# University of Cape Town

# Impact of Subsidized Credit on Agricultural Performance and Food Security:

***Comparison between commercial and smallholder farmers in Zimbabwe.***



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*This mini-dissertation is submitted in partial fulfillment of a Masters of Commerce in Economics Degree.*

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## ABSTRACT

Agricultural credit has been seen as an important vehicle in agricultural development as it fosters adoption of advanced and more modern technology (Schultz, 1964). The problem which continues to haunt the smallholder farmers in developing countries has been identified to be the slow pace of adopting modern agricultural technology, and this severely impacts on their production levels causing high levels of poverty in this sector. This author attributes this problem to the inequality associated with the distribution of credit between commercial and smallholder farmers which then distorts its much acclaimed role in attainment of food security. Smallholder farmers are those farmers with 30 or less hectares of land for use in any agricultural activity (crop production or cattle raring) and commercial farmers have more than 30 hectares (according to the Zimbabwean farming sectors). This paper analyzes the impact of the inequality in distribution of credit on food security and welfare using a case of farmers in Zimbabwe.

Using the Johansen Technique, the major finding was that credit is an important part of agricultural production but the output elasticity of credit is elastic in the commercial sector and inelastic in the smallholder sector. Thus the commercial farmers can improve on their capital base in a way to impact effectively on production levels using the subsidized loans. Unlike the commercial farmers, the smallholder farmers do not benefit much from the subsidized loans, hence supporting the hypothesis which was being tested by the study.

Another important input in agriculture production was identified to be land. It is from these findings that policy recommendations regarding land redistribution and government support through subsidized credit were made with the thrust of helping to alleviate poverty in the smallholder farming sector of Zimbabwe.

# CHAPTER 1: INTRODUCTION

## i) Introduction

Agricultural credit, which is defined as funds borrowed by farmers, has been viewed as an important vehicle for agricultural development as evidenced by its role in boosting production levels and helping farmers cope with the modern agriculture systems which are mainly capital intensive. The constant change in prices of inputs (seed, fertilizers, chemicals, labour, and transport) is among the major problems that farmers face each year. Availability of credit makes it easier as farmers get an opportunity to acquire all the necessary inputs required in agricultural production without much financial constraints. In order to enhance its utilization most governments of developing countries have introduced subsidized[1] credit. The main goal has been to achieve economic efficiency and distribute income more equally throughout the population. However, statistics seem to reveal that over the years the funds have been disbursed in favor of the rich and powerful (commercial farmers), sidelining the poor and disadvantaged (smallholder farmers)[2]. This then worsens the situation which is supposed to be solved and this author perceives this biasness as a contributing factor to the high food insecurity, low incomes and consequently high poverty levels in the rural sectors of African countries. Using a case study of the Zimbabwean agricultural sector, we will investigate the importance of credit in agricultural production and eventually poverty alleviation.

In the context of this paper, smallholder farmers refer to farmers who have 30 hectares (ha) or less of land. The 30 ha includes arable land for ploughing, paddocks and pastures for their cattle. This group comprise of the communal farmers and those farmers who were resettled during the early years after independence in Zimbabwe. On the other hand, commercial farmers comprise of the small-scale and the large-scale commercial farmers. These commercial farmers own large pieces of land, more than 30ha and have the major machineries which are required in agricultural production. They use their title deeds to land and their assets as collateral in their applications for loans whereas the smallholder farmers only have cow-drawn ploughs and hoes as their major assets. This huge divergence in asset

[1] Subsidized credit is funds which are lent out at a lower interest rate with the other part being paid by the government in this case.
[2] Statistics will be provided later on in the paper.

ownership makes the commercial farmers more eligible for credit as there is clear guarantee that they will be able to pay back. This inequality between access to credit by the smallholder farmers and the commercial farmers is one of the factors that have possibly hindered progress in the rural sectors of Africa by reducing production of food and cash crops, which subsequently affected food security and rural income, resulting in increased levels of poverty. This assertion is what this paper will investigate in the following sections.

Available data shows that over the years commercial farmers have always benefited more than the smallholder farmers from the credit schemes and have managed to produce greater tonnages than smallholder farmers. (See figures 1 & 2 below)

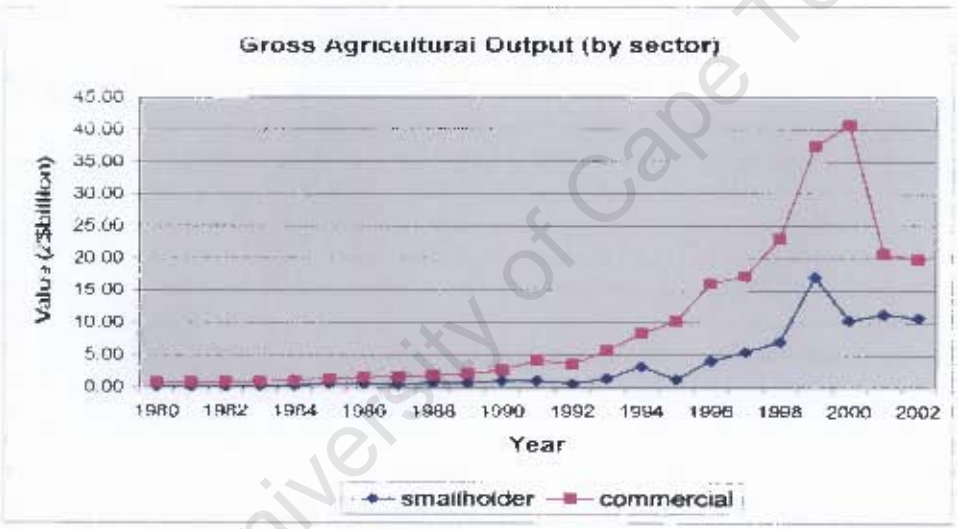



**Figure 1: Gross Output from Commercial & Smallholder Sectors**

Source of data: The Agricultural Sector of Zimbabwe, Statistical Bulletin- 2001 & Rukuni, Tawonezvi & Eicher, 2006

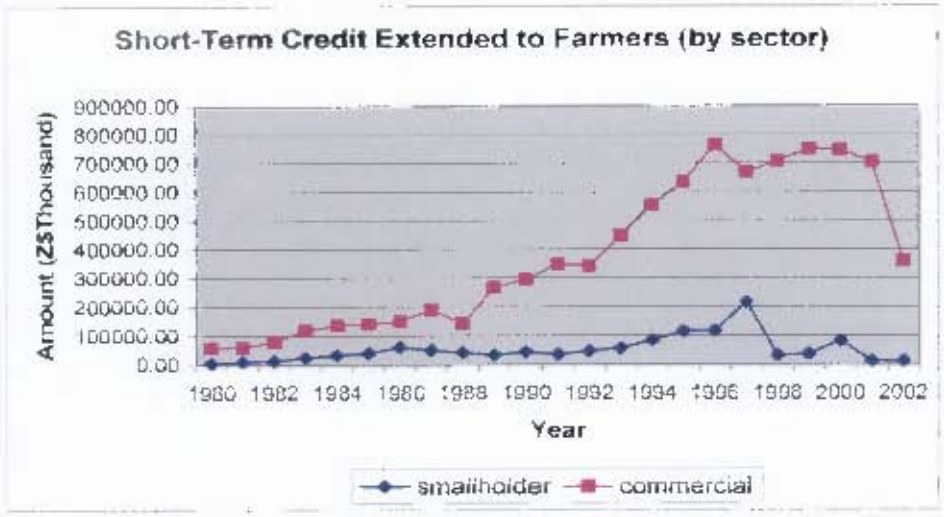



**Figure 2: Short Term Loans (subsidized credit) Extended to Commercial & Smallholder Farmers**

Source of data: The Agricultural Sector of Zimbabwe, Statistical Bulletin- 2001 & Rukuni, Tawonezvi & Eicher, 2006

The output and the credit graphs seem to be trending in the same way for each sector suggesting close correlation between the two. It is the thrust of this paper to assess the contribution of credit in agricultural production which will bring out its importance in the attainment of food security and eventually food poverty alleviation.



## ii) Background Information

Zimbabwe is a landlocked country with an estimated population of about 12 million. Approximately three quarters of this population reside in the communal areas where the major economic activity is agriculture which is the backbone of the Zimbabwean economy. Zimbabwe has a favorable savanna climate which provides good temperatures and rainfall for crop production. Maize is the chief food crop. Tobacco and cotton are the principal cash crops. The other significant agricultural products include sorghum, groundnuts, wheat, soyabeans, sugarcane, coffee and tea. Agriculture is among the three highest contributors to the country's Gross Domestic Product (GDP) (see table 1 in appendix 1 and figure 3 below) and contributes approximately 42% of the country's exports (Alwang & Taruvinga, 2001). In as much as Zimbabwe's economy relies on agriculture, the smallholder farmers' contribution to the economy in terms of food and foreign currency is minute as they mostly produce for

subsistence. The commercial farmers produce the greater part of the crop concentrating mostly on production of the cash crops.

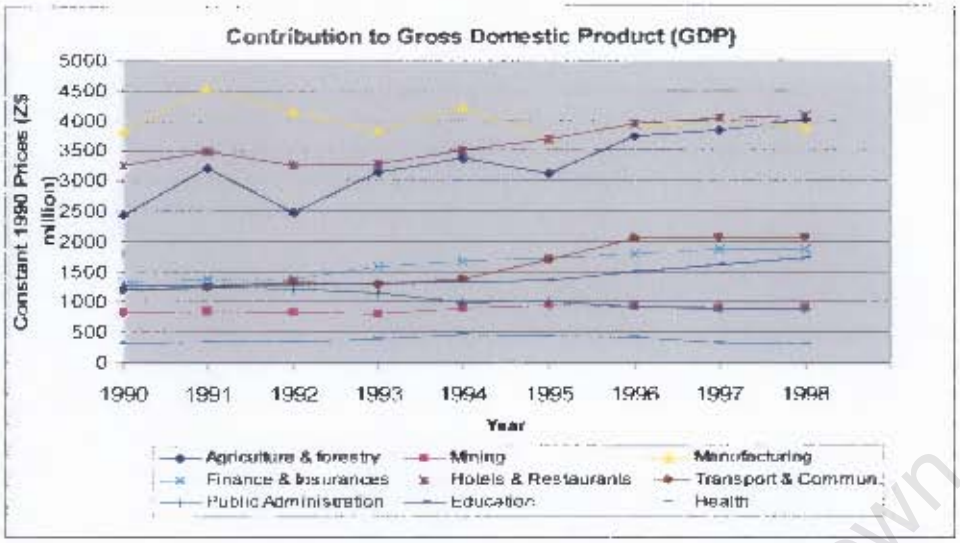



**Figure 3: Percentage Contribution of Different Sectors to GDP**

Source of data: The Agricultural Sector of Zimbabwe, Statistical Bulletin- 2001

Zimbabwe is characterized by a diversified and relatively industrialized production industry which relies mostly on agriculture for its raw materials. This manufacturing industry, which is largely agro-based including grain milling, food processing and timber production, only to mention a few, is the largest sector in the economy contributing about 27% of GDP. Agriculture on its own is the third highest contributing about 15% of GDP. 42% of the countries exports come from the agricultural sector of which tobacco and cotton constitute the highest percentage of the exported crops (Thomas & Bautista, 1999).

Between 1980 and the early 90s, Zimbabwe did enjoy a brisk economic recovery. Real growth for 1980-81 exceeded 20% with agriculture contributing more than 30% of this growth (Thomas & Bautista, 1999). The changes in the reforms in the 90s coupled by the droughts brought about a new twist to the performance of the agricultural sector. Zimbabwe's Gross National Product dropped from US$650 in 1991 to US$470 in 2002 and a further drop by 13% in 2003 (Rukuni, Tawonezvi & Eicher, 2006). The country lost its share of tobacco exports due to reduced area and volume of production. Poor maize production removed Zimbabwe from its bread basket role in the Southern African Development Community (SADC).

Despite the droughts, foreign currency crisis and the recent poor management of the economy which caused inflation to rise uncontrollably, Zimbabwe has experienced some economic growth although it was low compared to other countries in the Southern African region. With enough resources directed to the agricultural sector, it is this author's opinion that Zimbabwe's economy has potential to improve and match those of other developing countries like South Africa. Improvement of the agricultural sector will also mean improvement in the manufacturing industry due to the significant forward/backward linkages that exist between the two sectors. The growth of the agricultural sector will also have a positive impact towards the alleviation of poverty among the smallholder farmers

### iii) Problem Statement

For the past 10 or so years, low economic growth rates, dramatic rise in inflation, growing unemployment, "smart sanctions", shortages of foreign currency, poor weather conditions, growing crime, rising costs and fuel prices have all been observed in Zimbabwe. These problems have politically been blamed on the poor performance of the agricultural sector (which is the backbone of the economy) and the illegal expulsion of the white commercial farmers during the controversial Fast Track Land Reform Programme of 2000 (Economic Commission for Africa, 2002). Some authors have attributed the poor performance to inadequate extension and research, distorted markets based on controlling, decontrolling and re-controlling policy regimes, poor land use patterns, inexperienced newly resettled farmers (former communal farmers and farm workers), financial, human and infrastructural resources not being optimally used, reduction in the use of fertilizers, chemicals and poor export performance (Rukuni, Tawonezvi & Eicher, 2006). In short, the poor performance of the agricultural sector, especially by the smallholder sector has been blamed for the down fall of the Zimbabwean economy.



By addressing the agricultural challenges one would also expect to tackle the problems of the economy. Now that the land invasions have been concluded, as it stands, the programme seems irreversible and the only solutions to ensure food security have to be home grown. This is what the government has been advocating for through the New Economic Recovery Plan (NERP) of 2001. One of the strategies in this Plan is to financially support the undercapitalized smallholder farmers through the provision of subsidized inputs and credit. This is not the first time this avenue has been walked and past experience has proved

otherwise. Smallholder farmers (who make up most of the Zimbabwean population) have failed to benefit much from the previous funds that were availed through the financial markets meant for farmers (from the former AFC and now Agribank). This paper then investigates how such efforts as providing easy and cheap credit to farmers impacts on agricultural performance especially in the smallholder sector. The success of the agricultural sector will also be good for the other sectors of the economy, like manufacturing, that have strong linkage with agriculture. Increasing agricultural performance will also increase rural income and ensure food security hence a move towards poverty alleviation.

## iv) Main Objective of the Study

- To establish whether the much-acclaimed credit can be viewed as a necessity to improve agricultural production.

**- Specific Objectives of the Study**

- To formulate and estimate an agricultural production function for both commercial and smallholder sectors and determine the contribution of credit to production.
- On the basis of results from above, will provide policy recommendation on how to improve agricultural production in the smallholder sector.

## v) Hypothesis

- The credit scheme has no impact on agricultural production i.e. changes in production levels can be explained by other factors other than credit.
- Commercial farmers benefit more than smallholder farmers from subsidized loans.

## vi) Justification of the study

This study aims to generate knowledge for smallholder farmers to assist them in accessing credit from the informal and formal sectors. It also seeks to establish whether the much-acclaimed credit can be viewed as a panacea for smallholder farmers' problems. The need for this study arises from the fact that credit has been identified as a pertinent vehicle for agricultural development and yet those who really need it are failing to have easy access to it.

# CHAPTER 2: LITERATURE REVIEW

## i) Structure Of Agricultural sector in Zimbabwe

The agricultural system in Zimbabwe is divided into two main sectors namely commercial sector and the smallholder sector. The smallholder sector is further divided into communal areas and the resettlement areas. Smallholder farmers own pieces of land which are less than 30ha and are generally involved in subsistence farming characterized by two major activities namely crop production and livestock production. These farmers are self employed and produce the staple food and to some extent commercial goods. Crop production is the major source of food for the households and is also the source of income through selling of surplus yields. The major crops grown in the smallholder farming sector are maize (dominant food crop), sorghum, millet, groundnuts and sunflower. The livestock provides animal draught for tillage, transport, manure, milk, meat, some cash income and are also a stock of wealth. Over the years, poverty levels in this farming sector have been increasing and this was closely related to the poor farming systems, low land holdings and poor resource base (Von Blanckenburg, 1994).

On the other hand, commercial farmers are mostly into intensive cropping of commercial maize, tobacco and horticultural activities. They are two classes of commercial farmers' namely small-scale commercial and large-scale commercial depending on the size of land holdings. The small-scale commercial farmers own between 30-80ha whilst the large-scale owns more than 80ha. Generally commercial farmers own most of the farming equipment needed for land preparation, planting and harvesting like tractors, combine harvesters, irrigation equipment and trucks for carrying their produce to the market (Rukuni & Eicher, 1994). Sometimes they hire-in labour from the smallholder farmers to assist during peak periods like, planting and hand picking of cotton and some horticultural crops. They have a comparative advantage over smallholder farmers when it comes to accessing loans from the banks as they can use their farm assets as collateral. They also use their earnings from their sales to increase their investments on their farms resulting in better yields in each successive production year. With the commercial farmers owning most of the equipment needed in farming and being able to buy all the inputs (seeds, chemicals, fertilizers) needed to maximize production, their yields/ha are higher than those of the smallholder farmers who

use minimal inputs (see table 2 in appendix 1), and who generally do not have access to credit facilities.

Failure to adopt better farming equipment and techniques by smallholder farmers could possibly be attributed to their failure to access loans from the bank and also slow growth in levels of production. This led to ever rising levels of poverty in the rural sector.

> "...*Failure of African agriculture has been attributed to various kinds of 'biases'-* ***commodity bias*** *(cash versus subsistence crops, exports versus food crops),* ***spatial bias*** *(rural versus urban areas),* ***sectorial bias*** *(industry versus agriculture, formal versus informal sectors),* ***market bias*** *(external versus domestic market),* ***scale bias*** *(small scale versus large scale),* ***gender bias,*** ***technological bias*** *(capital intensive versus labour intensive, appropriate versus inappropriate technologies),* ***class bias*** *(capitalist versus working class, feudal versus peasants),* ***fractional bias*** *(state or bureaucratic bourgeoisie versus agrarian or industrial bourgeoisie)...*" (Makandawire & Bourenane, 1987)

The contribution of the smallholder farmers to the country's food reserves has always been smaller than that of commercial farmers as evidenced by the data in appendix 1, table 2. The table portrays the smallholder farmers as the highest producers of food grains like maize although it is also evident that their yield/ ha is lower than that of the commercial farmers. The possible reason for the higher levels is that they are more smallholder farmers with small pieces of land per farmer averaging less than 30ha. With the smallholder farmers mostly producing for subsistence, they are usually left with little surplus grains to sell to the marketing boards resulting in commercial farmers contributing the most to the grain reserves of the country (see table 1 below). The commercial farmers also dominate the production of cash crops. This ***commodity, technological and scale bias*** is closely related to the differences in capital ownership and farming techniques employed by the two farming sectors.



**Table 1: Share of Crop Production: Smallholder & Commercial Sectors**

| Year | Commercial Sector (%) | Smallholder Sector (%) | National Total (%) |
|---|---|---|---|
| 1983 | 81.8 | 18.2 | 100 |
| 1984 | 80.1 | 19.9 | 100 |
| 1985 | 67.5 | 32.5 | 100 |
| 1986 | 72.8 | 27.2 | 100 |

| | | | |
|---|---|---|---|
| 1987 | 81.5 | 18.5 | 100 |
| 1988 | 80.2 | 19.8 | 100 |
| 1989 | 83.0 | 17.0 | 100 |
| 1990 | 89.1 | 10.9 | 100 |
| 1991 | 91.5 | 8.5 | 100 |
| 1992 | 96.7 | 3.3 | 100 |
| 1993 | 66.9 | 33.1 | 100 |
| 1994 | 86.8 | 13.2 | 100 |
| 1995 | 72.3 | 27.7 | 100 |
| 1996 | 89.1 | 10.9 | 100 |
| 1997 | 89.8 | 10.2 | 100 |
| 1998 | 90.3 | 9.7 | 100 |
| 1999 | 87.2 | 12.8 | 100 |

Source of data: The Agricultural Sector of Zimbabwe, Statistical Bulletin- 2001

### ii) Government in agricultural production (subsidized agricultural production and the land issue)

**- Pre-Independence Era**

Some studies have attributed poverty in the smallholder agricultural sector to the policies implemented during the country's colonial era. The pre-independence social, economic and political climate tended to bestow political benefits on whites as opposed to the black community. The most outstanding characteristic of the colonial Zimbabwe was its dualism, in which the state supported the white commercial farming sector, which possessed the most fertile land, with access to national and international markets, credit, technology, extension services, manufactured inputs and consumption goods (Makandiwire & Bourenane, 1987). The smallholder farmers were "settled on poor and small portion of land, producing mainly for family consumption and local markets, were denied equal education and employment opportunities and even salaries for the same job differed with race" (Von Blanckenburg, 1994).

The history of agricultural credit in colonial Zimbabwe goes back to 1924 when the Land and Agricultural Bank of Southern Rhodesia was set up for the purposes of granting loans to

white commercial farmers. Whilst the manipulation of prices and markets by the state for the benefit of commercial farmers was an important element of agricultural policy, the greatest form of subsidy to them was in the form of loans (Makandawire & Bourenane, 1987). A number of state sources of agricultural credit were made available to assist white commercial farmers after the establishment of the Land and Agricultural Bank of Southern Rhodesia among which were the African Loan Development Company Limited established in 1961 and the Agricultural Loan fund formed in 1964 (Rukuni, Eicher & Tawonezvi, 2006). The Agricultural Finance Corporation (AFC) was then formed in 1971 as a successor of the Land and Agricultural Bank of Southern Rhodesia with its major function being the granting of medium and long-term loans at low interest rates (Makandawire & Bourenane, 1987). It absorbed the Farm Irrigation fund, the Agricultural Diversification Scheme, the Tenant Farming Scheme, the Coffee Scheme and the Land Owners Development Loan Scheme which were all set up in the 60's as supporting bodies for white commercial farmers.

The loans from AFC were to be used for the following purposes:

- Purchase of land
- Erection of building and dip tanks
- Erection of fencing and security items
- Purchase of implements
- Crop production costs
- Payment of bonds
- Purchase of livestock

**Table 2: Production levels of maize in the smallholder and commercial farming sectors 1970-1979**

| Year | Smallholder | | | Commercial | | |
|---|---|---|---|---|---|---|
| | Production (t) | Loan Amount (Z$'000) | Yield (kg/ha) | Production (t) | Loan Amount (Z$'000) | Yield (kg/ha) |
| 1970 | 245700 | 0 | 402 | 839600 | 12159 | 2875 |
| 1971 | 455000 | 0 | 677 | 1400500 | 13494 | 4607 |
| 1972 | 551100 | 0 | 829 | 1762100 | 14824 | 4541 |
| 1973 | 145000 | 0 | 305 | 810400 | 14619 | 2570 |
| 1974 | 471000 | 0 | 650 | 1634400 | 18535 | 5254 |
| 1975 | 435000 | 0 | 600 | 1328100 | 26222 | 4774 |
| 1976 | 550000 | 0 | 724 | 1287800 | 30819 | 5005 |
| 1977 | 400000 | 0 | 667 | 1213300 | 36751 | 4589 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1978 | 450000 | 0 | 643 | 1178200 | 33770 | 4314 |
| 1979 | 455000 | 0 | 569 | 685000 | 38944 | 2491 |

Source of data: The Agricultural sector of Zimbabwe Statistical Bulletin-2001

From table 2 above, it is clear that commercial farmers had higher output than the communal farmers. This was mainly because of the support that they received from the government. The loans made it possible for them to acquire all the necessary inputs such as fertilizers, chemicals, seeds and machinery required to boost production levels.

With the rapidly increasing inputs costs, arrangements were made to ensure that assistance for crop production would be repaid to marketing boards or tobacco floors to which crops if grown would be sold. This meant that farmers could get the loans without the worry of having an initial deposit, but use their expected output as guarantee for repayment. Lending institutions had to recover part of their investment through the operation of stop orders registered against crop proceeds. The State even made it more conducive for the commercial farmers as the product pricing and marketing policies were set in such a way that ensured the high living standards for the settler farmers. Price stabilizations were also put in place to avoid changes in retail food prices on the local market so as to minimize inflation (Makandawire & Bourenane, 1987). Because of the favorable selling price, the commercial farmers where left with enough money to finance the following season's requirements.

**- Post-Independence Era**

At independence about 700 000 families were in the smallholder areas which had a carrying capacity of 325 000 families, thus there was significant over-crowding on generally less fertile land (formally known as reserves) combined with generally poor husbandry, poor agricultural and physical infrastructure (Von Blanckenburg, 1994). About 6000, mainly white commercial farmers, held title to about 51% of the land outside urban areas and national parks (44% of the total land area of Zimbabwe, with farms ranging between 500 and 2000ha in size and mostly in the better ecological zones (natural region I, II and III)[3] (Government of Zimbabwe Publication, 1982). Until independence in 1980, the financial services available to the smallholder households were restricted to deposits and withdrawals only.

[3] See appendix 1 for the full agro ecological classifications and their characteristics

The attainment of independence in 1980 saw a twist in the policy instruments. These new policies were now aimed at improving agricultural productivity and rural incomes. The Zimbabwean government started focusing more on commercialization of agriculture through black economic empowerment, which was referred to as indigenization. The starting point was land redistribution which had to be bought from the white farmers on a willing buyer willing seller basis. Land was to be reallocated in phases with the first phase commencing soon after independence targeting to settle 162 000 families on 8 300 000ha.

The first phase of land redistribution lasted from 1980 to 1986 and white commercial farmers sold there land to the government on a willing buyer willing seller basis. No one was forced to sell their land and as a result most of the land was purchased mainly from the marginal areas which the white farmers considered unproductive for them. The programme was co-financed by the British and the Government of Zimbabwe's grants.

As a way to complement the first phase land redistribution programme, the government introduced some financial support services for the rural sector which was previously serviced by mostly non-governmental or church organizations. The AFC also opened doors to the smallholder farmers. In the 1980/81 season 18000 loans amounting to Z$4.8million were disbursed to smallholder farmers (Rukuni, Tawonezvi & Eicher, 2006). Other sources of credit for the smallholder farmers after independence were the Small Enterprises Development Corporation and the informal loans and savings schemes like Association of Women's Clubs and Rotating Savings Credit Associations.

Despite the policy changes, the participation of the smallholder farmers in accessing loans was not satisfactory. According to research by Chimedza (1993), in 1989 only 16.5% of all Building Societies outlets were located in communal lands where 70% of the country's total production resided. The AFC was the only public lending institution servicing the two sectors of farmers. Nevertheless this institution failed to meet demand in the rural areas servicing less than 10% of smallholder land farmers in 1986. By 1990, the figure was less than 5% of the total smallholder land farmers (Makandawire & Bourenane, 1987). Due to inadequacy of formal finance in the rural areas, a very large proportion of financial intermediation took place informally. The bulk of the informal financial institutions were designed to either mobilize savings, advance loans or both. The table below shows the distribution of financial institutions as of 1990.

**Table 3: Distribution of financial institutions: 1990**

| Name | Total Outlets | Rural Outlets | % Rural |
|---|---|---|---|
| Central African Building Society | 72 | 11 | 15 |
| Founders Building Society | 29 | 1 | 3 |
| Beverley Building Society | 52 | 14 | 30 |
| Barclays Bank | 69 | 14 | 30 |
| Standard Chartered | 71 | 28 | 39 |
| Zimbank | 46 | 8 | 17 |
| Bank of Credit & Commerce | 14 | 5 | 36 |
| **Total** | **548** | **209** | **38** |

Source: Rukuni, Tawonezvi & Eicher, 2006

AFC was operating as a parastatal and dependent on the government for its financing. Its major obligation was to disburse loans at a subsidized interest rate of 13% between 1981 and 1991 while the inflation rate was 15% or more per year causing huge losses in the corporation (Rukuni, Tawonezvi & Eicher, 2006). According to a report from AFC income statement, the corporation was losing Z$0.16 on each dollar lent to the smallholder farmers, while lending to commercial farmers yielded Z$0.07 profit on each dollar lent in the 1989/1990 season (Rukuni, Tawonezvi & Eicher, 2006). Most of the loans granted to commercial farmers where medium-term and long term allowing them to invest in machinery and also cater for the variable cost. On the contrary, loans granted to the smallholder farmers were mostly short-term loans hence were mostly used for variable costs and immediate expenses.

Although AFC increased its disbursements over the ten year period (1981-1991), with a peak being experienced in 1986 where 65,269 farmers benefited, only 10% of these farmers where smallholder farmers (Rukuni, Tawonezvi & Eicher, 2006). From 1986 onwards, the number started declining with major declines being observed among the smallholder farmers. The major explanations to account for the decline included poor repayment performance and dissatisfaction with the management of the stop-order repayment system. On the part of the farmers, the complaint was on the high demands of the loans associated with high application failure rates (totaling about 40% of applications) and higher transaction costs (Rukuni, Tawonezvi & Eicher, 2006). In an effort to reach more smallholder farmers, the corporation launched the group lending pilot programme in 1990 season.

Overally in the period 1980-1999, in spite of recurring droughts, the hardships brought about by the Economic Structural Adjustment Programme (ESAP) and political instability beginning at the turn of the 21st century, there was a substantial increase in the levels of production by the smallholder sector. However, the rural income remained a puzzle unsolved as reflected by the increasing level of poverty in the smallholder farming areas. Nevertheless, the increase in levels of production can be attributed to a number of factors which include the land redistribution programme, availability of extension services, availability of credit facilities (though minimal) and reforms in the marketing policies only to mention a few. Of course, the causality and correlation linkage here still need to be tested and this is dealt with later on in this paper.

The second phase of land redistribution commenced in 1987 and extended to 1996. This period marked the beginning of economic liberalization which was aimed at creating black capitalist farmers with minimal state support (Rukuni, Eicher & Taruvinga, 2006). Because of failure by the government to acquire fertile lands from the willing buyer willing seller agreements, the government then embarked on compulsory acquisition. This was not accepted by the international community resulting in the British withdrawing their financial assistance in land reform. The result was low intensity and low profile occupations. Those who were mostly resettled were the smallholder farmers with little capital to fully utilize the land.

The third phase of the land reform programme which was supposed to run from 1997-2004 was moving very slowly resulting in an accelerated programme in 2000 being triggered by the land invasions by land hungry peasant farmers. However these invasions were politicized resulting in The Fast track Resettlement phase which ran from July 2000 to December 2001 targeting to redistribute 9 million ha. By mid November 2001, about 160 000 families had been resettled on 3 074 previously large scale commercial farms covering about 7,3 million ha (UNDP, 2002). Land reform was then announced completed in August 2002 (Chiremba & Masters, 2003).

On the financing side, in 1999 the AFC was transformed into two entities, Agribank, a commercial bank, and a special fund, the Agricultural Development Assistance Fund

(ADAF). Agribank was to cater for the commercial farmers whilst ADAF was to cater for the smallholder farmers but is yet to develop a sustainable rural financial system. Under the ADAF, an increase in demand for credit by the smallholder farmer has been observed although there are still problems with satisfying their demands. The traditional banking requirement of requesting collateral cannot be applied to smallholder farmers but are requested to show proof of savings as proof of collateral. Some of the smallholder farmers are still not able to meet this requirement. The slow transition of the bank led the government to introduce funding through key agricultural ministries (that is Ministry of Agriculture working with Ministry of Finance) as a way to boost production much faster.

Following the Fast Track Land Reform Programme of 2000, the government was faced with a huge number of undercapitalized new farmers who were expected to produce for the country. Due to financial constraints on the part of the farmers, the 2000 agricultural output was pathetic and was indicated as one of the worst in the history of Zimbabwe's agricultural production (The Herald, 2001). The government then sort loans from Iran, Egypt, Malaysia and China for the purchase of equipment such as tractors and combined harvesters (Rukuni, Eicher & Tawonezvi, 2006) and this equipment was to be distributed to the farmers in the form of a loan.

In 2001 the Government of Zimbabwe introduced the Crop and Livestock Inputs Scheme which is more directed towards the smallholder farmers. This operates more like the credit scheme which was available for the white commercial farmers in the colonial era. The smallholder farmers are given inputs without any payment only to pay back through a stop order system through the marketing boards at harvesting. The Government has been giving farmers inputs in the form of seeds, fertilizers, chemicals, tillage services and loans for hiring labour, irrigation rehabilitation and barn rehabilitation. This is a move to promote growing of all major food crops and cash crops and also encourage restocking of livestock.

Whether this programme is helping or not is still a matter to be analyzed but statistics on the disbursements for a targeted hectares against actual hectares planted shows that some of the farmers are not using the disbursed funds or crop packs for the intended objective which could possibly be one of the reasons why the well being of the smallholder farmers is not

improving[4] (Progress Report for the Input & Credit Scheme, Nov 2004). A Government Official interviewed said that in every year at most 2/3 of the targeted hectares were planted and less than a 1/3 of the total funds disbursed have been recovered. He attributed this to recurrent drought which caused poor crops hence reduced yields.

**Table 4: Total amount disbursed since 2002, US$million**

| Year | 2002 | 2003 | 2004 |
|---|---|---|---|
| Amount Disbursed | 21 | 70 | 120 |

Source: Progress Report for the Inputs and Credit Schemes, Ministry of Agriculture, Zimbabwe

**-These figures were converted into US$ using the prevailing official bank rates, that is 824Z$/US$ for 2002 and 2003 and 5000Z$/US$ for 2004.**

With most commercial farmers having been kicked out during the land invasions, the government is striving to provide the smallholder farmers with the same resources and equipment similar to those that commercial farmers were using. However, it is not yet clear whether the policies (subsidized credit and crop packs) are the right one's as there is still no clear empirical evidence showing whether credit can also work for Zimbabwe's smallholder farmers and the newly resettled farmers. It is important to establish whether credit did play any pivotal role in production levels by commercial farmers. However we will only be able to establish the contribution of credit to production only after we have done a more analytical assessment.



### iii) Women and Agriculture

Performance of the agricultural sector also has a gender dimension to it and as such challenges faced by this sector will necessarily also affect women. In Zimbabwean society, women play multiple roles, particularly in the smallholder farming sector. Women constitute about 55% of Zimbabwe's population with 86% of this population living in rural areas where 70% of them are farmers (Rukuni, Tawonezvi & Eicher, 2006). They have the societal role of being mothers, housewives but are also agricultural labourers and farm managers and also carry out household chores such as fetching fuel and water, processing food, cooking, herding cattle, and caring for children, the sick and the elderly.

[4] Statistics could not be provided as it was considered as confidential.

During the colonial period the two most significant factors that affected the role of African women in agriculture were male migration and the introduction of cash crops. Those who wanted to make a living (as opposed to an existence) had to go and work in the towns. Because the wages were generally low there and conditions at work places did not cater for them, the husbands had to go alone, leaving wives behind to grow food. Empirical studies show that women and children produced most of the food during colonial era (Rukuni & Eicher, 1994). The frequent contributor to food production was the rural housewife, aged between 20 and 45, school leavers aged between 15 and 20 (especially girls), widows and the elderly (Rukuni & Eicher, 1994). However, younger women and rural youth carried out the major share of production because the children went to school and the elderly were physically incapable of contributing.

The colonial government emphasized cash crop production, but directed its research and extension to white commercial farmers and the small number of progressive Black farmers. The introduction of the labour-intensive cash crop production saw the women being forced to contribute most of their time in the farms of the commercial farmers. This affected women in agriculture by increasing their tasks and responsibilities while at the same time reduced their food security and decision making power. The neglect of women as a target audience for agriculture contributed to their poverty and increased their dependence on men's income (Chimedza, 1993).

Attainment of independence saw an improvement in women's access to agricultural products like extension services. The passing of the Legal Age of the Majority Act in 1982 made it easier for women to have direct access to market through the personal possession of a Grain Marketing Board card. On the financial side, most of their financial needs have been handled by non-governmental organizations which have always encouraged the women to save. However the savings have not been enough to help them adopt more modern technologies as part of the savings have to be used for family expenses like fees for children. Despite the financial constraints they are also other factors which affect women in agriculture production.

Many studies carried out show that the plots controlled by women have lower yields than those controlled by man and this has been attributed to use of less labour and fertilizers per acre rather than inefficiency (Rukuni, Tawonezvi & Eicher, 2006). This reduction in man

labour has been also found to shift production towards less nutritious crops and a decrease in yields and output, or an increase in women's reliance on child labour. Poor households may go to the extreme of withdrawing their children from school. A number of factors have been identified as contributing factors that constrain women in production. Some of these factors are highlighted below.

**Table 5: Key gender assumptions in agriculture**

| | |
|---|---|
| iv) | Access to land |
| | a. women are denied access to land in the land reform programmes |
| | b. inheritance laws are unfair to women |
| | c. unmarried women are denied access to land, which is given to household (men) and not women |
| v) | Land tenure |
| | a. Women have tenure insecurity based on cultural practices |
| | b. Land allocated is usually in the name of the man as the head of the household |
| vi) | Agricultural finance |
| | a. Most agricultural finance is provided on the basis of collateral which is usually held by men |
| vii) | Household income |
| | a. Women have no decision-making role with respect to income jointly obtained with the men |
| | b. Men tend to spend the proceeds from agriculture, whilst women make investments (including agriculture-related) for the benefit of the family |
| viii) | Appropriate technology |
| | a. Most technologies are based on masculinity hence women cannot easily use them in agriculture. |
| ix) | Access to markets |
| | a. Men participate in the market while women are confined to household and farm level chores |
| x) | Use of natural resources |
| | a. Women are less destructive to natural resources as compared to men |
| | b. Women use natural resources for the household, whereas men commercialize leading to their destructive |

Source: Rukuni, Tawonezvi & Eicher, 2006, pg 635

Despite these constraints highlighted above, there is evidence which suggests that women could increase agricultural output if they had greater access to inputs such as improved seeds, fertilizers, and credit and extension information.

### iv) Role of Credit in Agricultural Development and Poverty Alleviation

In many countries, credit has been seen as playing a crucial role in agricultural development. Some authors have described it as a pertinent vehicle for agricultural development (Schultz, 1964). This is because it fosters adoption of improved operational equipment and modern technology and other inputs that ensure increased output production. The adoption of modern technology helps remove farmers from the technical and economic equilibrium trap (Patricks, 1966). This is true in African states were the commercial farmers, who have all types of modern technologies, are doing better than the smallholder farmers as evidenced by the difference in output levels. The smallholder farmers still use the old farming systems and the old equipment like hoes and cow drawn ploughs which can only be used on small pieces of land.

The role of credit has been very limited in dealing with the problems of traditional agriculture, that is, use of hoes and cow drawn ploughs. In order for the smallholder farmers to keep up with new technology it requires farmers to substitute traditional inputs with comparatively large quantities of modern inputs that are needed to produce a given level of output. Most smallholder farmers have been slow in adopting the modern technology because of the failure to provide the collateral required by the banks to secure the loans. Chimedza, (1993), in her study on the investment behavior of rural household found out that it is difficult for the rural folks to access credit because most of the household are lead by females with their husbands working in the city centers. These women are considered not eligible for the loans because they do not have any assets in their name to use as collateral. Osuntogun & Adeyemo (1973), holds the view that unless productive credit is made available on suitable terms, the majority of smallholder farmers will be seriously handicapped in adopting new profitable technology. Failure to adopt this technology will mean that the smallholder farmers will not be able to improve their well being.

Some countries have boosted their production levels as a result of the credit policies but have not yet alleviated food poverty in the smallholder sector. For example, the Colombian government in the 1970's set interest rates for agricultural credit below equilibrium levels in an attempt to promote agricultural production and to subsidize farmers, especially smallholder farmers. The result was an excess demand for agricultural credit (because of

favorable interest on certain class of time deposits and risk free securities), which in turn necessitated rationing devices and procedures to ensure that credit was allocated to desirable activities and crops. *Fondo Financiero Agropecuario* (FFAP), a department of the Colombia's central bank, was given a role to support commercial farmers with more costs/ha whilst *Caja Agraria*, the largest bank in Colombia, supported the smallholder farmers. This ensured that almost all farmers had access to the credit facility although smallholder farmers were given small amounts which were not enough to ensure adoption of modern technology (Pischke, Adams & Gordon, 1984). For the commercial sector farmers, the large amounts they received where enough to purchase more advanced technology[5]. In as much as food poverty has not been alleviated, production levels have been increased in the smallholder sector which is a positive move towards poverty alleviation.

The fact that production levels can rise as a result of provision of credit means that it is also possible to alleviate food poverty through provision of credit. Vaughan, (1997) holds the view that reorientation of systems of rural financing is a short term remedy to poverty, and the development of more effective rural financial services has a long term impact. She argues that the financial services can be expected to reduce poverty and redress inequality only where services are provided in conjunction with the opening of productive opportunities, thus there is need to keep developmental roles sharply in mind when providing financial services.

She identifies three spheres which might have dramatic effect on providing and supporting economic opportunities in the rural areas as:

i. Financing land
ii. Financing small, medium and micro enterprises
iii. Financing of agriculture- this can be done through farmer support or contract system.

The former credit support services which were there in South Africa are good examples to illustrate why it is important to link developmental roles with the provision of credit. Before South Africa's independence, programmes for financing of agricultural production which targeted the smallholder farmers in former Bantustan areas of South Africa were Farmer Support Programmes and the credit offered through the Financial Aid Fund. These support programmes were meant to provide agricultural support in a developmentally strategic way.

[5] Figures on the production levels were not provided.

The thrust was to make a range of appropriate services (like credit, inputs and extension advice) available to farmers at a local level on a request based, user-pays principle[6]. This contrasted with previous practices within the Bantustans of simply providing various services irrespective of the needs or desires of the recipients. These services from the Farmer Support Programmes were not fully utilized by the farmers in the former Bantustan areas and Vaughan,(1997), attributes this to the conditions found in these areas, (for example, the absence of adequate markets). Failure by farmers to market their output resulted in the failure of the credit funds to revolve.

The key lessons to be learned from the Farmer Support Programmes experience as outlined by Vaughan, (1997):3, are that:-

- "Generalized farmer credit programmes made available within economically depressed contexts are unlikely to be sustainable.
- Farmer credit programmes are likely to be successful where there is a broad demand for such services based on productive and marketing opportunities.
- New credit programmes for agricultural production should be linked to support the opportunities opened up through land reform".

This point of view is supported by the findings from International Fund for Agricultural Development (IFAD) in their report on poverty in Africa. A key lesson emerging from IFAD's experience from financing of projects in Africa is that the only sustainable way to ensure poverty reduction is through helping poor produce more and gain higher income. However, the key to viable poverty alleviation lies with the poor themselves and their under-utilized talents and capacities. This supports the fact that provision of money through credit or input schemes can help improve the performance of the smallholder and resettled farmers only if the farmers themselves are willing to work towards that goal and the funds are provided in conjunction with other necessary institutions like marketing.

In as much as credit can be viewed as an important tool for development, some authors feel that it is the root cause for poverty in the smallholder sector. The traditional view of rural credit and finance has been identified as the main culprit for lack of progress in agriculture in developing countries. These views include:

[6] Request based user-pays principle means that only those who request and have the potential to pay back will be given the funds.

- Cheap loan policy as a compensation for macro-economic policy that might have depressed farm income.
- Making loans available to all farmers as the only means of enhancing technological adoption and profitable farming.
- Informal credit is exploitative and tends to support consumption rather than investment behaviour, so a cheap formal credit provides an escape route (Pischke, Adams & Gordon, 1984).

Because of these traditional views, the smallholder farmers have become too lazy to do any farming. This then calls for a lot of extension on the use of credit as a way to reinstate the importance of credit in production. As Chimedza, (1993) wrote "credit can only be productive when a farmer has reached a certain level of acceptance, adoption and understanding of the improved technologies". The absence of this level of acceptance and understanding can possibly explain for the low economic growth and the high levels of poverty in the rural sectors of many African countries. Clearly from this we see that the role of credit in agricultural performance and subsequently poverty alleviation can be ambiguous hence motivates for an empirical analysis.

There are a number of studies which have been carried out in the past on agricultural production by smallholder farmers in Zimbabwe at farm level. One of the studies was on a comparative analysis of productivity levels between borrowers and non-borrowers. Chimedza (1993) carried out the study in Zvimba communal areas were the output of borrowers and non-borrowers were found to be not significantly different for borrowers and non-borrowers. This was also true for the rate of investment in productive assets and their savings (cash deposits). This finding is in line with the question this paper seeks to investigate on whether provision of subsidized credit to be the solution to the smallholder farmer's problems.

A large body of theory supported by experience has highlighted a number of facts applicable to credit programs. These include:

- Projects that lend funds at free-market rates and pay market rates to savers can be financially viable and successful.
- Farmers can increase output profitably while paying market rates of interest.
- The best approach to correcting market failure is to address it head-on through reforming economic policy and institutions.

- Small farmers and small entrepreneurs benefit from financial liberalization policies and the development of institutions able to efficiently provide financial services to them. (Credit access is more important than credit price).
- Through their local knowledge, nongovernmental agencies and private voluntary agencies have advantages over government agencies in lending to small enterprises.

Source: Buttari, 1995

These facts suggests that it is high time that the policy makers get a wake up call and realize that subsidized credit is not the best solution to farmers problems but should rather improve on administration of general credit. In as much as we would like to buy this argument there is still need to analyze how much credit contributes to production levels in Zimbabwe and ensure whether it is a solution to the countries poverty problems.

Most of the documented literatures on impact of credit on production as highlighted above are based on farm levels analysis. It is this author's view that a farm level analysis may not provide sufficient information especially for economy wide policies. Subsidized credit is an economy wide policy and it is from this point that we need to do an analysis of the aggregate production function for commercial and smallholder farmers as we try and figure out to what extent subsidized credit impact their levels of production. Based on the results obtained from this analysis we will be able to determine whether subsidized credit can be used as an important remedy to smallholder farmer's problems.

# CHAPTER 3: ANALYTICAL FRAMEWORK & RESULTS

## i) The Economic Theory Of Aggregate Production

Macroeconomic and development studies identified three factors of production as capital, land and labour. Factors of production are defined as the inputs to production from outside the business sector (Jonathan, 2006). The traditional specification of the production function can be represented as:

$$Q = Q(K,N,L,t) \quad \text{.....(i)}$$

where Q represents output

K represents capital services of different types

N represents labour services of different types

L represents land services of different types

t is time trend

The assumptions of this production function are as follows:

***Assumption 1*: The aggregate production function is increasing**

Thus if $K \geq K'$ and $N \geq N'$ and $L \geq L'$ then $Q(K,N,L) \geq Q(K',N',L')$

Increasing the factor inputs increases the set of feasible plans. The maximum of a function over a bigger set is necessarily bigger.

***Assumption 2*: The function Q(K,N,L,) exhibit constant returns to scale**

$$Q(\lambda K,\lambda N,\lambda L) \geq \lambda Q(K,N,L,)$$

The best plan given (K,N,L) can be scaled by factor $\lambda$ to give $\lambda Q(K,N,L)$ using $(\lambda K,\lambda N,\lambda L)$. The maximal feasible output must be greater than or equal to all feasible outputs given $(\lambda K,\lambda N,\lambda L)$.

***Assumption 3*: The function is concave**

Let X1=(K1,N1,L1) and X2=(K2,N2,L2)

$$F((X_1 + X_2)/2) \leq Y((z_1+z_2)/2)=1/2Y(z_1)+1/2Y(z_2)=1/2F(X_1)+1/2F(X_2)$$

where $z_1$ and $z_2$ are the optimal plans for $X_1$ and $X_2$ respectively.

The inequality follows from the fact that $(z_1+z_2)/2$ is a feasible plan given $(X_1+X_2)/2$. The linearity of Y implies the first equality. The optimality of the $z_i$ given the $X_i$ implies the second equality. This establishes that the aggregate production function is concave.

Considering a Cobb Douglas production function which can be presented as follows

$$\mathbf{Q=AK^{\alpha 1}N^{\alpha 2}L_{\alpha 3}e^{\gamma t}}\text{.....(ii)}$$

By taking logs, this simplifies to

$$\mathbf{Log\ Q= a + \alpha_1\ LogK_t + \alpha_2\ LogN_t + \alpha_3\ LogL_t + \gamma_t}\text{.....(iii)}$$

Where a= LogA, $\gamma$ is an error term and the $\alpha_i$**'s** will be interpreted as elasticity coefficients.

## ii) Model And Estimation Procedure

Carrying over the same Cobb-Douglas production function as expressed in equation (iii) above, we will now develop the model for estimation. Equation (iii) specifies the three explanatory variables for agricultural output as capital, labour and land. Rainfall is another important variable in agricultural production but is implicitly captured under the land variable. In this study, it will be included explicitly as the fourth explanatory variable. A key assumption of our analysis which will allow us to capture the impact of subsidized credit is that capital stock will be mostly purchased using the funds from the credit scheme, thus replacing the capital variable with the loans variable. The new model will thus be presented as follows:

$$\mathbf{Loutput = a + \alpha_1 Larea + \alpha_2 Lloan + \alpha_3\ Llabour + \alpha_4 Lrain}\text{.....(iv)}$$

| | |
|---|---|
| Loutput | is the ln(total output in tonnes) |
| Larea | is the ln(total area under cultivation) |
| Lloan | is the ln(total subsidized loans disbursed) |
| Lrain | is the ln(rainfall amount received) |
| Llabour | is the ln(total labour units employed) |

A positive relationship is expected with all the explanatory variables. An additional unit of any of the right hand side variable will increase total output.

Using the same framework as specified above we will employ a multivariate systems approach (Johansen cointegration technique)[7] to estimate the production function for both commercial and smallholder farming sectors. This technique allows us to deal with the simultaneity problem which is mostly common when estimating a multi-system. With four variables explaining gross output, it is highly likely that one of the variables could also be explained by gross output, hence the estimated coefficients will be biased.. Letting $\Delta$ represent the first-difference operator, the *m*-dimension Vector Autoregression (VAR) written as a Vector Error Correction Model (VECM) can be presented as follows;

$$\mathbf{A\Delta Z_t = \theta_0 + \theta_1 t + \sum \Gamma i \Delta Z_{t-1} + \Pi Z_{t-k} + \varepsilon_t}$$

where

| | |
|---|---|
| $\mathbf{Z_t}$ | is a vector of I(1) variables (let *m* represent the number of I(1) variables in the vector), thus $Z_t$ is an *mx1* matrix. |
| **A, $\prod$, $\Gamma$i, $\theta_0$, $\theta_1$** | are structural coefficients |
| A: | the contemporaneous structural coefficients |
| t | is a time trend |
| $\varepsilon_t$ | are the structural shocks. |
| $\prod = \alpha\beta'$ | Rank of $\prod$ depends on the number of cointegrating vectors (r) in the system where $0 < r < m$ |
| $\beta'$ | is an *m x r* matrix of long run structural coefficients |
| $\alpha$ | is an *m x r* matrix of adjustment coefficients |

The VECM specified above is in general form hence there in need to identify the order of the vector autoregressive model (VAR) together with the number of cointegrating vectors (CVs) before we can carry out the estimation. Johansen technique will derive the maximum likelihood estimates for $\alpha$, $\beta$, and $\Gamma_i$ and a test statistic for the hypothesis that there are at most *r* cointegrating vectors. Though this technique we will also test hypotheses regarding individual elements of $\alpha$ and $\beta$. However, before we proceed to do this we will start by

[7] The Johansen Technique consists of the following steps:
1. Testing the order of integration of each variable entering the multivariate model
2. Selecting the appropriate lag length for the endogenous variables
3. Determining the number of CVs in the VAR
4. identifying the system by imposing just-identified restrictions
5. Using over-identifying restrictions
6. Estimating the ECM to determine the short-run dynamics

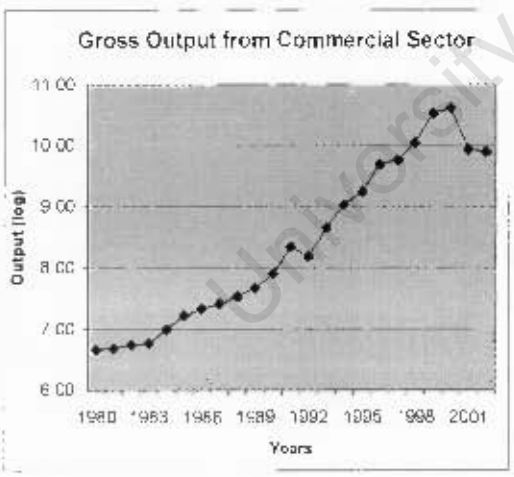
carrying a visual analysis of the data for both the commercial and smallholder farming sectors. This will allow us to detect any structural breaks or other characteristics of the series.

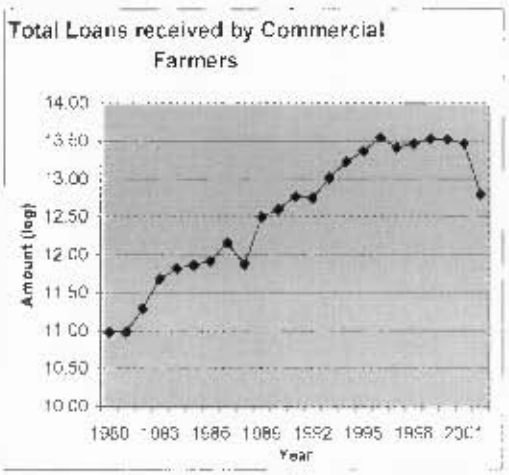
### iii) Data & Descriptive Analysis

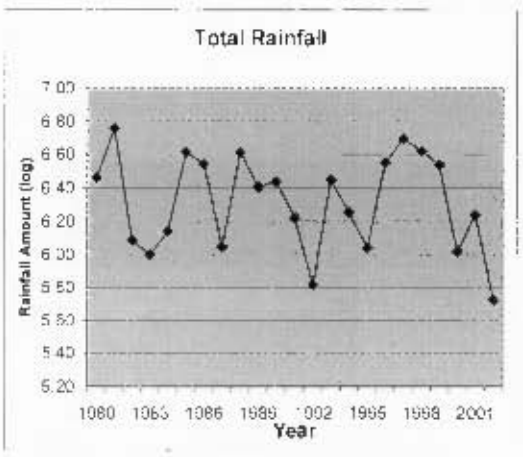
The analysis uses log transformed annual data obtained from the Statistical Year Book 1997 and the Agricultural Sector of Zimbabwe Statistical Bulletin-2001 merged with some data from FAOSTAT Classic website.

**- The commercial sector data & unit root tests**

The period to be analyzed starts from 1980 to 2002 for commercial sector and the variables to be used are gross agricultural output, *loutput*, total land area under cultivation, *larea*, total labour employed, *llabour*, total loan amount disbursed to the sector through the government subsidy administered by the Agribank (former AFC), *lloan*, and the total amount of rainfall received, *lrain*. The decision to use a small sample was a result of failure to get data for some of the variables in the pre 1980 period. This is a very small sample to work with but we will continue with it because of the interesting information that can be observed in it which is important in making policy recommendations. All data was log transformed first hence all results will be interpreted as elasticities.







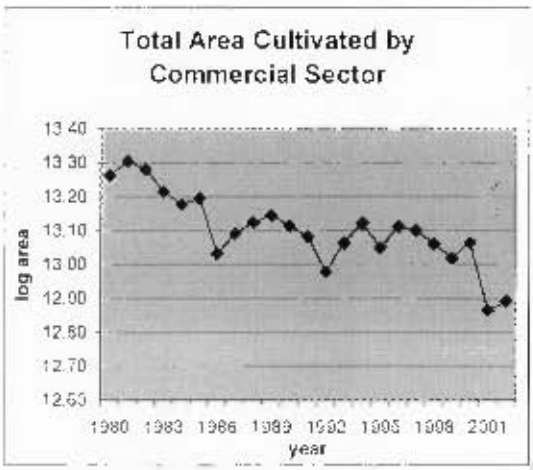



**Figure 4: Plots of the commercial sector data**

An upward trend can be observed in the gross output, loans and labour series for the commercial sector suggesting the presence of a unit root. The slight drop in output observed in 1992 can possibly be attributed to the drought in 1991-1992 periods. The steep drop in both output and loans received by the commercial sector from 2000 are highly related to the highly controversial Fast Track Land reform of 2000 which was characterized with illegal expulsion of white commercial farmers. The rainfall series is highly volatile (with major troughs observed in drought years i.e. 1983, 1987, 1992 and 2002) although the series appears to be stationary[8]. In testing for a long run relationship using the Johansen technique, the crucial requirement is that all the variables be integrated of order 1 (I(1)) thus become stationary after 1st differencing. The upward trend observed in the series is highly indicative

[8] A series is said to be stationary if its mean and variance are constant over time and the value of the covariance between two periods depends only on the lag between the two time periods and not the actual time (Gujarati, 2003)

of non-stationarity or presence of a stochastic trend hence suggesting that the series could be I(1). Two tests of stationarity were done in-order to establish the order of integration for each series. Below are the results of the Augmented Dickey Fuller (ADF) test using the Perron Test sequence. Also find the autocorrelation function for both levels and differenced data in figure 1 of the appendix.

**- Testing for Stationarity in data for commercial farmers**

**Table 6: Testing for a unit root in levels commercial data**

| Variable | $\tau$ | $\Phi_2$ | $\mu$ | $\tau_\mu$ | $\Phi_3$ | $\beta$ | $\tau_\beta$ |
|---|---|---|---|---|---|---|---|
| Loutput (3) | 1.0216 | 1.5766 | .76427 | -1.0600 | 1.5790 | .11037 | -1.5970 |
| Larea | -1.2822 | 2.0070 | 2.6095 | -1.0881 | 2.8438 | -.00871 | -2.3794 |
| Lloan (1) | 1.2299 | 2.1615 | 1.9676 | -1.7463 | 3.0198 | -.07747 | 1.1949 |
| Llabour | -.50524 | 1.8639 | 3.1337 | -1.8635 | 2.4894 | -.0105 | -.47185 |
| Lrain | **-2.75477** | **5.4845** | 6.6460 | -3.2090 | 4.8697 | -.00102 | -3.1161 |

**Table 7: Testing for a unit root in first differenced commercial data**

| Variable | $\tau$ | $\Phi_2$ | $\mu$ | $\tau_\mu$ | $\Phi_3$ | $\beta$ | $\tau_\beta$ |
|---|---|---|---|---|---|---|---|
| Doutput (1) | **-1.8686** | **4.1731** | .20602 | -2.864 | 3.9146 | -.00316 | -2.5325 |
| Darea | **-3.4148** | **8.2565** | -.03193 | -4.0477 | **7.7119** | .1244E-3 | -3.9207 |
| Dloan | **-1.9376** | 1.2073 | .03576 | -1.2990 | 3.5835 | -.02440 | -2.3831 |
| Dlabour | **-1.9993** | **4.7908** | -.2347 | -2.8320 | 2.7883 | -.00918 | -2.3515 |
| Drain | **-4.6184** | **10.2865** | -.0344 | -4.5351 | **10.4173** | -.0111 | -4.4701 |

| **Critical values** | | | | | |
|---|---|---|---|---|---|
| Sig. level | $\tau$ | $\tau_\mu$ | $\tau_\beta$ | $\Phi_2$ | $\Phi_3$ |
| 5% | -1.968 | -2.949 | -3.554 | 5.140 | 7.223 |
| 10% | -1.613 | -2.605 | -3.205 | 4.064 | 5.906 |

*Note: Numbers in bold shows stationarity of the series[9]

[9] $\Delta y_t = \mu_c + \gamma_c t + \beta y_{t-1} + \varepsilon_t$

**and** $\beta = (p_c - 1)$

Where: $\tau_\beta$: tests $H_0: \beta=0$, test statistics: $\tau_\beta$

$\beta$ : tests $H_0: \beta=0$, test statistics: t

$\Phi_3$ : tests $H_0: \beta=0=\gamma_c=0$, test statistic: $\Phi_3$

As was suspected from the visual inspection of the data, gross output, loans, area and labour series were found to be I(1), thus become stationary after first differencing. Comparing the calculated statistics with the critical values we see that differenced labour and output series are stationary with a drift (4.7908>4.064 and 4.1731>4.064 respectively) and this is true at 10% level of significance. The area series is stationary with a trend and a drift at 5% level of significance (7.7119>7.223).Differenced loans is stationary with no drift and no trend. These findings are also supported by the autocorrelation functions in appendix (figure 1). The rain series is stationary in levels thus is I(0) and cannot be included in the long run relationship. However it can still be used to explain the short run dynamics.

**- The smallholder sector data & unit root test**

For the smallholder farmer's production function, area under maize was used as a proxy for total area cultivated due to unavailability of data. Since maize production contributes above 90% of the total production in the smallholder sector, area under maize appears to be a good proxy for total area under cultivation. The labour variable is completely left out of the smallholder farmers production function because of the absence of documented data on it. A possible proxy variable which could have been used is rural population, however it had lots of missing values and proved difficult to work with. Because of these impediments the smallholder farmer production is presented as maize output being explained by total area under maize, total loans received and rainfall. Plots of these variables are given below for the period 1973 to 2002;



---

$$\Delta y_t = \mu_b + \mu y_{t-1} + \varepsilon_t$$

**and** $\mu = (p_b - 1)$

$\tau_\mu$ : tests $H_0$: $\mu=0$, test statistic: $\tau_\mu$

$\Phi_2$ : tests $H_0$: $\mu = \mu_b = 0$, test statistic: $\Phi_2$

$\mu$ :tests $H_0$: $\mu=0$, test statistic: t

$$\Delta y_t = (pa-1) y_{t-1} + \varepsilon_t$$

$\tau$ : tests $H_0$: (pa-1), test statistic $\tau$

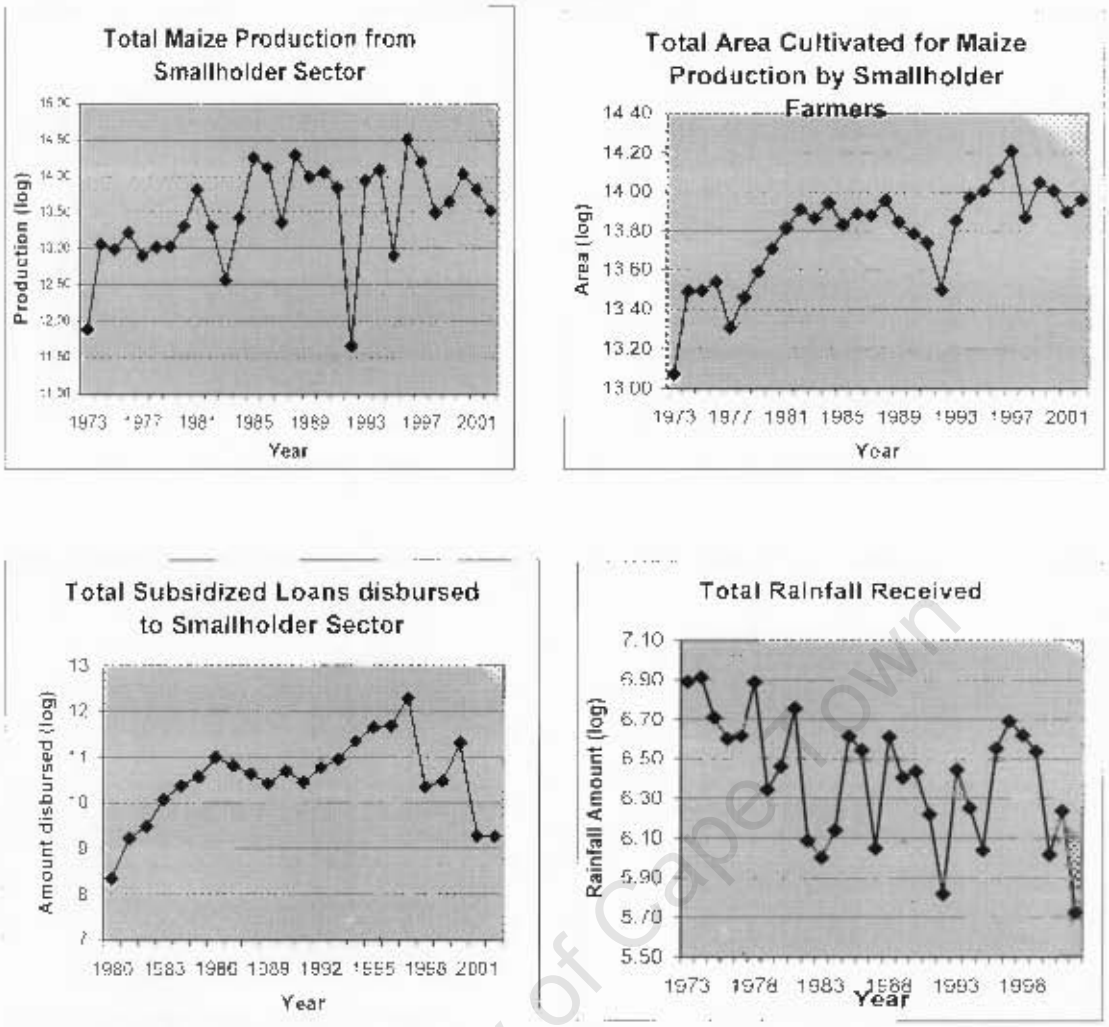



**Figure 5: Plots of the smallholder sector data**

A similar upward trend as that observed from commercial data is also observed for output and loans disbursed to the smallholder sector although the slope is flatter. Output is highly volatile with a huge trough in 1992. As mentioned earlier on, this could be attributed to the drought of 1991-1992. This trend is also tracked closely by the area cultivated series. For the loans series, since 1980 the amounts disbursed rose constantly until 1986 when the disbursements started decreasing. They then picked up from early 90's but started falling steeply in the late 1990s. This could possibly been the effects of the transformation of Agribank into two entities which assigned the poorly serviced ADAF to service the smallholder farmers. The rainfall series shows a negative trend over the years and also appears non-stationary.

As is required that the series be I(1) in-order to estimate the long run production function using Johansen Technique, there is need to run tests of stationarity for the smallholder data before running the estimations. In-order to avoid bias we include a dummy variable for 1992, which captured the impact of the drought of 1991. This dummy was included for the output and area cultivated series. See the results of the standard augmented Dickey Fuller Test and Phillips-Perron Test sequence in table 8 & 9 below.

**- Testing for stationarity in levels data for smallholder farmers**

**Table 8: Testing for a unit root in levels smallholder data**

| Variable | $\tau$ | $\Phi_2$ | $\mu$ | $\tau_\mu$ | $\Phi_3$ | $\beta$ | $\tau_\beta$ |
|---|---|---|---|---|---|---|---|
| Loutput (3) | 1.7959 | 2.9335 | 5.3819 | -1.5069 | 2.4318 | .019606 | -1.8852 |
| Larea (3) | 1.4030 | 3.0697 | 3.7206 | -1.9517 | 2.9535 | .00912 | -2.4055 |
| Lloan (3) | -.74687 | 1.4221 | 4.3409 | -1.5334 | .91794 | -.014196 | -.89869 |
| Lrain (3) | -.91766 | 2.2578 | 4.4678 | -1.9160 | 2.2727 | -.013534 | -2.4177 |

**Table 9: Testing for unit root in first differenced smallholder data**

| Variable | $\tau$ | $\Phi_2$ | $\mu$ | $\tau_\mu$ | $\Phi_3$ | $\beta$ | $\tau_\beta$ |
|---|---|---|---|---|---|---|---|
| Doutput (1) | **-7.8090** | **29.8987** | .080151 | -7.7286 | **19.5547** | -.010729 | -7.6550 |
| Darea (1) | **-4.2200** | **9.0313** | .02204 | -4.2387 | **5.9914** | -.00234 | -4.2106 |
| Dloan (1) | **-3.5712** | **6.0331** | .01923 | -3.4094 | **8.0331** | -.07813 | -4.8320 |
| Drain (1) | **-5.8136** | **17.3393** | -.06124 | -5.8875 | **11.0967** | -.00124 | -5.7470 |

*Note: Numbers in bold shows stationarity of the series

| **Critical values** | | | | | |
|---|---|---|---|---|---|
| Sig. level | $\tau$ | $\tau_\mu$ | $\tau_\beta$ | $\Phi_2$ | $\Phi_3$ |
| 5% | -1.968 | -2.949 | -3.554 | 5.140 | 7.223 |
| 10% | -1.613 | -2.605 | -3.205 | 4.064 | 5.906 |

Note: Refer to foot note 9 for definition of symbols

Results show that the series are all I(1) thus all series become stationary after first differencing. Comparing the calculated statistics with the critical values we see that the calculated statistics are greater than the critical values at 5% level of significance. This means we can include all the variables in the long run relationship. This finding is also supported by the plots of the autocorrelation functions in figure 2 in the appendix.

Having obtained the order of integration of the series, we can now proceed to test for cointegration.

### iv) Testing For Cointegration

The first step in testing for cointegration will be to determine the lag length of the VAR. Patterson (2000: 649) indicates that "the Akaike Information Criteria (AIC) performs well in the context of simultaneously estimating the lag length and the cointegrating rank of the VAR". Taking this into consideration, the optimal lag length for the commercial data was found to be equal to two and for the smallholder data equal to one (see tables 6 & 7 in appendix for the full set of results).

*Number of CVs:*

**Table 10: commercial sector cointegrating test with unrestricted intercepts and restricted trend**

**VAR(2): loutput=[larea, lloan, llabour & lrain]**

| H0: r = p | H1: | λ-max | 95% CV | λ-trace | 95% CV |
|---|---|---|---|---|---|
| r = 0 | r = 1 | 37.0547 | 31.7900 | 79.6300 | 63.0000 |
| r ≤ 1 | r = 2 | 21.0774 | 25.4200 | 42.5753 | 42.3400 |
| r ≤ 2 | r = 3 | 14.7645 | 19.2200 | 21.4979 | 25.7700 |
| r ≤ 3 | r = 4 | 6.7334 | 12.3900 | 6.7334 | 12.3900 |

*Eigenvalues: λ1=0.84319 λ2=0.65141 λ3=0.52204 λ4=0.28586

**Table 11: Smallholder Sector cointegrating test with unrestricted intercepts and no trend**

**VAR(1): loutput=[larea, lloan, lrain & D1]**

| H0: r = p | H1: | λ-max | 95% CV | λ-trace | 90% CV |
|---|---|---|---|---|---|
| p = 0 | p = 1 | 31.5568 | 27.4200 | 51.9672 | 48.8800 |
| p ≤ 1 | p = 2 | 12.5110 | 21.1200 | 20.4104 | 31.5400 |
| p ≤ 2 | p = 3 | 5.8771 | 14.8800 | 7.8995 | 17.8600 |
| p ≤ 3 | p = 4 | 2.0224 | 8.0700 | 2.0224 | 8.0700 |

*Eigenvalues: λ1=0.76174 λ2=0.43373 λ3=0.23443 λ4=0.87828

From table 10 above, the maximum eigenvalue test statistic suggests that there is a single cointegrating vector in the commercial sector data but the trace statistic fails to reject the null of two or less cointegrating vectors at 5% level of significance. According to Patterson (2000) the trace statistics works better in small sample thus we will continue with 2 cointegrating vectors which can be normalized on the production function and the credit function for the commercial sector.

From table 11 above, both the maximum eigenvalue and trace statistics fail to reject the null of 1 or less cointegrating vector at the 5% and 10% level of significance. Thus for the smallholder sector data there is only one cointegrating vector which is the production function. Below are the results of the long run econometric models for both sectors under study .

## v) Econometric Model Estimation

*Table 12: Estimated cointegrating vectors and β matrix hypothesis tests for the* ***commercial sector***

(i) Unrestricted model

loutput = **2.1272** larea*** + **1.5185** lloan*** – **0.17707** llabour

lloan = **0.7692** loutput – **2.0345** larea – **0.02512** t

(ii) Testing whether loans doubles output

loutput = **3.2366** larea + **2.00** lloan – **1.2845** llabour

Likelihood ratio statistics: $\chi^2_{(1)} = 14.3531$ [0.000]

(iii) restrict the loans coefficient to 1.7

loutput = **5.9813** larea + **1.7** lloan + **0.0734** llabour

Likelihood ratio statistics: $\chi^2_{(1)} = 2.4285$ [0.119]

(The full set of results summarized above together with the tests for statistical significance are reported in tables 8-16 in appendix.)

*** means the coefficient is significant at 1% level of significance

Output in the commercial sector is positively increased by area cultivated and loans disbursed. The coefficients on these two variables (from (i) above) are both greater than one suggesting a very elastic relationship with output, and the coefficients are statistically significant at 1% level. Loans almost double output with a coefficient of about 1.5185, thus

on average a 1% increase in loans disbursed will increase total output by about 1.5% holding all other things constant (from (ii) and (iii) above we see that there is less than a 1:2 relationship between loans and output). Despite loans causing a huge impact on output, area cultivated has an upper hand. Area cultivated more than doubles output. Labour shows a negative relationship which is difficult to interpret economically. This coefficient is statistically insignificant.

*Table 13: Estimated cointegrating vectors and β matrix hypothesis tests for the* ***smallholder sector***

(i) Unrestricted model

loutput = **-2.0409** larea + **0.3240** lloan** + **0.0881** lrain

(ii) testing for one-to-one relationship between credit and output

loutput = **21.5419**larea + lloan – **6.2987** lrain

Likelihood ratio statistics: $\chi^2_{(1)} = 20.9060$ [0.000]

(iii) testing for a 50% increase in output in response to a unit increase in loans.

loutput = **-3.0955**larea + **0.500**lloan – **0.2202** lrain

Likelihood ratio statistics: $\chi^2_{(1)} = 0.63706$[0.425]

(The full set of results summarized above together with the tests for statistical significance are reported in tables 8-16 in appendix.)

** means the coefficient is significant at 5% level of significance

For the smallholder sector a positive relationship is observed with loans and rainfall although the rainfall coefficient is statistically insignificant. A 1% increase in loans will increase output on average by 0.5% holding all other things constant (see (iii) above). Area cultivated is negatively related to output and this is the opposite of what we expected. By imposing a restriction of zero on the area variable, we failed to reject the null hypotheses suggesting that the area coefficient is statistically insignificant.

Clearly from the regression results reported above, commercial farmers benefit more than the smallholder farmers from subsidized loans in the long run. Land is also an important factor in agricultural production as shown by the large coefficient in the commercial sector regression. As shown in the regression for the smallholder farmers, increases in area cultivated do not

increase their production levels possibly because of lack of enough capital to work on the land. This draws us back to the problem statement of this study which touches on the issue of inequality associated with the disbursements of loans. Smallholder farmers are given very little funds which are not enough to pay for the adequate capital inputs required to fully utilize the land. With the loans being inelastic it means any additional loans acquired will not increase output that much as the funds will not be enough to purchase the required inputs.

From the regression results for the smallholder farmers, land does not have a significant impact on production thus any additional units of land given to smallholder farmers will not improve their production levels. This could possibly be explained by the fact that the smallholder farmers are not in a position to purchase inputs to use on the additional pieces of land. Instead the smallholder farmers will use the available little inputs, divide them through the whole hectares ploughed, resulting in reduced and poor harvests. Unlike the commercial farmers who are given more loans, smallholder farmers will not be able to adopt the more recent forms of mechanizations. As a result, poor and reduced harvests will continue to prevail in the smallholder sector. Unless the land redistribution is accompanied with inputs, land redistribution on its own will not alleviate poverty in the smallholder sectors of Zimbabwe.

**Table 14: Short run dynamics in the model-Commercial Sector**

| Dependent Variable | Δloutput | Δlloan |
|---|---|---|
| Explanatory Variables | Coefficient<br>(t-values in parentheses) | Coefficient<br>(t-values in parentheses) |
| Constant | 56.5363**<br>(2.559) | 43.5774*<br>(1.9839) |
| dloutput | 0.68656**<br>(2.3918) | 0.26413<br>(0.9254) |
| Dlarea | -0.59013<br>(-0.6495) | 1.323<br>(1.4647) |
| Dlloan | 0.55394<br>(0.97591) | -0.0411<br>(-0.0729) |
| dllabour | 1.0109*<br>(1.9859) | 1.2538**<br>(0.50612) |
| Ecm1(-1) | -0.3728**<br>(-1.8994) | -0.0729<br>(-0.3737) |
| Ecm2(-1) | -1.1767**<br>(-2.9138) | -0.8041*<br>(-2.003) |

| | | |
|---|---|---|
| Lrain | 0.7774***<br>(3.9171) | 0.1345<br>(0.6814) |
| R2 statistics | 0.65 | 0.63 |
| Adjusted R2 statistics | 0.55 | 0.42 |
| Durbin-Watson statistics | 1.8256 | 2.1611 |
| Lagrange Multiplier test | $\chi2(1)$=0.4449[0.505] | $\chi2(1)$=1.4081[0.235] |
| Ramsey RESET test | $\chi2(1)$=5.1584[0.023] | $\chi2(1)$=6.1036[0.013] |
| Jarque-Bera Normality test | $\chi2(2)$=0.3943[0.821] | $\chi2(2)$=1.5551[0.460] |
| White Heteroscedastictiy test | $\chi2(1)$=0.059[0.807] | $\chi2(1)$=1.0645[0.302] |

ECM1 = loutput -2.1272larea -1.5185lloan +0.17707llabour

ECM2 = -0.76926loutput +2.0345larea +lloan +0.25122trend

Note:

*** is significant at 1% level

** is significant at 5% level

* is significant at 10% level

Back to the commercial sector, in the short run previous years output, rainfall and labour plays a significant role in increasing output in the commercial sector. 1% increase in labour units will increase output by 1% holding all other things constant. A coefficient of -0.3728 on ECM(1) means that about 37% of the deviations in the production functions from the previous period is corrected in the next period. This model explains about 65% of the variation in output. The diagnostics are good although they suggest a wrong functional form.

**Table 15: Short run dynamics in the model - Smallholder Sector**

| Dependent Variable | Δloutput |
|---|---|
| Explanatory Variables | Coefficient<br>(t-values in parentheses) |
| Constant | 33.2715***<br>(6.5601) |
| Ecm1(-1) | -0.87159***<br>(-6.5390) |
| D1 | -2.3855***<br>(-4.8933) |
| R2 statistics | 0.77 |
| Adjusted R2 statistics | 0.75 |
| Durbin-Watson statistics | 2.3366 |
| Lagrange Multiplier test | $\chi2(1)$=1.0714[0.301] |
| Ramsey RESET test | $\chi2(1)$=0.81048[0.368] |
| Jarque-Bera Normality test | $\chi2(2)$=0.81363[0.666] |

| | |
|---|---|
| White Heteroscedastictiy test | $\chi 2(1)=0.67574[0.411]$ |

ECM1 = loutput + 2.0409larea – 0.3240lloan – 0.08809lrain

Note:

*** is significant at 1% level

** is significant at 5% level

* is significant at 10% level

For the smallholder sector, most of the activity in the short run mostly involves correction of previous years deviations from the long run equilibrium. About 87% of the previous years deviation is corrected in the current period. This significant at 1% level. Other variables like the droughts and the floods seem to explain a significant moment of variation as shown by the dummy (D1) which is also significant at 1% level. This model explains about 77% of the variation in smallholder sector output. The diagnostics shows absence of serial correction or heteroscedasticity which is an indication of a good model.

# CHAPTER 4: CONCLUSION & RECOMMENDATIONS

## i) Conclusion

The major finding coming out from this study is that besides credit, commercial output is driven also by area cultivated. Short run variations are also influenced by labour units employed. Although credit is an important input in agricultural sector, the findings from the commercial sector suggests that land is more important. For the smallholder sector, the only variable which is significant is credit (capital) input but the variable is inelastic. This means that giving the smallholder farmers more credit alone will not help them but rather there is need to first improve their structure so that they can match or resemble the commercial farmers. One of the ways to transform the smallholder farmers is through the programme which has already been implemented by the government, which is land redistribution. This programme was executed tied with political interests and without international financial support creating a lot of questions about its sustainability (Rukuni, Eicher & Taruvinga, 2006). Although the programme was not executed in an ethical manner, this does not mean that it was not a necessary step. However, land reallocation on its own will not solve the problems in the smallholder sector but has to be accompanied by other services like extension and helping the farmers acquire modern technology (by providing enough credit).



## ii) Policy Recommendations

The only way to ensure that farmers acquire modern technology will be through provision of subsidized credit in large amounts. This means that the government has to raise more revenue either through taxes or donors. The first option is a non starter if we look at the current economic situation in the country, leaving the donor option. Since the government is not in a position to lobby for funds from the donors because of the sanctions, it is important that policies be put in place that allow direct interaction of the donors with the smallholder farmers without interference of the politicians.

These funds will fail to achieve the intended goal if the agricultural services are not improved. It is important that the research & extension services be improved to ensure that the smallholder farmers become more educated on the right and more productive farming

methods as well as finance management. Farmers need to be encouraged to save their returns for future farming seasons. This will wean off the farmers quickly from the debt burden.

Special programmes directed specifically towards the smallholder farmers can also be organized through government. This will ensure that the intended beneficiaries will receive the support without grouping them under the broad umbrella of farmers.

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## Appendix 1

### Table 1: Short Term Loans Extended to Farmers & maize tonnage

| Year | loans to smallholder (Z$'000) | maize yield (mt) | loans to commercial (Z$'000) | maize yield (mt) |
|---|---|---|---|---|
| 1970 | 0 | 245700 | 12159 | 839600 |
| 1971 | 0 | 455000 | 13494 | 1400500 |
| 1972 | 0 | 551100 | 14824 | 1762100 |
| 1973 | 0 | 145000 | 14619 | 810400 |
| 1974 | 0 | 471000 | 18535 | 1634400 |
| 1975 | 0 | 435000 | 26222 | 1328100 |
| 1976 | 0 | 550000 | 30819 | 1287800 |
| 1977 | 0 | 400000 | 36751 | 1213300 |
| 1978 | 0 | 450000 | 33770 | 1178200 |
| 1979 | 0 | 455000 | 38944 | 685000 |
| 1980 | 4200 | 600000 | 58388 | 910700 |
| 1981 | 10100 | 1000000 | 58846 | 1833400 |
| 1982 | 13200 | 595000 | 80027 | 1213400 |
| 1983 | 23400 | 285000 | 118000 | 624800 |
| 1984 | 32000 | 670000 | 135804 | 678500 |
| 1985 | 38900 | 1558000 | 141169 | 1153000 |
| 1986 | 60000 | 1348000 | 150151 | 1064000 |
| 1987 | 49400 | 627700 | 189374 | 466000 |
| 1988 | 41300 | 1609300 | 143315 | 643800 |
| 1989 | 33400 | 1188200 | 267570 | 743000 |
| 1990 | 43800 | 1262300 | 295947 | 731500 |
| 1991 | 34700 | 1019300 | 349373 | 566500 |
| 1992 | 47030 | 115200 | 343044 | 245800 |
| 1993 | 56350 | 1133600 | 447003 | 878250 |
| 1994 | 83790 | 1313800 | 554105 | 1012400 |
| 1995 | 114855 | 399400 | 635183 | 440200 |
| 1996 | 116870 | 1987000 | 764038 | 922000 |
| 1997 | 215414 | 1453800 | 669300 | 738370 |
| 1998 | 30696 | 727550 | 705900 | 690480 |
| 1999 | 35000 | 845300 | 749100 | 674260 |
| 2000 | 81429 | 1240000 | 745100 | 908110 |
| 2001 | 10643 | 993940 | 703000 | 482300 |
| 2002 | | | 358730 | |



### Table 1: Gross Domestic Product by Industry at constant 1990 prices (Z$millions)

| Industry | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|---|---|---|
| Agriculture & forestry | 2435 | 3221 | 2474 | 3145 | 3375 | 3119 | 3737 | 3834 | 4023 |
| Mining | 830 | 843 | 823 | 805 | 892 | 936 | 913 | 895 | 899 |
| Manufacturing | 3835 | 4530 | 4146 | 3825 | 4209 | 3726 | 3875 | 3992 | 3886 |
| Electricity & Water | 497 | 512 | 501 | 443 | 486 | 477 | 469 | 473 | 447 |
| Construction | 615 | 619 | 645 | 633 | 635 | 483 | 541 | 633 | 661 |
| Finance & Insurances | 1336 | 1380 | 1373 | 1578 | 1673 | 1723 | 1794 | 1848 | 1865 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Real Estates | 474 | 494 | 522 | 549 | 569 | 594 | 617 | 648 | 681 |
| Hotels & Restaurants | 3267 | 3488 | 3268 | 3277 | 3504 | 3696 | 3946 | 4037 | 4075 |
| Transport & Commun. | 1185 | 1230 | 1334 | 1273 | 1383 | 1706 | 2043 | 2062 | 2062 |
| Public Administration | 1215 | 1235 | 1208 | 1153 | 997 | 1002 | 920 | 872 | 870 |
| Education | 1269 | 1286 | 1290 | 1307 | 1325 | 1357 | 1495 | 1612 | 1712 |
| Health | 316 | 340 | 347 | 381 | 466 | 441 | 415 | 314 | 299 |
| Domestic services | 348 | 355 | 339 | 331 | 346 | 327 | 348 | 356 | 363 |
| Other services | 770 | 891 | 930 | 924 | 951 | 900 | 971 | 1077 | 111 |
| Les imputed bank service | -425 | -448 | -315 | -412 | -517 | -402 | -307 | -288 | -242 |
| **GDP AT FACTOR COST** | **17967** | **19976** | **18885** | **19212** | **20294** | **20085** | **21777** | **22365** | **22712** |

Source: The Agricultural Sector of Zimbabwe, Statistical Bulletin- 2001

## Table 2: Production levels by sector over the period 1980-2001

| Year | Maize (t) | | | | Sorghum (t) | | Soya Beans (t) | |
|---|---|---|---|---|---|---|---|---|
| | s/scale production (t) | s/scale kg/ha | commercial production (t) | commercial kg/ha | s/scale production (t) | commercial production (t) | s/scale production (t) | commercial production (t) |
| **1980** | 600,000 | 667 | 910,700 | 3,279 | 66,000 | 16,300 | 8,040 | 89,363 |
| **1981** | 1,000,000 | 1,000 | 1,833,400 | 5,045 | 100,000 | 25,100 | 6,750 | 66,131 |
| **1982** | 595,000 | 541 | 1,213,400 | 3,835 | 50,000 | 17,400 | 3,010 | 88,586 |
| **1983** | 285,000 | 271 | 624,800 | 2,201 | 44,000 | 7,500 | 2,000 | 78,626 |
| **1984** | 670,000 | 590 | 678,500 | 3,021 | 37,400 | 18,100 | 970 | 88,763 |
| **1985** | 1,558,000 | 1,530 | 1,153,000 | 4,845 | 76,000 | 54,000 | 1,680 | 85,537 |
| **1986** | 1,348,000 | 1,255 | 1,064,000 | 4,433 | 66,200 | 65,000 | 960 | 72,600 |
| **1987** | 627,700 | 590 | 466,000 | 3,168 | 40,400 | 11,900 | 871 | 93,924 |
| **1988** | 1,609,300 | 1,400 | 643,800 | 4,292 | 163,100 | 12,700 | 2,264 | 118,146 |
| **1989** | 1,188,200 | 1,154 | 743,000 | 4,415 | 65,300 | 16,100 | 4,500 | 121,615 |
| **1990** | 1,262,300 | 1,300 | 731,500 | 4,091 | 72,500 | 18,400 | 1,800 | 108,513 |
| **1991** | 1,019,300 | 1,101 | 566,500 | 3,237 | 51,300 | 16,800 | 2,040 | 95,255 |
| **1992** | 115,200 | 158 | 245,800 | 1,607 | 10,350 | 21,420 | 650 | 50,475 |
| **1993** | 1,133,600 | 1,090 | 878,250 | 4,436 | 69,510 | 20,000 | 1,445 | 69,075 |
| **1994** | 1,313,800 | 1,124 | 1,012,400 | 4,364 | 90,800 | 30,920 | 1,215 | 100,090 |
| **1995** | 399,400 | 330 | 440,200 | 2,333 | 16,730 | 12,750 | 220 | 77,050 |
| **1996** | 1,687,000 | 1,268 | 922,000 | 4,498 | 86,200 | 21,320 | 415 | 109,895 |
| **1997** | 1,453,800 | 980 | 738,370 | 4,700 | 115,128 | 14,940 | 2,565 | 89,600 |
| **1998** | 727,550 | 688 | 690,480 | 4,140 | 60,750 | 11,040 | 2,436 | 108,070 |
| **1999** | 845,300 | 670 | 674,260 | 3,657 | 72,400 | 13,200 | 3,724 | 103,454 |
| **2000** | 1,240,000 | 1,025 | 908,110 | 4,393 | 85,000 | 18,329 | 4,320 | 139,272 |
| **2001** | 993,940 | 917 | 482,300 | 3,470 | 41,240 | 19,500 | 10,900 | 164,180 |

Source: Agricultural Sector of Zimbabwe Statistical Bulletin-2001

## Table 4: Short term loans extended to farmers by Sector

| Year | Smallholder sector (Z$'000) | Commercial sector (Z$'000) |
|---|---|---|
| 1970 | 0 | 12,159 |
| 1971 | 0 | 13,494 |
| 1972 | 0 | 14,824 |
| 1973 | 0 | 14,619 |
| 1974 | 0 | 18,535 |
| 1975 | 0 | 26,222 |
| 1976 | 0 | 30,819 |
| 1977 | 0 | 36,751 |
| 1978 | 0 | 33,770 |
| 1979 | 0 | 38,944 |

| | | |
|---|---|---|
| 1980 | 3,073 | 58,388 |
| 1981 | 3,097 | 58,846 |
| 1982 | 4,212 | 80,027 |
| 1983 | 6,211 | 118,000 |
| 1984 | 7,148 | 135,804 |
| 1985 | 7,430 | 141,169 |
| 1986 | 16,683 | 150,151 |
| 1987 | 21,042 | 189,374 |
| 1988 | 15,924 | 143,315 |
| 1989 | 29,730 | 267,570 |
| 1990 | 29,595 | 266,352 |
| 1991 | 34,938 | 314,440 |
| 1992 | 34,304 | 308,740 |
| 1993 | 44,700 | 402,303 |
| 1994 | 77,575 | 476,530 |
| 1995 | 76,222 | 558,961 |
| 1996 | 114,606 | 649,432 |
| 1997 | 147,099 | 833,562 |
| 1998 | 176,592 | 1,000,689 |
| 1999 | 56,990 | 1,082,810 |

Source: Agribank, Harare



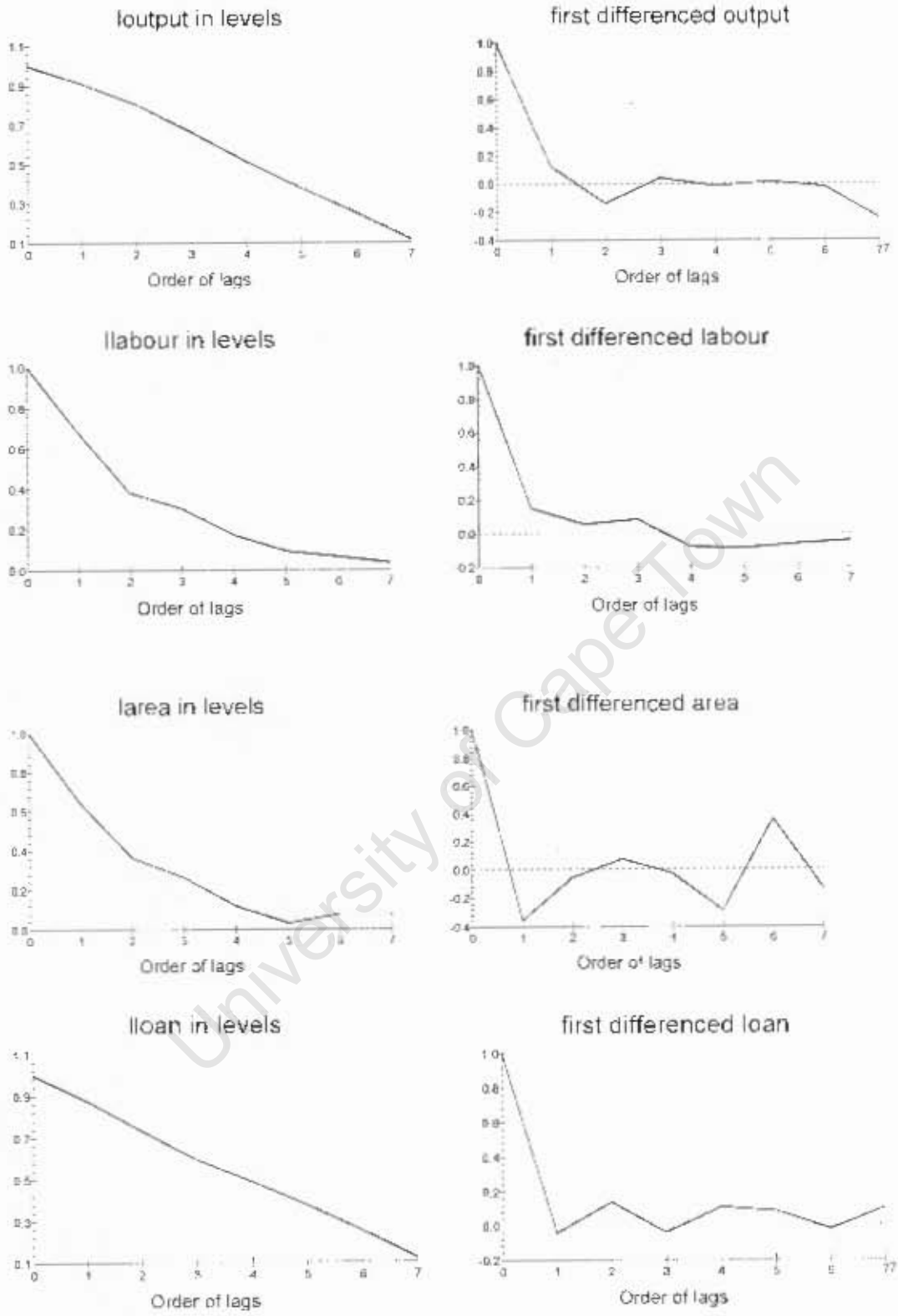
**Table 5: Agricultural Land Classifications in Zimbabwe**

Agricultural land is classified into 5 regions on the basis of climatic and soil conditions.

| Natural Region | Area (km2) | Rainfall (mmyr-1) | Agricultural |
|---|---|---|---|
| I | 7 000 | > 1 000 | specialized and diversified farming e.g. dairy farming, forestry |
| II | 58 600 | 750-1000 | intensive farming e.g maize, tobacco |
| III | 72 900 | 650-800 | semi-intensive farming, severe mid-season dry spell are common e.g. livestock production |
| IV | 147 800 | 450-650 | semi extensive farming, periodic seasonal droughts and severe dry spells. |
| V | 104 400 | < 450 | extensive farming, suitable for extensive cattle ranching or game ranching. |

**Source: Moyo (2000)**

**Figure1: Autocorrelation Functions for levels and differenced data- commercial farmers**



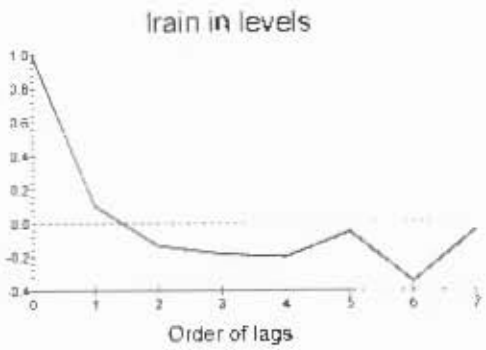
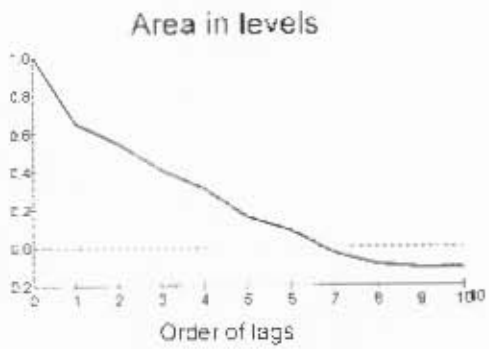
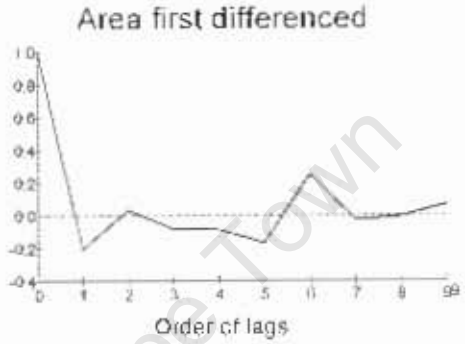
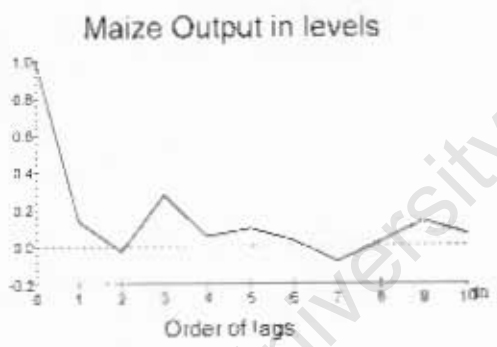
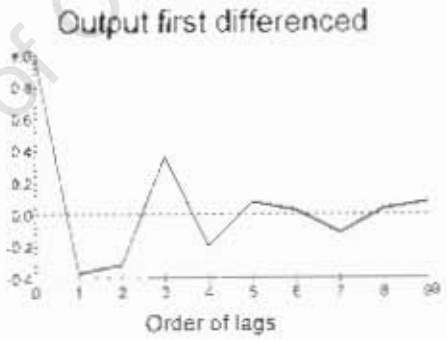


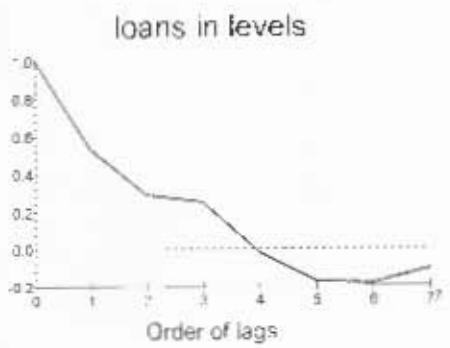

**Figure 2: Autocorrelation Functions for levels and differenced data- smallholder farmers**

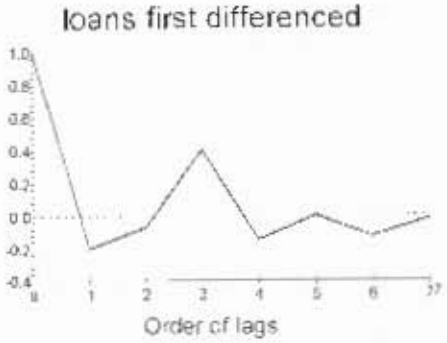


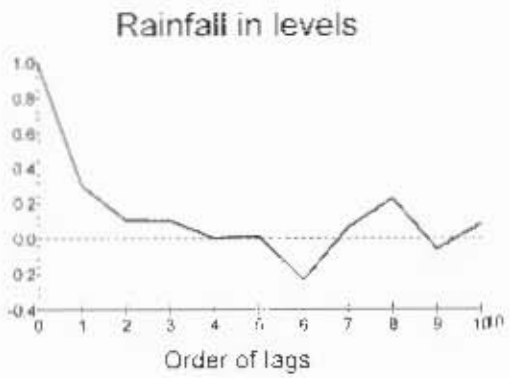



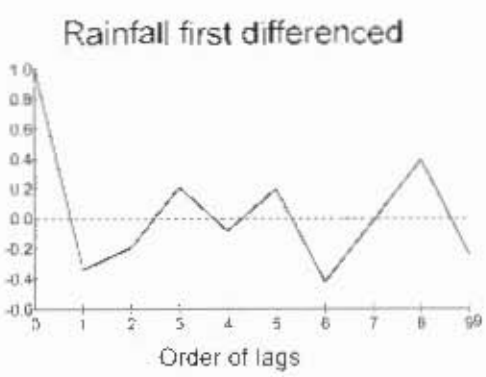





## Model Results

Commercial sector: Loutput larea lloan llabour & lrain
Smallholder sector: loutput larea lloan lrain

### Table 6: Selecting the order of VAR

**commercial sector**

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

```
**************************************************************************
Based on 20 observations from 1983 to 2002. Order of VAR = 3
List of variables included in the unrestricted VAR:
LOUTPUT      LAREA        LLOAN        LLABOUR
List of deterministic and/or exogenous variables:
LRAIN
**************************************************************************
Order   LL      AIC     SBC         LR test       Adjusted LR test
  3   125.5103  73.5103  47.6213        ------          ------
  2   88.6723   52.6723  34.7491  CHSQ( 16)= 73.6762[.000]  25.7867[.057]
  1   74.2255   54.2255  44.2682  CHSQ( 32)= 102.5697[.000]  35.8994[.291]
  0  -41.0890  -45.0890 -47.0805  CHSQ( 48)= 333.1988[.000]  116.6196[.000]
**************************************************************************
AIC=Akaike Information Criterion    SBC=Schwarz Bayesian Criterion
```

**smallholder sector**

Test Statistics and Choice Criteria for Selecting the Order of the VAR Model

```
**************************************************************************
Based on 21 observations from 1982 to 2002. Order of VAR = 2
List of variables included in the unrestricted VAR:
LOUTPUT      LAREA        LLOAN        LRAIN
List of deterministic and/or exogenous variables:
D1
**************************************************************************
Order   LL      AIC     SBC         LR test       Adjusted LR test
  2    8.8931 -27.1069 -45.9083        ------          ------
  1   -4.0001 -24.0001 -34.4453  CHSQ( 16)= 25.7864[.057]  14.7351[.544]
  0 -114.9584 -118.9584 -121.0474  CHSQ( 32)= 247.7030[.000]  141.5446[.000]
**************************************************************************
AIC=Akaike Information Criterion    SBC=Schwarz Bayesian Criterion
```

### Table 7: identifying number of CVs

**commercial sector**

Cointegration with unrestricted intercepts and restricted trendsin the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

```
**************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
List of eigenvalues in descending order:
.84319    .65141    .52204    .28586     0.00
**************************************************************************
Null   Alternative   Statistic    95% Critical Value    90%Critical Value
r = 0    r = 1       37.0547        31.7900              29.1300
r<= 1    r = 2       21.0774        25.4200              23.1000
r<= 2    r = 3       14.7645        19.2200              17.1800
r<= 3    r = 4        6.7334        12.3900              10.5500
**************************************************************************
Use the above table to determine r (the number of cointegratingvectors).
```

```
Cointegration with unrestricted intercepts and restricted trendsin the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix
**************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LLABOUR      Trend
```

List of I(0) variables included in the VAR:
LRAIN
List of eigenvalues in descending order:
.84319 .65141 .52204 .28586 0.00

| Null | Alternative | Statistic | 95% Critical Value | 90%Critical Value |
|---|---|---|---|---|
| r = 0 | r>= 1 | 79.6300 | 63.0000 | 59.1600 |
| r<= 1 | r>= 2 | 42.5753 | 42.3400 | 39.3400 |
| r<= 2 | r>= 3 | 21.4979 | 25.7700 | 23.0800 |
| r<= 3 | r = 4 | 6.7334 | 12.3900 | 10.5500 |

Use the above table to determine r (the number of cointegratingvectors).

## smallholder sector

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

22 observations from 1981 to 2002. Order of VAR = 1.
List of variables included in the cointegrating vector:
LOUTPUT LAREA LLOAN LRAIN
List of I(0) variables included in the VAR:
D1
List of eigenvalues in descending order:
.76174 .43373 .23443 .087828

| Null | Alternative | Statistic | 95% Critical Value | 90%Critical Value |
|---|---|---|---|---|
| r = 0 | r = 1 | 31.5568 | 27.4200 | 24.9900 |
| r<= 1 | r = 2 | 12.5110 | 21.1200 | 19.0200 |
| r<= 2 | r = 3 | 5.8771 | 14.8800 | 12.9800 |
| r<= 3 | r = 4 | 2.0224 | 8.0700 | 6.5000 |

Use the above table to determine r (the number of cointegratingvectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

22 observations from 1981 to 2002. Order of VAR = 1.
List of variables included in the cointegrating vector:
LOUTPUT LAREA LLOAN LRAIN
List of I(0) variables included in the VAR:
D1
List of eigenvalues in descending order:
.76174 .43373 .23443 .087828

| Null | Alternative | Statistic | 95% Critical Value | 90%Critical Value |
|---|---|---|---|---|
| r = 0 | r>= 1 | 51.9672 | 48.8800 | 45.7000 |
| r<= 1 | r>= 2 | 20.4104 | 31.5400 | 28.7800 |
| r<= 2 | r>= 3 | 7.8995 | 17.8600 | 15.7500 |
| r<= 3 | r = 4 | 2.0224 | 8.0700 | 6.5000 |

Use the above table to determine r (the number of cointegratingvectors).



**(3) just-identified model-** to interpret the coefficients here you change the sign i.e. the negative signs are interpreted as positive relationship
Vector 1 is the production function. Value 1 in the vector represents the y variable

### Table 8: Long run relationship

## Commercial sector

ML estimates subject to exactly identifying restriction(s)
Estimates of Restricted Cointegrating Relations (SE's in Brackets)
Converged after 2 iterations
Cointegration with unrestricted intercepts and restricted trendsin the VAR

20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:

```
LOUTPUT      LAREA       LLOAN       LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0; b3=1; b4=0;
********************************************************************************
          Vector 1    Vector 2
LOUTPUT        1.0000      -.76926
          (  *NONE*)  (   .39300)

LAREA         -2.1272      2.0345
          (  1.8175)  (  1.9320)

LLOAN         -1.5185      1.0000
          (  .11251)  (  *NONE*)

LLABOUR        .17707       0.00
          (  .60838)  (  *NONE*)

Trend           0000      .025122
          (  *NONE*)  (  .092631)

********************************************************************************
LL subject to exactly identifying restrictions=  93.6210
********************************************************************************
```

## Smallholder sector

```
ML estimates subject to exactly identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
              Converged after 2 iterations
    Cointegration with unrestricted intercepts and no trends in the VAR
********************************************************************************
22 observations from 1981 to 2002. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA       LLOAN       LRAIN
List of I(0) variables included in the VAR:
D1
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1;
********************************************************************************
          Vector 1
LOUTPUT        1.0000
          (  *NONE*)

LAREA          2.0409
          (  1.5002)

LLOAN          -.32400
          (  .18463)

LRAIN         -.088096
          (  .62948)

********************************************************************************
LL subject to exactly identifying restrictions= -11.4785
********************************************************************************
```

**Table 9: Over-identified: Testing for significance of credit in the production function**

## Commercial sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
              Converged after 2 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
********************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA       LLOAN       LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0; b3=1; b4=0; a3=0;
```

```
**************************************************************************
          Vector 1     Vector 2
LOUTPUT          1.0000       .19972
          (   *NONE*)   (   .30842)

LAREA            4.0086      -6.3552
          (   5.2596)   (   *NONE*)

LLOAN             .0000       1.0000
          (   *NONE*)   (   *NONE*)

LLABOUR          -3.9279        .0000
          (   1.8101)   (   *NONE*)

Trend             -.0000      -.26941
          (   *NONE*)   (   *NONE*)

**************************************************************************
LR Test of Restrictions        CHSQ( 1)=  20.5422[.000]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions=  93.6210
LL subject to over-identifying restrictions=  83.3499
**************************************************************************
```

## Smallholder sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 21 iterations
    Cointegration with unrestricted intercepts and no trends in the VAR
**************************************************************************
22 observations from 1981 to 2002. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LRAIN
List of I(0) variables included in the VAR:
D1
**************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a3=0;
**************************************************************************
          Vector 1
LOUTPUT          1.0000
          (   *NONE*)

LAREA            1.0604
          (   1.2775)

LLOAN            -.0000
          (   *NONE*)

LRAIN            -.22510
          (   .63759)

**************************************************************************
LR Test of Restrictions        CHSQ( 1)=   4.1001[.043]
DF=Total no of restrictions(2) - no of just-identifying restrictions(1)
LL subject to exactly identifying restrictions= -11.4785
LL subject to over-identifying restrictions= -13.5286
**************************************************************************
```

**Table 10: Testing for a one-to-one relationship between credit and output**

## Commercial sector

```
                ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 19 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
**************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LLABOUR      Trend
List of I(0) variables included in the VAR:
```

```
LRAIN
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0;  b3=1; b4=0; a3=-1;
********************************************************************************
            Vector 1     Vector 2
LOUTPUT          1.0000      -.23345
          (  *NONE*)   (   .26698)

LAREA           -1.3221      -1.8047
          (  *NONE*)   (  *NONE*)

LLOAN           -1.0000       1.0000
          (  *NONE*)   (  *NONE*)

LLABOUR         -1.5471       -.0000
          (   .39437)  (  *NONE*)

Trend            -.0000      -.12869
          (  *NONE*)   (  .047475)

********************************************************************************
LR Test of Restrictions        CHSQ( 1)=  9.9904[.002]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions=  93.6210
LL subject to over-identifying restrictions=  88.6258
********************************************************************************
```

## Smallholder sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 1166 iterations
    Cointegration with unrestricted intercepts and no trends in the VAR
********************************************************************************
22 observations from 1981 to 2002. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LRAIN
List of I(0) variables included in the VAR:
D1
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a3=-1;
********************************************************************************
            Vector 1
LOUTPUT          1.0000
          (  *NONE*)

LAREA           -21.5419
          (  18.1120)

LLOAN            -1.0000
          (  *NONE*)

LRAIN             6.2987
          (  11.1258)

********************************************************************************
LR Test of Restrictions        CHSQ( 1)=  20.9060[.000]
DF=Total no of restrictions(2) - no of just-identifying restrictions(1)
LL subject to exactly identifying restrictions= -11.4785
LL subject to over-identifying restrictions= -21.9315
********************************************************************************
```

## Table 11: Credit increases output on average by 50%

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 19 iterations
    Cointegration with unrestricted intercepts and no trends in the VAR
********************************************************************************
22 observations from 1981 to 2002. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LRAIN
```

```
List of I(0) variables included in the VAR:
DI
*******************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a3=-0.5;
*******************************************************************************
          Vector  1
LOUTPUT          1.0000
         (   *NONE*)

LAREA            3.0955
         (   1.4076)

LLOAN            -.50000
         (   *NONE*)

LRAIN            .22024
         (   .71017)

*******************************************************************************
LR Test of Restrictions        CHSQ( 1)=   .63706[.425]
DF=Total no of restrictions(2) - no of just-identifying restrictions(1)
LL subject to exactly identifying restrictions= -11.4785
LL subject to over-identifying restrictions= -11.7971
*******************************************************************************
```

## Table 12: Testing whether credit doubles output

### Commercial sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 21 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
*******************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
*******************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0;  b3=1; b4=0; a3=-2;
*******************************************************************************
          Vector  1     Vector  2
LOUTPUT          1.0000      -.73935
         (   *NONE*)   (   *NONE*)

LAREA           -3.2366       1.5274
         (   *NONE*)   (   *NONE*)

LLOAN           -2.0000       1.0000
         (   *NONE*)   (   *NONE*)

LLABOUR          1.2845       -.0000
         (   *NONE*)   (   *NONE*)

Trend            -.0000       .011660
         (   *NONE*)   (   *NONE*)

*******************************************************************************
LR Test of Restrictions        CHSQ( 1)=  14.3531[.000]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions=  93.6210
LL subject to over-identifying restrictions=  86.4445
*******************************************************************************



ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 140 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
*******************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
```

```
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0;  b3=1; b4=0; a3=-1.7;
********************************************************************************
          Vector 1     Vector 2
LOUTPUT          1.0000      -.56600
         (  *NONE*)   (   .42783)

LAREA           -5.9813       3.1671
         (  7.4196)   (  3.7087)

LLOAN           -1.7000       1.0000
         (  *NONE*)   (  *NONE*)

LLABOUR         -.073409       -.0000
         (  1.6121)   (  *NONE*)

Trend            -.0000     -.0063720
         (  *NONE*)   (   .12594)

********************************************************************************
LR Test of Restrictions        CHSQ( 1)=  2.4285[.119]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions=  93.6210
LL subject to over-identifying restrictions=  92.4068
********************************************************************************
```

**Table 13: Testing for the significance of the rainfall variable in the production function**

## Commercial sector

Could not be tested since the rainfall variable did not enter the long run relationship

## Smallholder sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
              Converged after 22 iterations
    Cointegration with unrestricted intercepts and no trends in the VAR
********************************************************************************
22 observations from 1981 to 2002. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LRAIN
List of I(0) variables included in the VAR:
D1
********************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a4=0;
********************************************************************************
          Vector 1
LOUTPUT          1.0000
         (  *NONE*)

LAREA            2.1097
         (  1.4697)

LLOAN           -.33479
         (   .17369)

LRAIN            -.0000
         (  *NONE*)

********************************************************************************
LR Test of Restrictions        CHSQ( 1)=  .018521[.892]
DF=Total no of restrictions(2) - no of just-identifying restrictions(1)
LL subject to exactly identifying restrictions= -11.4785
LL subject to over-identifying restrictions= -11.4878
********************************************************************************
```

## Table 14: Testing for the significance of area cultivated

### Commercial sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 2 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
*******************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
*******************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0; b3=1; b4=0; a2=0;
*******************************************************************************
           Vector 1     Vector 2
LOUTPUT          1.0000      -.64905
          (  *NONE*)   (  *NONE*)

LAREA            -.0000       1.1630
          (  *NONE*)   (  *NONE*)

LLOAN            -.59703      1.0000
          (  *NONE*)   (  *NONE*)

LLABOUR          -1.9997       .0000
          (  *NONE*)   (  *NONE*)

Trend            -.0000     -.011436
          (  *NONE*)   (  *NONE*)

*******************************************************************************
LR Test of Restrictions        CHSQ( 1)=  14.3540[.000]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions=  93.6210
LL subject to over-identifying restrictions=  86.4440
*******************************************************************************
```

### Smallholder sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                Converged after 2 iterations
    Cointegration with unrestricted intercepts and no trends in the VAR
*******************************************************************************
22 observations from 1981 to 2002. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA        LLOAN        LRAIN
List of I(0) variables included in the VAR:
D1
*******************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a4=0; a2=0;
*******************************************************************************
           Vector 1
LOUTPUT          1.0000
          (  *NONE*)

LAREA            -.0000
          (  *NONE*)

LLOAN            -.18390
          (  .12204)

LRAIN             .0000
          (  *NONE*)

*******************************************************************************
LR Test of Restrictions        CHSQ( 2)=  3.0952[.213]
DF=Total no of restrictions(3) - no of just-identifying restrictions(1)
LL subject to exactly identifying restrictions= -11.4785
LL subject to over-identifying restrictions= -13.0262
```

**********

## Table 15: Testing for the significance of labour in production

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
              Converged after 15 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
*******************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA       LLOAN       LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
*******************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0; b3=1; b2=0; a4=0;
*******************************************************************************
          Vector 1    Vector 2
LOUTPUT        1.0000     -.39207
          (  *NONE*)  (  .19099)

LAREA         -2.3919     -.0000
          (  1.5951)  (  *NONE*)

LLOAN         -1.5062     1.0000
          (  .10579)  (  *NONE*)

LLABOUR         .0000     -.30831
          (  *NONE*)  (  .21191)

Trend          -.0000     -.061451
          (  *NONE*)  (  .036611)

*******************************************************************************
LR Test of Restrictions       CHSQ( 1)=  .083620[.772]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions=  93.6210
LL subject to over-identifying restrictions=  93.5792
*******************************************************************************
```

## Table 16: Testing for significance of land in the credit function

### Commercial sector

```
ML estimates subject to over identifying restriction(s)
    Estimates of Restricted Cointegrating Relations (SE's in Brackets)
              Converged after 22 iterations
 Cointegration with unrestricted intercepts and restricted trendsin the VAR
*******************************************************************************
20 observations from 1983 to 2002. Order of VAR = 2, chosen r =2.
List of variables included in the cointegrating vector:
LOUTPUT      LAREA       LLOAN       LLABOUR      Trend
List of I(0) variables included in the VAR:
LRAIN
*******************************************************************************
List of imposed restriction(s) on cointegrating vectors:
a1=1; a5=0; b3=1; b4=0; b2=0;
*******************************************************************************
          Vector 1    Vector 2
LOUTPUT        1.0000     -.55812
          (  *NONE*)  (  .33553)

LAREA          4.1750     -.0000
          ( 12.5167)  (  *NONE*)

LLOAN          1.0545     1.0000
          (  5.6402)  (  *NONE*)

LLABOUR       -5.0506      .0000
          ( 22.5490)  (  *NONE*)
```

```
Trend          -.0000     -.049235
          ( *NONE*)   ( .054852)

*******************************************************************************
LR Test of Restrictions        CHSQ( 1)= 15.0542[.000]
DF=Total no of restrictions(5) - no of just-identifying restrictions(4)
LL subject to exactly identifying restrictions= 93.6210
LL subject to over-identifying restrictions= 86.0940
*******************************************************************************
```

**Table 17: The short run dynamics of the production function and speed of adjustment to long run relationship**

## Smallholder sector

```
ECM for variable LOUTPUT estimated by OLS based on cointegrating VAR(1)
*******************************************************************************
Dependent variable is dLOUTPUT
22 observations used for estimation from 1981 to 2002
*******************************************************************************
Regressor          Coefficient      Standard Error      T-Ratio[Prob]
Intercept           33.2715          5.0718          6.5601[.000]
ecm1(-1)            -.87159          .13329          -6.5390[.000]
D1                 -2.3855          .48751         -4.8933[.000]
*******************************************************************************
List of additional temporary variables created:
dLOUTPUT = LOUTPUT-LOUTPUT(-1)
ecm1 =   1.0000*LOUTPUT +  2.0409*LAREA  -.32400*LLOAN  -.088096*LRAIN
*******************************************************************************
R-Squared                .77360   R-Bar-Squared              .74977
S.E. of Regression       .47611   F-stat.   F( 2, 19)  32.4617[.000]
Mean of Dependent Variable  .0100000   S.D. of Dependent Variable    .95179
Residual Sum of Squares    4.3069   Equation Log-likelihood     -13.2776
Akaike Info. Criterion    -16.2776   Schwarz Bayesian Criterion   -17.9142
DW-statistic              2.3366   System Log-likelihood       -11.4785
*******************************************************************************


                  Diagnostic Tests
*******************************************************************************
*   Test Statistics *      LM Version      *       F Version       *
*******************************************************************************
*             *                  *                    *
* A:Serial Correlation*CHSQ(  1)=  1.0714[.301]*F(  1,  18)=  .92151[.350]*
*             *                  *                    *
* B:Functional Form  *CHSQ(  1)=  .81048[.368]*F(  1,  18)=  .68849[.418]*
*             *                  *                    *
* C:Normality        *CHSQ(  2)=  .81363[.666]*     Not applicable      *
*             *                  *                    *
* D:Heteroscedasticity*CHSQ(  1)=  .67574[.411]*F(  1,  20)=  .63377[.435]*
*******************************************************************************
  A:Lagrange multiplier test of residual serial correlation
  B:Ramsey's RESET test using the square of the fitted values
  C:Based on a test of skewness and kurtosis of residuals
  D:Based on the regression of squared residuals on squared fitted values
```

## Commercial sector

```
ECM for variable LOUTPUT estimated by OLS based on cointegrating VAR(2)
*******************************************************************************
Dependent variable is dLOUTPUT
20 observations used for estimation from 1983 to 2002
*******************************************************************************
Regressor          Coefficient      Standard Error      T-Ratio[Prob]
Intercept           56.5363          22.0927          2.5590[.034]
dLOUTPUT1             .68656           .28705           2.3918[.044]
dLAREA1              -.59013           .90848          -.64958[.534]
dLLOAN1               .55394           .56761           .97591[.358]
dLLABOUR1              1.0109           .50905           1.9859[.082]
ecm1(-1)             -.37283           .19629          -1.8994[.094]
ecm2(-1)             -1.1767           .40384          -2.9138[.019]
LRAIN                 .77736           .19845           3.9171[.004]
*******************************************************************************
List of additional temporary variables created:
```

```
dLOUTPUT = LOUTPUT-LOUTPUT(-1)
dLOUTPUT1 = LOUTPUT(-1)-LOUTPUT(-2)
dLAREA1 = LAREA(-1)-LAREA(-2)
dLLOAN1 = LLOAN(-1)-LLOAN(-2)
dLLABOUR1 = LLABOUR(-1)-LLABOUR(-2)
ecm1 =  1.0000*LOUTPUT  -2.1272*LAREA  -1.5185*LLOAN +  .17707*LLABOUR
  0.00*Trend;ecm2 = -.76926*LOUTPUT +  2.0345*LAREA +  1.0000*LLOAN
0.00*LLABOUR  +  .025122*Trend
**************************************************************************
R-Squared              .64847  R-Bar-Squared           .54512
S.E. of Regression     .23534  F-stat.  F( 7, 12)  1.6856[.204]
Mean of Dependent Variable  .15766  S.D. of Dependent Variable  .26339
Residual Sum of Squares  .66461  Equation Log-likelihood  5.6641
Akaike Info. Criterion  -2.3359  Schwarz Bayesian Criterion  -6.3189
DW-statistic           1.8256  System Log-likelihood  93.6210
**************************************************************************


                  Diagnostic Tests
**************************************************************************
*  Test Statistics  *      LM Version      *      F Version       *
**************************************************************************
*                   *                      *                      *
* A:Serial Correlation*CHSQ( 1)=  .44490[.505]*F( 1, 11)=  .25026[.627]*
*                   *                      *                      *
* B:Functional Form  *CHSQ( 1)=  5.1584[.023]*F( 1, 11)=  3.8232[.076]*
*                   *                      *                      *
* C:Normality        *CHSQ( 2)=  .39430[.821]*     Not applicable     *
*                   *                      *                      *
* D:Heteroscedasticity*CHSQ( 1)= .059614[.807]*F( 1, 18)= .053813[.819]*
**************************************************************************
  A:Lagrange multiplier test of residual serial correlation
  B:Ramsey's RESET test using the square of the fitted values
  C:Based on a test of skewness and kurtosis of residuals
  D:Based on the regression of squared residuals on squared fitted values
```

## Table 18: Short run dynamics of the credit function and the adjustment to long run relationship

```
ECM for variable LLOAN estimated by OLS based on cointegrating VAR(2)
**************************************************************************
Dependent variable is dLLOAN
20 observations used for estimation from 1983 to 2002
**************************************************************************
Regressor          Coefficient     Standard Error     T-Ratio[Prob]
Intercept           43.5774         21.9656          1.9839[.083]
dLOUTPUT1            .26413          .28540           .92547[.382]
dLAREA1             1.3230           .90325          1.4647[.181]
dLLOAN1            -.041129          .56435          -.072878[.944]
dLLABOUR1           1.2538           .50612          2.4773[.038]
ecm1(-1)           -.072939          .19516          -.37374[.718]
ecm2(-1)           -.80414           .40151         -2.0028[.080]
LRAIN               .13445           .19731          .68141[.515]
**************************************************************************
List of additional temporary variables created:
dLLOAN = LLOAN-LLOAN(-1)
dLOUTPUT1 = LOUTPUT(-1)-LOUTPUT(-2)
dLAREA1 = LAREA(-1)-LAREA(-2)
dLLOAN1 = LLOAN(-1)-LLOAN(-2)
dLLABOUR1 = LLABOUR(-1)-LLABOUR(-2)
ecm1 =  1.0000*LOUTPUT  -2.1272*LAREA  -1.5185*LLOAN +  .17707*LLABOUR +
  .0000*Trend;ecm2 = -.76926*LOUTPUT +  2.0345*LAREA +  1.0000*LLOAN
 0.00*LLABOUR +  .025122*Trend
**************************************************************************
R-Squared              .63346  R-Bar-Squared           .41964
S.E. of Regression     .19708  F-stat.  F( 7, 12)  2.9626[.047]
Mean of Dependent Variable  .075010  S.D. of Dependent Variable  .25870
Residual Sum of Squares  .46609  Equation Log-likelihood  9.2123
Akaike Info. Criterion  1.2123  Schwarz Bayesian Criterion  -2.7706
DW-statistic           2.1611  System Log-likelihood  93.6210
**************************************************************************
```

Diagnostic Tests

| Test Statistics | LM Version | F Version |
|---|---|---|
| A:Serial Correlation | CHSQ( 1)= 1.4081[.235] | F( 1, 11)= .83311[.381] |
| B:Functional Form | CHSQ( 1)= 6.1036[.013] | F( 1, 11)= 4.8314[.050] |
| C:Normality | CHSQ( 2)= 1.5551[.460] | Not applicable |
| D:Heteroscedasticity | CHSQ( 1)= 1.0645[.302] | F( 1, 18)= 1.0119[.328] |

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values