde gemiddelde produksiekoste en winsgewendheid van mielies in die somersaaigebied
Estimated average production cost and profitability of maize in the summer production areas
2007 /2008 Produksiejaar/Production year

Produksiekoste per hektaar Production cost per hectare					
1. Lopende koste/Variable cost	**Provinsie**	**Vrystaat**	**Vrystaat**	**Middelburg**	**K/Z-Natal**
Saad/Seed	**Northwest**	**NW Free State**	**Eastern FS**		
Kunsmis en kalk/Fertiliser & Lime					
Onkruidbeheer/Weed control	275.20	324.23	358.00	485.38	717.00
Plaagbeheer/Pest control	835.40	1591.02	729.00	1854.95	1704.00
Brandstof/Fuel	166.98	181.13	176.00	333.93	324.00
Herstelwerk en onderdele/Repairs & parts	0.00	0.00	114.00	0.00	208.00
Oesversekering/Crop insurance	586.99	699.17	754.00	597.28	623.00
Seisoensarbeid/Casual labour	377.96	420.60	459.00	401.12	436.00
Gereelde arbeid/Permanent labour	24.31	28.55	127.00	106.67	256.00
Lisensies en versekering/License & Insurance	78.40	43.93	18.00	0.00	37.00
Bemarkingskoste en advertensie/Marketing cost	164.50	231.15	386.00	360.76	338.00
Droog- en sifkoste/Drying & cleaning cost	0.00	45.52	0.00	0.00	0.00
Pakmateriaal	159.33	130.13	61.00	218.07	62.00
Rente op produksiekrediet/Interest on production cred	0.00	8.94	42.00	0.00	20.00
Kontrakwerk/Contract work	0.00	0.00	0.00	0.00	0.00
Ander koste/Other cost	224.15	318.10	271.88	344.85	382.58
Totaal lopende koste/Total variable cost	44.47	76.11	68.00	0.00	100.00
	275.14	460.80	333.00	239.89	276.00
2. Kapitaalkoste/Capital cost	**3212.83**	**4559.38**	**3896.88**	**4942.90**	**5483.58**
Masjinerie en gereedskap/Machinery & Equipment:					
Depresiasie/Depreciation					
Rente/Interest					
Vaste verbeterings/Fixed improvements:	180.73	184.06	189.86	226.99	363.00
Rente/Interest	244.04	291.42	284.79	340.47	303.71
Depresiasie/Depreciation					
Herstel en onderhoud/Repairs & maintenance	0.00	0.00	0.00	0.00	210.54
Totaal kapitaalkoste/Total capital cost	0.00	0.00	0.00	0.00	0.00

	37.04	52.98	39.60	13.64	58.08
Totale koste per hektaar/Total cost per hectare	**461.80**	**528.46**	**514.25**	**581.10**	**935.33**
Opbrengs/Yield (ton/ha)	**3674.64**	**5087.84**	**4411.13**	**5524.00**	**6418.91**
Koste/Cost (R/ton)	4.23	5.85	4.10	6.20	5.11
Inkomste/Income	868.71	869.72	1075.88	890.97	1256.15
Produsenteprys/Producer price (R/ton)					
Per hektaar/per ha:					
	1893.74	1632.83	1713.00	1850.00	1735.00
Wins/Verlies/Profit/Loss	8010.52	9552.06	7023.30	11470.00	8865.85
Per ha:					
Per ton:					
	4335.88	4464.22	2612.18	5946.00	2446.95
	1025.03	763.11	637.12	959.03	478.85

Source: Grain South Africa

0.00
0.00

0.00
0.00

0.00