THE ROLE OF BANK CREDIT ON AGRICULTURAL OUTPUT OF SMALL-SCALE FARMERS IN SOUTH AFRICA

by

KULANI MAFUYEKA

submitted in accordance with the requirements for

the degree of

MASTER OF COMMERCE

in the subject

Economics

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROF. TEMITOPE LYDIA LESHORO

November 2021

DECLARATION

I, Kulani Mafuyeka student number 10344950, hereby declare that this dissertation is my own work and all information sources that I have used or quoted have been indicated and acknowledged by means of complete references.

15 November 2021

Signature Date

ACKNOWLEDGEMENTS

I would like to thank God Almighty for protecting and guiding me throughout the research and writing of this dissertation. I would also like to express my sincere gratitude to my supervisor, Professor Temitope Lydia Leshoro for her guidance, coaching, support and encouragement. Finally, I would like to thank everyone who supported me, especially Miglas Phuti Mphela for their support through the completion of this dissertation. I also thank and acknowledge the love, support, guidance and assistance of my family throughout my studies.

ABSTRACT

There has been an on-going debate on the relationship between bank credit and agricultural output, especially in developing countries. Several studies conducted have mainly found that credit has a significant positive impact on the agricultural output. Access to bank credit is very important in improving the living standard of the rural people in agricultural communities. The small-scale agriculture sector has been identified as a weapon which can be used to fight unemployment and poverty. With increased access to credit, small-scale farmers have a role to play in bettering this situation. Though literature has emerged on the impact of bank credit on agricultural output, there appears to be limited literature on the effect of bank credit on agricultural output among South African small-scale farmers and thus present a research gap in this respect.

In order to empirically investigate the long-run relationships and short-run dynamic interactions between the agricultural gross domestic product of small-scale farmers and bank credit, as the focus of the study, the Johansen and Juselius (1990) co-integration method and the vector error correction model (VECM) were employed. Capital investment, labour and rainfall are the control variables. The VECM was used to establish the long-run and short-run relationship. Annual time series data from 1978 to 2020 was used. In the long run we found that bank credit, capital investment and labour have significant positive impact on agricultural output of small-scale farmers in South Africa while rainfall has significant negative impact on agricultural output. In the short-run, we discover that capital investment has a significant positive impact on agricultural output in the short-run whereas bank credit and other control variables reflect negative impact on agricultural output. Nevertheless, the ECM coefficient is negative and highly significant, showing that agricultural gross domestic product rapidly adjusts to short-run disruptions.

Based on these findings, this study recommends an increase and continuous supply of long-term bank credit to small-scale farmers since it has ability to accelerate agricultural output and expand farming operations. The study promotes policies that will increase and maintain the availability of bank credit for small-scale farmers at low interest rates.

Keywords: bank credit; agricultural output; co-integration; Vector Error Correction Model; South Africa; small-scale farmers

CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1. Introduction and background

The relationship between bank loans and agricultural output, particularly in developing nations, has been the subject of ongoing discussion. Several studies have been undertaken using various approaches to determine the influence of bank credit on agricultural productivity, with the findings indicating that credit has a major positive impact on agricultural productivity. Access to bank loans is critical for rural people in agricultural communities to improve their living standards. In order to increase agricultural productivity, credit is essential. Appropriate credit access allows farmers to purchase the necessary inputs and machinery for their farming operations. (Abdul, Hussain and Munir, 2009).

Developing countries increase their agricultural output by using modern agricultural technology like tractors, modern irrigation systems, chemical fertilizers, and recommended seeds. Credit is required to purchase the inputs necessary for the successful implementation of modern agricultural techniques. Nonetheless, in South Africa, the agricultural sector, particularly small-scale agriculture, continues to face difficulties in obtaining bank credit. There is a desperate need for bank credit as a result of the introduction of new technology that stimulates greater productivity. In South Africa, these credits, which are essential for the purchase of new technology, are not accessible and this impedes output growth. Even when the credits are available, the lending rates are likely very high, discouraging farmers from borrowing. In addition, the farmers do not have collateral to use for this credit, as most farmers involved in agriculture are commonly rural dwellers, farming on communal land without tittle deeds to their land.

Challenges confronted by non-farm small medium enterprises (SMEs) are alike to those of small-scale farmers. Although small-scale farmers are commonly observed as belonging to the SME category, a generally acceptable definition of a small-scale farmer has been argumentative. According to the International Finance Corporation (2011) small-scale farmers are categorised into two; first, commercial small-scale farmers that produce crops that may be sold for cash and secondly the medium-sized farmers that realise relatively higher profits from farming operations.

In South Africa, Department of Agriculture, Forestry and Fisheries (RSA, DALRRD) (2018) defines a small-scale farmer as a farmer who grows agricultural products that are primarily intended for the market. The small-scale farmer earns continuous income from the farming business, which forms the family's source of income. The farmer has the capability to extend the farming operation and grow to be a commercial farmer but needs access to technological, financial, and managerial resources. These are generally the new contestants with an annual turnover of between R50 000 and R5 million. The Department of Trade and Industry (DTI) classifies small-scale farmers under SMEs because of their small size and space of operation. Table 1.1 summarises the description of SME on different South African sectors. The small-scale farmer is described as a farmer generating an annual revenue of up to R3m from farming operations, where they typically have employees to a maximum of 50 and net assets value of R3m. it can be noted from the table that the small enterprises in agriculture are the highest in terms of net assets value, this is because agriculture is capital intensive.

Table 1.1: Small medium enterprises levels in different sectors

Sector	**Class**	**Employee (maximum limit in hundreds)**	**Annual turnover in South Africa (million rand)**	**Total net asset (million rand)**
Agriculture	Medium	100	5	5
	Small	50	3	3
Manufacturing	Medium	200	51	19
	Small	50	13	5
Construction	Medium	200	26	5
	Small	50	6	1
Catering, accommodation & other trade	Medium	200	13	3
	Small	50	6	1

Source: DTI, (2008)

For the purpose of this study, a small-scale farmer is a farmer whose operations are classified as such by DALRRD and classified as an SME by the DTI. The definition is also adopted by Statistics South Africa.

Small-scale farmers are unable to embrace new farming technologies due to lack of finance. Insufficient access to formal credit is the main blockage in development. Small-scale farmers have restricted access to credit from formal institutions since the products and services offered by the formal financial institutions to the small-scale farmers do not necessarily meet their needs. In an attempt to address the above challenge, government has set up the Land and Agricultural Bank of South Africa (Land Bank). In South Africa, the Land bank is the single development finance institution that is dedicated towards agriculture and rural development (Land Bank, 2011).

Agriculture is a vital part of the South African economy, contributing to food security, job creation, poverty reduction, and the gross domestic product of the country (GDP) (Mayowa, 2015). Over the past two decades, other economic sectors of South Africa have grown at a faster pace than the agricultural sector. The agricultural sector's contribution dropped from more than 7% in the 1980s to just 2.2% in 2019 (Stats SA, 2020). The agricultural sector contribution to the GDP has experienced the biggest decline since 1967 compared to other primary sectors in South Africa. While primary agriculture's contribution has declined, it still remains a critical sector in providing inputs for the manufacturing sector, job creation and food security. The table 1.2 below illustrates the percentages that the various primary sectors in South Africa have contributed to GDP of the country.

Table 1.2: Sectoral contributions to the GDP of South Africa since 1967

Period	Agriculture	Mining and quarrying	Wholesale & retails trade, catering, accommodation	Manufacturing	Other
1967-1970	7.50	9.83	22.18	14.38	44.47
1990-1994	4.60	8.00	12.34	14.20	60.62
1995-1999	2.90	6.86	10.74	13.90	64.62
2000- 2004	2.10	7.82	11.36	13.98	63.30
2005- 2007	2.20	8.03	10.97	13.80	64.27

2008 -2010	2.40	9.06	15.20	14.20	58.60
2011- 2013	2.00	9.27	14.87	13.07	60.39
2014-2016	2.10	8.13	14.90	13.43	61.14
2017-2018	2.30	8.20	15.00	13.40	60.71
2019- 2020	2.10	7.90	15.07	13.34	61.49

Source: Stats SA (2020)

The decline by the agricultural sector is due to the sector being sensitive to changing climatic conditions and the significant variations in the exchange rate over the years (Tregurtha, Vink and Kirsten, 2010).

South Africa is unquestionably blessed with vast acreages of agricultural farmland as well as topographical characteristics that favour agricultural output all year round. The South African agricultural sector is dualistic, with large-scale commercial and small-scale producers coexisting. Farms that are well-equipped and developed, as well as cutting-edge production technologies, make up the commercial agricultural industry. This sector covers a production area of about 86 million hectares and produces the majority of agricultural output of South Africa (Tregurtha et al, 2010). The small-scale sector covers over 17 million hectares of agricultural land and their farms are located typically in the former homeland areas of South Africa (Tregurtha et al, 2010).

Over the past fourteen years, South African agricultural debt has increased by about 80%, from R31 827 million in 2004 to R169 065 million in 2018 (RSA, DALRRD, 2018). The increase in agricultural debt is caused by a strong reliance on credit to finance capital investments, such as machinery, vehicles, livestock, implements and land (RSA, DALRRD, 2018). Farmers must deal with market risk as well as environmental issues like weather, making agriculture a risky industry. This puts the agriculture industry at a disadvantage when competing for scarce financial resources with other industries (Mudhara, 2010). More than 60% of small-scale farmers indicated that they received start-up capital from informal financial institutions and just above 5% had access to credit services from the formal financial sector (Machethe, Moyo, Mahlati, Vink and Coetzee, 2011). A large number of small-scale farmers are perceived as higher risk by financial institutions compared to the commercial farmers as shown by their reluctance to lend to the small-scale sector (Bradstock, 2005; Williams and van Zyl, 2008; and Agricultural Business Chamber, 2011).

Furthermore, the South African agricultural sector is comprised largely of field crop production and livestock (Tregurtha et al, 2010). Moreover, maize is the largest grain plant produced in the country and is produced mostly in the rain-fed areas namely, Mpumalanga, Free State and the North West provinces as shown in figure 1.1. This figure provides a demonstration of regional distribution of the leading agricultural commodities in South Africa. The main agricultural commodities had some changes since 1980s, the total area of maize planting has dropped by around 40% while the production of sugarcane increased by around 25% to a total area of 5 million hectares. This is mainly due to development of new production areas in Mpumalanga and growth of small to medium scale black farmers within the industry. Also, the horticultural industries have shown a rise since the 1990's as results of increased exports (Tregurtha et al, 2010).

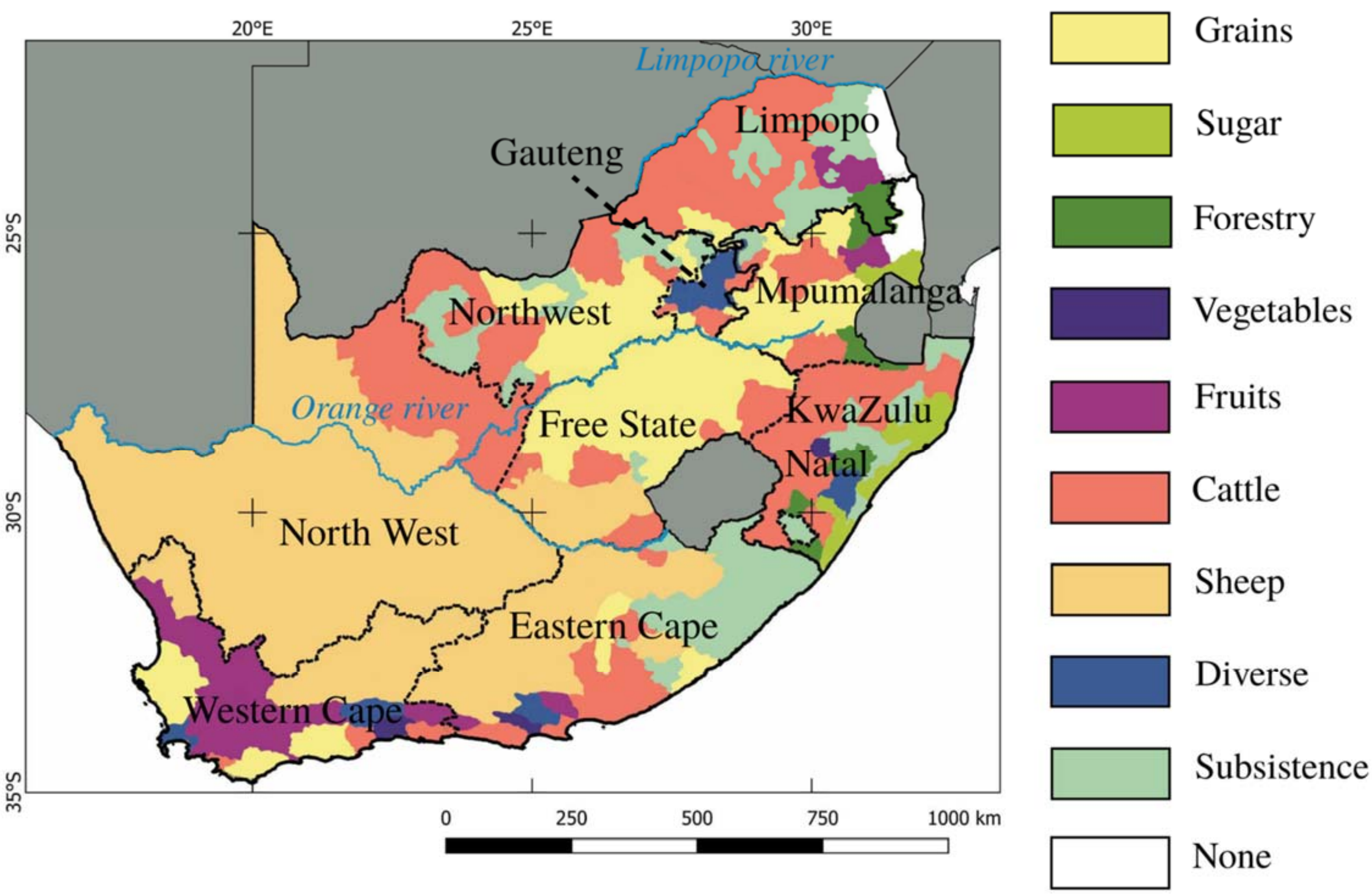


Figure 1.1: Agricultural regions in South Africa

Source: Waldner, Hansen, Potapov, Low, Newby, Ferreira and Defourny (2017)

Although there was a decline in the planted areas for maize, nonetheless the yields increased, indicating increase efficiency in the production methods adopted by farmers (Tregurtha et al, 2010). About 80% of South Africa's livestock sales are supplied from feedlots, primarily because of the feed which gives them a competitive advantage over farmers who depend mainly on grazing, which can be of poor quality particularly in winter or during drought periods (Tregurtha et al, 2010).

In the commercial agricultural sector major changes have been noted, where units of agriculture declined from 60,938 in 1996 to 39,982 farming units in 2007. This decrease in agricultural units was due to the consolidation of the agricultural land into larger units (Tregurtha et al, 2010). The bigger commercial farmers were more interested in this transition because, unlike the smaller farmers, they could benefit from economies of scale. Less productive commercial farmers working on a smaller scale were pushed out of the field and the nearby large-scale commercial farmers purchased the small-scale farms to expand their farming units (Tregurtha et al, 2010). Table 1.3 demonstrates the number of farming units per province from 1996 to 2017. In 1996, the provinces with highest number of farming units were Free State 11 272(18.4%), Western Cape 9 759(16%), North West 7 512 (12.3%) and Limpopo 7 273 (11.9%).

Table 1.3: Number of commercial farming units by province 1996 to 2017

Province	**1996**	**2002**	**2007**	**2017**
Eastern Cape	6338	4 376	4 009	4 214
Free State	11 272	8 531	7 482	7 951
Gauteng	2 342	2 206	1 804	2 291
KwaZulu-Natal	5 037	4 038	3 584	3 103
Limpopo	7 273	2 915	2 947	3 054
Mpumalanga	4 675	5 104	3 535	2 823
North West	7 512	5 349	4 921	4 920
Northern Cape	6 730	6 114	5 131	4 829
Western Cape	9 759	7 187	6 666	6 937
Total	**60 938**	**45 818**	**39 982**	**40 122**

Source: Stats SA (2017)

According to Stats SA (2017), the total number of agricultural units engaged in commercial farming in 2017 amounted to 40 122. In the same year, the province with the largest number of farms was the Free State with 7 951 farms (19.8%), followed by the Western Cape 6 937 (17.3%), North West 4 920

(12,3%) and the Northern Cape 4 829 (12%) while Gauteng 2 291 (5,7%), Mpumalanga 2 823 (7,0%) and Limpopo 3 054 (7,6%) were the provinces with the lowest number of farms. The largest proportion of farms were engaged in farming livestock 33,9% followed by mixed farming 31,1% and field crops 21,3% (Stats SA, 2017).

1.2. Small-scale sector in South Africa

In South Africa, small-scale agriculture is practiced mostly in remote rural areas of the former homelands, in townships and cities. The farming sector operations are typically located within South Africa's former homeland areas where they occupy more than 17 million hectares of agricultural land (Tregurtha et al, 2010). The importance of small-scale agriculture in South Africa cannot be ignored for numerous reasons such as contribution to economic growth, food security, poverty eradication and rural development (Machethe, 2004).

In addition, small-scale farming plays a key role in improving the standard of living among the rural poor. The development of small-scale farming can lead to a speedy rate of poverty alleviation, by raising the incomes of rural farmers and decreasing the cost of food, and consequently lessening income inequality (World Bank, 2008). In support of the same view, Makhura (2001) stated that development of the small-scale sector is critical for the economic and social transformation of the rural economy and the agricultural sector as a whole. The development of rural incomes through agricultural production has the potential to drive demand for inputs, as well as consumer goods and services via the sector's solid backward and forward linkages that agriculture has with the rest of the economy. Despite the importance of small-scale farming for household food security, its productivity is low (RSA, DALRRD, 2012). To ensure long-term food security, small-scale farmers must significantly raise their productivity. This can be achieved by encouraging small-scale farmers to pursue viable increases in production through improved inputs, among other things.

In South Africa, the small-scale industry has a number of challenges that limit its potential to grow and contribute to the economic growth of the country. Lack of credit, lack of access to land, and a lack of physical and institutional infrastructure are just a few of the challenges they face (RSA, DALRRD, 2012). The lack of assets, information, and access to services makes it difficult for small-scale farmers to participate in potentially lucrative marketplaces. Small-scale farmers usually receive limited technical support and regularly have low productivity as a result of shortage of investment in enriched soil and seeds replacement (WIEGO, 2014). Small-scale farmers require a wide range of support services in order to boost production and participate meaningfully in large-scale commercial agriculture. Credit facilities, transportation services, irrigation development, training, and market information are examples of support services. Building dynamic unions and cooperatives, as well as increasing chances for farmer education, will require institutional backing (Lahiff and Cousins, 2005).

Another substantial constraint identified for small-scale farmers is the shortage of human capital. The farmers are typically illiterate with poor technological skills, which can become severe impediments in accessing valuable technological information from formal institutions. According to DALRRD (2012) poor production knowledge leads to poor quality in production. Moreover, Waweru (2016) debated that the reason for such low productivity and efficiency from small-scale farmers is due to financial illiteracy, shortage of credit and lack of acceptable collateral to use when applying for finance in financial institutions. Because many farmers lack marketing and financial abilities, they are unable to meet the high quality criteria imposed by fresh produce markets and food processors.

The financial constraint on small-scale farmers has been extensively documented in the literature. In South Africa, the factors of production that inhibit growth for small-scale farmers are in effect embedded in financial constraints. Due to high risk and high costs, formal financial institutions have been unable to meet the effective demand for small-scale farm finance (Pissarides, 1999; Spio, 2002; Spio, 2003; Okurut, Banga and Mukungu, 2004). Large financial institutions were prevented from financing the small-scale farmers due to lack of information (Spio, 2003). The formal finance institutions generally provide the small-scale farmers with savings and transactional products. Agricultural lending to small-scale farmers continues to be least, with only 5.6% of farmers in 2010 having access to credit products from formal finance institutions in South Africa (Machethe et al, 2011).

In many developing countries, access to credit for small-scale farmers remains a problem. This is demonstrated by the trend of bank credit provided to South African small-scale farmers, both before and after the democratic South Africa was established. According to Chisasa and Makina (2012), the credit extended to the small-scale farmers have been far lower compared to credit extended to commercial farmers for the period ranging from 1986 to 2009. Commercial farmers' credit has increased from R7bn in 1988 to R40bn in 2009 while credit to the small-scale sector only increased from R5bn in 1988 to R12bn in 2009. The commercial debt even increased further to R101bn in 2018 (RSA, DALRRD, 2018).

Ortmann and King (2007) mentioned that small-scale farmers in rural areas of South Africa have inadequate access to factors of production including credit and information. Markets are often constrained by insufficient property rights and high transaction costs. Regardless of these difficulties, some small-scale farmers have been able to produce food for selling and own consumption. The financial constraints that are encountered by the small-scale farmers have been well documented in the literature and they can generally be summarised into high transaction costs, high risk, liquidity, lack of collateral, poor record keeping and poor financial management.

1.3. Overview of the significant credit providers to the agriculture sector in South Africa

There have been some significant shifts in the dominance of private institutions in the supply of agricultural finance in South Africa between 2000 and 2019. Figure 1.2 illustrates the trend in the total farming debt composition for the period of 1999 to 2019. Between 1999 and 2003, the largest financiers to the agricultural sector were commercial banks (43.38%), this is followed by the Land Bank (28.42%), agricultural cooperatives (15.38%), other (10.62%) and DALRRD (2.2%). There have been substantial changes in terms of large contributing lending institutions, while the aggregate agricultural debt has continued to climb significantly over time. The contributions between 2009 and 2014 were as follows; commercial banks (58.9%), Land Bank (22%), agricultural cooperatives (10.8%), other (8%) and DALRRD (0.3%). Between 2015 and 2019, the commercial banks increased further their market share from 58% in 2009 and 2014 to 64% in 2015 and 2019 and Land Bank followed at 29.5%. A number of agricultural cooperatives in South Africa are involved in credit lending. The main ones are Senwes, Kaap and Agri Afgri. The contribution of the agricultural cooperatives in agriculture finance has been increasing since early 70’s where it increased from 20% contribution to 23% in 1985. Nevertheless, after 1990 their contribution has been declining every year. The decline in the participation of agricultural cooperatives was attributable to the abolition of the influence of the marketing boards that controlled agricultural sector prices (Chisasa and Makina, 2013).

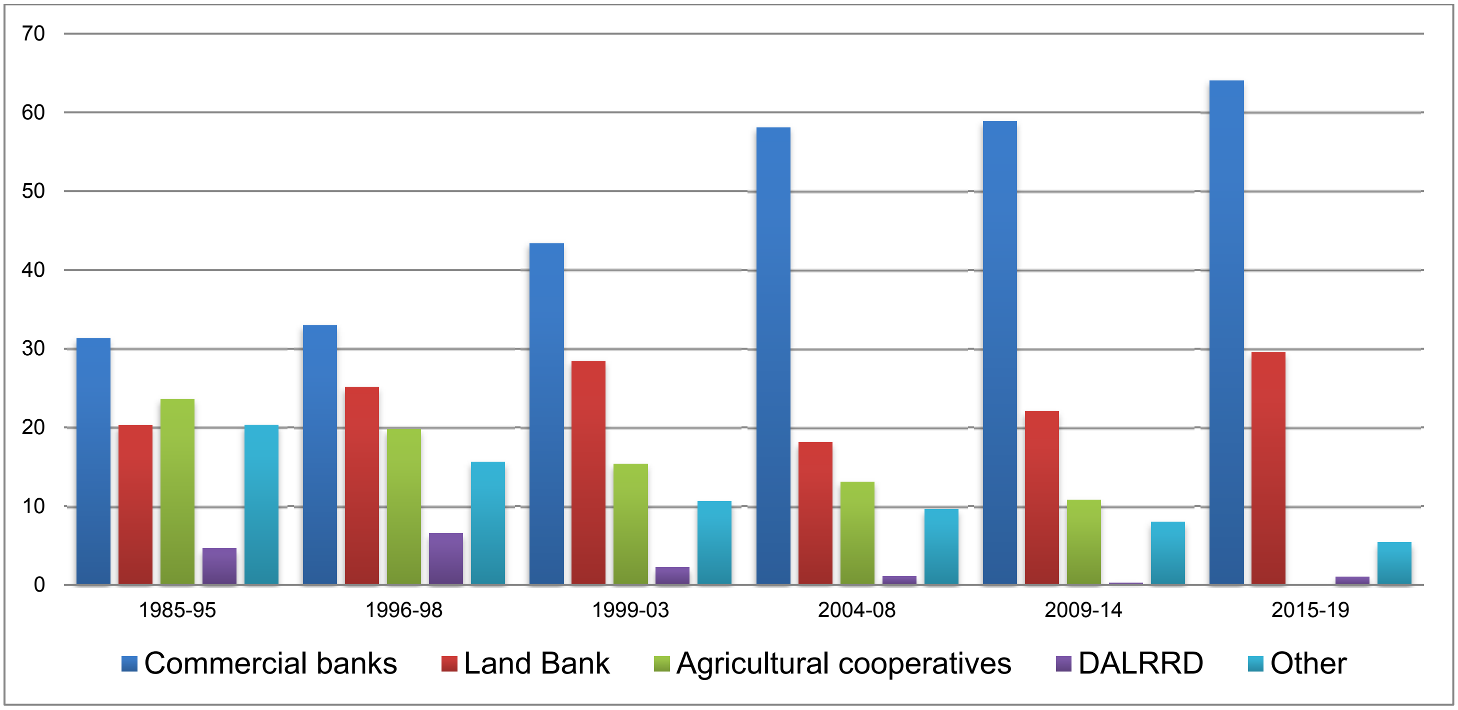


Figure 1.2: Total farming debt

Source: RSA, DALRRD (2019)

According to DALRRD (2019), The greatest source of farming debt owed by the agriculture industry was commercial banks (R101.47 billion), followed by the Land Bank (R48.83 billion) and agricultural cooperatives (R12.18 billion). Small-scale farmers receive only a small percentage of the funds. Farmers are nonetheless under pressure to produce appropriate collateral to get loans from formal financial institutions, despite the fact that lending to the agricultural sector has continuously expanded over time.

1.3.1. Commercial banks

In many developed and developing countries, the commercial banking sector remains the main provider of finance to SMEs (Zhou, 2009). It is then of high importance that the commercial banking sector develops efficient and viable ways of extending credit to the SME sector. According to Essang and Olajide (1974) a commercial bank is a financial institution belonging to either private individuals or government for the purpose of making profit. In chasing of the profit, the bank carries out several functions. One of these functions is the receipt of deposits from the public; the deposits are then lent out as credit to economic sectors, which result in increased production and employment.

As of 31 July 2019, there were 19 operating commercial banks and 15 local branches of foreign banks in South Africa, and also 4 mutual banks and 30 representative offices of foreign banks. The

South African banking industry is dominated by four key players; namely, Standard Bank of South Africa (SBSA), the Amalgamated Bank of South Africa (ABSA), First National Bank (FNB) and Nedbank, and these banks combined account for about 85% of the sector's total assets (Akinboade and Kinfack, 2014). Usual forms of bank credit comprise of overdraft facilities, term loans, revolving loans, leasing, export and import financing and instalment sale finance (Uchida, 2011). Nonetheless, all these financial services and products need necessary documentation from SMEs, but due to information asymmetry the bulk of SMEs in South Africa fail to meet the criteria employed by commercial banks for client screening. Regardless of the fact that profit maximisation is the primary objective of commercial banks, they perceive SME financing as risky due to lack of collateral and default risk (Steijvers and Voordeckers, 2008). In an effort to reduce risks, banks then minimise loan approvals for SMEs.

Despite all the challenges faced by commercial banks in lending to the agriculture sector, there has been notable growth in small-scale agricultural financing by commercial banks in South Africa. This is mainly because financial institutions are becoming more aware of the need to improve credit assessment procedures and have implemented models for managing default risk in credit portfolios (Bandyopandhyay, 2007; Salame, 2011), and also the rise in demand for credit by small-scale farmers (RSA, DALRRD, 2018). Since the 1980s, commercial banks have played a bigger role in agricultural financing (Du Randt and Makina, 2012). In both developing and developed countries, an enormous body of literature has documented the important role of commercial bank credit in generating growth in SME, for instance Schumpeter (1911) believes that the banking sector fast tracks economic growth due to its role as a financier of productive projects.

1.3.2. The Land and Agricultural Development Bank of South Africa

In numerous developing countries, the government tries to find means to intervene in addressing the problems confronting farmers in acquiring agricultural financing. The Land Bank is the only development finance agency in South Africa dedicated to agricultural and rural development (Land Bank, 2011). The Land and Agricultural Bank of South Africa (Land Bank) is a government-owned bank in South Africa that was established in 1912 as a development financing institution by the then-government of South Africa. In the 1950's, the Agricultural Credit Board (ACB) was established to provide financial services to farmers who were perceived credit unworthy by private financial institutions (Ndlovu, 2013). The Land Bank is mandated under the Land and Agricultural Bank Act (Act No.15 of 2002) to, among other things; assist small-scale farmers in acquiring agricultural land, boosting farm productivity and profitability, and promoting entrepreneurship in agriculture. The overall goals are to grow the agricultural sector (both small and commercial), create jobs and leverage rural development and food security initiatives to promote overall development (Land Bank, 2011).

The purpose of the Land Bank is to provide suitable products and services to both commercial and small-scale farmers, to attract private sector investment into the sector, and to develop financing approaches that lessen the market and weather-related risks that farmers face (Land Bank, 2011). The Land Bank formed a business model comprising of four components. These include Retail Emerging Markets (REM); Retail Commercial Banking (RCB); Business and Corporate Banking (BCB) along with the Land Bank Insurance Company (LBIC). In 2015, the business model was restructured into two components being the Corporate Banking & Structured Investments and Commercial Development & Business Banking (Land Bank annual report, 2016). The bank offers products by means of direct lending and indirect lending through service level agreement partners. The bank has also established a wholesale financing facility to broaden its lending to agricultural cooperatives and agri-business that are positioned towards small-scale farmers. The bank provides production loans and special mortgage loans with lowered interest rates as a way of supporting government attempts to increase access to land and provide financial support to small-scale farmers (Land Bank annual report, 2019).

The small-scale farmers were left without access to credit as many parastatal credit institutions have collapsed due to agricultural transformation in the country (Lefophane, Belete and Jacobs, 2013). As a result, the Land Bank was expected to expand its scope to cover small-scale farmers and other farmers from the collapsed financial institutions in the previous homeland. The Land Bank was then established to fill in this gap as the country's primary formal agricultural credit institution (Machethe, 2004). The Land Bank has successfully met the needs of small-scale farmers, However, the majority of small-scale farmers continue to be denied credit by this bank (Machethe, 2004).

1.3.3. The Department of Agriculture, Land Reform and Rural Development

The DALRRD have been actively seeking ways to address the problem of credit availability among the small-scale farmers in South Africa. In 2004, DALRRD established the Micro-Agricultural Finance Institutions of South Africa (MAFISA) with the purpose of channelling credit to small-scale farmers in order to stimulate small-scale agricultural development (Tregurtha et al, 2010). MAFISA is intended to provide financial support to small and emerging farmers in order to warrant the expansion of small, medium, and micro enterprises (SMMEs), thereby contributing to job opportunities in rural areas. MAFISA provide loans to enhance agricultural activities for the purchase of production inputs, livestock, farming equipment and implements (Tregurtha et al, 2010).

Also in 2004, DALRRD implemented the Comprehensive Agriculture Support Programme (CASP). CASP is a one-time grant that aims to help small-scale farmers compete in a market dominated by commercial agribusinesses. The CASP funds are typically utilized for large-scale infrastructure projects such as irrigation systems, warehouses, and poultry houses. Farmers apply once a year, and the grants are provided for a five-year term (Greenberg, 2010). DALRRD also runs the Ilima/Letsema grant which provides production inputs to substance and small-scale farmers to encourage optimum production in all agricultural projects (RSA, DALRRD, 2015).

1.4. Research problem statement

Small-scale farmers in South Africa confront various constraints that limit their capacity to grow and contribute to the economy as effectively as commercial farmers. Lack of credit, land access, and physical and institutional infrastructure are among the challenges they encounter (RSA, DALRRD, 2012). Credit is considered to be one of the most important aspects of agricultural productivity. Modern farm technologies require credit in order to purchase improved farming inputs (Umoren, Edet and Sunday, 2014). Small-scale farmers are credit constrained in South Africa and despite the importance of the sector, their output is low (RSA, DALRRD, 2012), does lack of availability of credit contributes to this low productivity? Could access to bank credit help in raising the low agricultural productivity? These empirical questions have not yet been dealt with conclusively in South Africa but partly discussed in the literature. The study aims to establish whether or not bank credit is an effective tool for generating higher agricultural output for small-scale farmers in South Africa. Empirical studies reveal an emerging conclusion showing a strong link between bank credit and productivity. Therefore, it is argued that improvement in the level of agricultural performance can be accomplished by implementing new production technology, in which improved access to agricultural credit is a prerequisite to gain access to such technology especially for the small-scale farmers.

Though literature has emerged on the effect of bank credit on agricultural output (Fenwick and Lyne, 1999; Chisasa, 2015; Mdoda, Meleni, Mujuru and Alaka, 2019). There appears to be a research gap in small-scale farmers in South Africa. According to our knowledge, only two studies by Chisasa and Makina (2013) and Chisasa (2015) have attempted to investigate the impact of bank credit on the agricultural output of small-scale farmers in South Africa. Chisasa (2015) only focused on the North West and Mpumalanga provinces, while Chisasa and Makina (2013) focused on total farm credit (both smallholder debt and commercial farm debt) from all financial institutions as an independent variable to total agricultural output. Both studies used the OLS technique, and the current study intends to use the VECM. The current study is more relevant as it spans from 1978 to 2020 (42 years). The current study only concentrates on South African small-scale farmers and intends to analyse their relationship between bank credit and agricultural output at a national level with the aim of adding to the few existing empirical studies.

1.5. Research questions

The study intends to provide answers to the following questions;

1) Is bank credit an important tool for increasing output of small-scale farmers in South Africa?
2) What is the impact of capital investment on the agricultural output of small-scale farmers in South Africa?

1.6. Research objectives

The main objective of this study is to assess the impact of agricultural credit on the agricultural productivity of small-scale farmers in South Africa. The specific objectives to be achieved by the study are:

1) To empirically determine the impact of bank credit on the agricultural output of small-scale farmers in South Africa.
2) To determine the impact of capital investment on the agricultural output of small-scale farmers in South Africa.

1.7. Hypothesis

H_0: Bank credit has no positive and significant impact on agricultural output in South Africa.

H_1: Bank credit has positive and significant impact on agricultural output in South Africa.

1.8. Significance of the study

The South African government is interested in finding strategies to promote and develop greater agricultural production and output in the small-scale farming sector. This is because employment creation, poverty reduction, and food security are all top priorities for the government (Machethe, 2004). According to Stats SA (2020), South Africa is currently experiencing high levels of unemployment and poverty rate. The non-agriculture private sector has been unable to create enough employment in the economy. The study is of national significance in South Africa, for the following two reasons. First, the agricultural sector contributes about 10% to formal employment. Despite contributing less than 3% of the South African GDP, agriculture has the highest employment per unit of GDP compared to other sectors (SARB, 2020). Second, a unit of agricultural output has a greater poverty impact than a unit of output from another economic sector, according to the World Bank (2008).

The small-scale agriculture sector has been identified as a weapon that can be used to fight unemployment and poverty. With increased access to bank credit, small-scale farmers have a role to play in bettering this situation. As a result, this study examines the long and short-term effects of bank credit on the agricultural output of small-scale farmers in South Africa. Few studies of this type have been undertaken. The study will also aid in the implementation of agricultural policy and correct analysis, resulting in more sustainable farm producers in the sector, ensuring food security and employment creation in South Africa.

1.9. Organisation of the study

The rest of this study will be organised as follows; Chapter 2 presents the existing theoretical and empirical literature review, Chapter 3 provides the research methodology employed in the study, Chapter 4 discusses the empirical results of the study while Chapter 5 summarises the study and draws relevant conclusions and recommendations based on the findings of this study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

A vast literature on the relationship between bank credit and agricultural output exists with varying and often contradicting views. The purpose of this chapter is to review both theoretical and empirical research on bank credit and agricultural output. It aims to investigate the theories that support this study before reviewing empirical studies on the impact of bank credit on agricultural output and identifying research gaps.

2.2. Theoretical literature review

2.2.1. Neo-classical growth model

The neo-classical model of growth was first originated by Robert Solow in 1956. In the finance-growth literature, bank credit is very important in assisting farmers attain new technology which increases total factor productivity. Bank credit nurtures growth through speeding up investment and a productivity channel. Mackinnon (1973) long argued that even though at times farmers can finance commercial fertilizers costs through their equity, it was a practical impossibility for small farmers to have the total amount needed for investment in new technology. It has also been argued that financial institutions such as the banks are in the better position to identify and assess entrepreneurs and therefore, banks are very likely that they will finance potential entrepreneurs with potential and viable business plans thus increasing the chance of prosperous innovation which accelerate economic growth (King and Levine, 1993).

Neo-classical economists believe that increasing the labour supply and enhancing the productivity of labour and capital will increase the long-term growth rate trend of the economy. Variances in the rate of technological change are said to describe much of the disparity in economic growth between developed countries (Greenwood and Jovanovic ,1990). Neo-classical growth theory positions that labour and capital are the key factors of production (Mankiw, Romer, and Weil, 1992).

$Y = f(K,L)$

Where, Y represents aggregate output,

K represents aggregate capital stock, and

L is the labour force.

If technology (A) is added, then equation becomes:

$$Y= F (K, A, L)$$

Bank credit plays a critical role in acquiring additional capital in this production function. When a new technology is available, the labour and capital need to be adjusted to sustain growth equilibrium. Financial sector services such as credit accessibility impact economic growth through their impact on capital accumulation and technological innovation (Levine, 1997). The capital accumulation channel is key for least developed and emerging countries. In ordinary neoclassical theories investment-savings is the core engine of economic growth. Though these models assume that savings translate straight to investment and consequently finance affects economic growth primarily through capital expansion (Papaioannou, 2007). The factors of production stated by Solow growth model must undoubtedly be utilized in order to boost production in the sector. The provision of bank credit to small-scale farmers allows them to be more productive and efficient, as they will be able to purchase the necessary machinery and pay for labour wages. The Solow growth model shows that the output of small-scale farmers has a positive relationship with the other variables.

2.2.2. The finance led growth theories

Schumpeter (1911) was the first academic to publish that financial progress could contribute to economic growth. It is a theory that originated on the concept that financial development acts as a facilitator of economic growth. He believed that efficient allocation of savings through funding of entrepreneurs, who have viable and sound business plans of fulfilling innovative products and production processes, is the most effective way to realise economic growth. Several scholars thereafter (Mckinnon 1973, Shaw 1973, King and Levine 1993) have supported the above notion about the importance of banks to the growth of the economy. Schumpeter (1911) debated that a well-functioning financial system facilitates technological innovations by distributing resources proficiently from unproductive to productive sectors of the economy.

Hypothetically, the positive effect of financial intermediaries on economic growth can be through two methods: the capital accumulation method and the productivity method. In the first method, the financial sector acts as mediator to mobilize savings to the productive sector, which will increase capital accumulation and output growth. In the second method, the financial sector plays a key role in financing innovative activities, which are important to boost economic productivity and thus accelerate economic growth (Schumpeter, 1911). He specially stresses the role of the banking sector as a fast tracker of economic growth because of its role as a financier of productive projects. Provision of bank credit to the small-scale farmers would positively affect the output of small-scale farmers.

McKinnon (1973) and Shaw (1973) have also stressed out the role of financial intermediaries and financial markets in the growing of the economy. McKinnon (1973) and Shaw (1973) debate that financial development is essential for economic growth. They indicate that financial development can positively affect growth via its impact on saving and investment. The McKinnon model assumes that investment in a usual developing economy is typically self-financed; investment cannot materialize unless sufficient saving is accumulated in the form of bank deposits (McKinnon, 1973). Moreover, Shaw (1973) has hypothesised that financial intermediaries stimulate investment and raise output growth via borrowing and lending.

2.2.3. Information asymmetry

The concept of asymmetric information was first presented through Lemons Theory which was developed by George Akerlof in 1970 (Ata, Korpi, Ugurlu and Sahin, 2015). The theory has since been studied in various contexts including labour, insurance, loan and capital markets. The theory of asymmetric information is concerned with splitting worthy borrowers from unworthy ones which arises due to adverse selection and moral hazards problems. Asymmetric information in credit markets occurs as a result of failure by lenders and borrowers to interchange complete and correct information amongst each other (Ata et al., 2015).

Many small, medium, and micro enterprises (SMMEs) are unable to provide prospective lenders with precise, up-to-date, and trustworthy information, resulting in asymmetric information in credit markets. Audited financial accounts, bankable company plans, and feasibility studies, to name a few, all contain this information. Only SMMEs, according to Stiglitz and Weiss (1981), know their genuine financial structure, the actual intensity of the investment project, and the vital desire to repay the debt. This implies that firms have access to higher-ranking, unique data (asymmetric information). As a result, the finance manager makes judgments based on incomplete and imbalanced information and operates under the danger of moral hazard and adverse selection.

Stiglitz and Weiss (1981), in their credit rationing theory of the financing gap, believe that information asymmetry is one of the key reasons why SMMEs have difficulty obtaining credit. In numerous theoretical literatures, it is debated that the presence of asymmetric information between financial institutions and borrowers results in difficulties of adverse selection and moral hazard which eventually impede the performance of credit markets (Stiglitz and Weiss, 1981). Adverse selection arises when a borrower with a high credit risk and low credibility is willing to borrow a loan at a higher interest rate (Ata, Korpi, Ugurlu and Sahin, 2015). Whereas, moral hazard is an ex-post problem that arises when borrowers do not use the funds for the designated purpose as a result of information gathered and on the terms of the contract. It is clear that banks are confronted with difficult decisions when it comes to financing small-scale farmers.

This emanates from the fact that the availability of information, which is a determining factor of the lending decision by funding institutions, is of crucial importance to the financing transaction (Harvie, 2011). This information enables the funding institution to assess the risk-return profile of the loan application and hence set the level and terms and conditions of credit to be extended to the borrower (Maziku, 2012). The absence of this information means that the creditworthiness of a borrower cannot be established and thus the ability of the borrower to pay back the loan cannot be determined. This results in credit rationing by funding institutions which impacts negatively on SMMEs access to credit. Credit constrained individuals are those whose participation in the credit market is limited as a result of asymmetric information (Maziku, 2012). The problems of adverse selection and moral hazard make it difficult for banks to provide the small-scale farmers with credit. These problems negatively affect the output of small-scale farmers.

2.3. Empirical literature review

In this section, existing empirical literature on the role of bank credit on agricultural output is explored. The studies reviewed below are grouped by countries; firstly, least developed countries are discussed, followed by developing, then developed countries and finally studies that were undertaken in South Africa. Very few studies on the focus of this study have been widely done in many countries; some of the countries are China, India, Nepal, Nigeria, Pakistan, Poland, Tanzania, Tunisia, Turkey, Uganda and Vietnam. A number of studies in different countries have utilised time series analysis to study the role of bank credit on agricultural output. According to the studies reviewed, bank credit has a positive impact on agricultural output.

In the least developed countries, Girabi (2013) assessed the impact of microfinance on agricultural productivity by smallholder farmers in Tanzania with the case study of Iramba district. Primary data from 98 respondents' credit beneficiaries and non-credit beneficiaries was obtained. The study employed descriptive statistics and OLS technique. The result showed that credit beneficiaries had high agricultural productivity compared to the non-credit beneficiaries' respondents. This may be attributable to the fact that the credit beneficiaries were able to access markets for agricultural commodities, use of inputs and embracing of enhanced farming technologies whereas non-credit beneficiaries are limited to this mentioned means of production. Non-credit beneficiaries are restricted to their production means as they do not receive any credits. The study highlights lack of information by smallholder farmers, inadequate credit supply, high interest rates and defaulting as key.

Rimal (2014) analysed the impact of commercial banks' agricultural credit on agriculture gross domestic product (GDP) in Nepal by using annual secondary data from 2002 to 2012. The study applied the OLS technique to estimate the Cobb-Douglas production function, empirical findings showed that agricultural credit flow of commercial banks during the study period positively and significantly impacted Nepal's agricultural GDP. The study did not investigate the short run and long term effect of the commercial bank's credit on Nepal's agricultural GDP. Results show that variables such as fertilizers and improved seeds had positive but insignificant impact on agricultural production. Hence, the study suggests that increasing availability of agricultural credit of commercial banks has positive impact on improving agricultural production in the farming country like Nepal.

Florence and Nathan (2020) studied the effect of commercial banks' agricultural credit on agricultural growth in Uganda using quarterly time series data from 2008Q3 to 2018Q4. The study analysed the influence of commercial bank's credit to different value chain segments (production, processing and market) on agricultural output of Uganda. The variables of this study included commercial bank credit to agriculture sector, commercial bank agriculture credit that specifically goes to production, commercial bank agriculture credit that specifically goes to processing and marketing. Employing the Autoregressive Distributed Lag (ARDL) to analyse short run and long run effects of the commercial banks' credit on agricultural sector growth, the study found that in the long run, credit has significant positive impact on agricultural output. Credit to production was found to have a much higher impact on agricultural output in comparison with credit to processing and marketing. The study found that in the short run, credit has negative impact on the agricultural output. The study found that commercial banks' credit plays a positive role in agricultural GDP performance in the long run. The results also point to the fact that credit to production has a higher impact on agriculture GDP than credit to processing and marketing.

Among the several studies conducted in developing countries on the impact of bank credit on agricultural output, many display diverse results. Some of the reviewed literature are Foltz (2004), Senapati, and John (2009), Ammani (2012), Duy (2012), Obilor (2013), Agunwa, Iyanya and Proso (2015), Faridi, Chaudhry and Tahir (2015), Narayanan (2015), Chandio, Yuansheng, Sahito and Larik (2016), Udoka, Mbat and Stephen (2016), Ahmad, Chani and Afzal (2018), Emenuga (2019), Medugu, Musa and Abalis (2019).

Foltz (2004) carried out a study on rural smallholder farmers in Tunisia, econometric estimates were run for agricultural investment and profitability as a function of credit access. The results revealed that the existence of credit market constraints does impact significantly on farm profitability, but not on investments. Moreover, additional increases in the amount of credit received had a direct positive effect on profitability of farms bound by liquidity constraints, whereas there was no such effect for farms with no liquidity constraint (Foltz, 2004). Although credit is an influential feature in profits and investment, market failures such as labour, land and transportation problems overpower the influence of credit (Foltz, 2004). Das, Senapati, and John (2009) examined the effect of agricultural credit on agriculture production in India employing annual secondary time series data spanning from 2001 to 2006 in India. Using Arellano–Bond regression in 1991, the study found that the amount of agricultural credit has a positive and statistically significant impact on agriculture production and that the impact can be detected instantly.

Furthermore, in Pakistan, several studies found positive and significant effect of bank credit on agricultural output. Chandio, Yuansheng, Sahito and Larik (2016) investigated the impact of formal credit on agricultural output in Pakistan by using annual secondary data from 1996 to 2015. The Johansen co-integration test results indicated that a long run relationship between formal credit and agricultural output exists. The findings revealed that formal credit has a significant positive impact on the agricultural output in Pakistan. Likewise, Ahmad, Chani and Afzal (2018) empirically assessed the long run relationship between formal credit and agricultural output in Pakistan. Using the ARDL bound testing approach on annual time series data from 1973 to 2014, the findings of the study indicated a proof of long-run positive and significant relationship between agriculture credit and agricultural output. The study suggests that lengthy formal credit procedure, political and bureaucratic influence and misallocation of credit utilisation are major constraints in lowering overall agriculture output.

Opposing the findings of the studies reviewed on Pakistan above, Faridi, Chaudhry and Tahir (2015) empirically examined the effect of institutional credit on agricultural productivity in Pakistan using Vector Error Correctional Model (VECM) approach and annual time series data for the period 1975-2012. The results indicate that the institutional credit is insignificant but positively impacts the agriculture productivity. The new and costly agriculture inputs of tube wells, fertilizers, pesticides and seeds positively influence agricultural productivity.

Ammani (2012) applied the OLS method to investigate the relationship between agricultural production and formal credit supply from 1981 to 2009 in Nigeria. The study found that formal credit had a positive influence on productivity of crops, livestock and fishing sectors. Agunuwa, Iyanya and Proso (2015) assessed the impact of commercial banks' credits on agricultural productivity in Nigeria using OLS technique. The study covered a period from 1980 to 2013, variables used were commercial banks' credit to the agricultural sector, interest rate on commercial banks' credit to agriculture and government spending on the agricultural sector. The OLS results revealed that commercial banks credit and government expenditure have positive and significant effects on agricultural productivity whereas interest rate has negative effect on agricultural output.

Likewise, Udoka, Mbat and Stephen (2016) analysed the effects of commercial banks credit on agricultural production in Nigeria by using annual secondary data from 1970 to 2014. The study used OLS technique, the findings revealed that commercial banks' credit, government expenditure on agriculture in Nigeria and agricultural credit guarantee scheme fund exert positive and significant effects on agricultural productivity in Nigeria. There is a negative relationship between interest rate and agricultural output. This is due to the fact that an increase in the rate of interest charged to farmers for funds borrowed will discourage many farmers from borrowing and hence less agricultural investment.

Emenuga (2019) empirically studied the effects of commercial banks' credit and some macroeconomic variables on the performance of the Nigerian agricultural sector using annual time series data from 1981 to 2017. The study employed the Johansen co-integration test and error correction model within the framework of OLS regression estimation. A long run relationship was revealed among the variables. The study also showed that commercial banks' credit to agriculture and agricultural credit guarantee scheme are positively related to agricultural development while interest rate was found to be negatively related to agricultural development in Nigeria.

Furthermore, Medugu, Musa and Abalis (2019) used data from 1980 to 2016 when studying the impact of commercial banks' credit on agricultural output in Nigeria. The variables of this study included commercial banks credit to agriculture, government expenditure on agriculture and interest rate. The co-integration test showed that a long run relationship exists among the variables. The study concluded that both commercial banks' credit to agriculture and expenditure made on agriculture by government are positively related to agricultural output in Nigeria. However, commercial banks' credit has a higher coefficient than government expenditure on agricultural output in Nigeria. A one Naira increase in commercial bank credit to agricultural sector will increase agricultural output value by nearly nine Naira, likewise if government expenditure to agricultural sector is increased by one Naira, it will increase agricultural output value by nearly three Naira. Interest rate is negatively related to agricultural output in Nigeria.

Contrary to the results of earlier studies on Nigeria, Obilor (2013) empirically analysed the credit from commercial banks to agricultural development in Nigeria for the period 1983-2007. Using secondary data and OLS method, the study revealed that commercial banks' credit to agricultural sector had positive but insignificant impact on agricultural productivity in Nigeria. Duy (2012) used the sample of rice farmers in the Mekong Delta of Vietnam to observe the Impact of both institutional and non-institutional credits on a production level and production efficacy of rural rice farmers. The study employed stochastic frontier analysis and quantile regression and found a positive effect of institutional and non-institutional credit on farm output and production efficacy in Vietnam.

In the developed countries, Tomasz (2008) observed the impact of agricultural credit in the development of the agricultural sector in Poland using annual secondary data from 1997 to 2006. Using one-factor ANOVA, Pearson correlations and linear regression; the study found that the agricultural credit by co-operative banks had positive and significant impact on agricultural growth of only two regions amongst country's sixteen regions. No significant relationship was observed on the other fourteen regions. The study established that the most important factors affecting agricultural development in Poland are average farm size and agricultural employment. In China, using survey data for 2008, Dong, Lu and Featherstone (2010) employed probit modelling to evaluate the effects of credit constraints on productivity and credit condition of rural households. The study found that agricultural productivity can be enhanced with increased usage of credit and that households which were credit constrained had lower productivity and the households who were not credit constrained had higher productivity. Simsir (2012) used yearly secondary data from 1970 to 2008 to empirically examine the link between agricultural loans and agricultural revenue in Turkey. The study employed the OLS technique and found that agricultural credit had a positive and significant influence on agricultural income and employment.

In the South African context, Fenwick and Lyne (1999) analysed the importance of liquidity and other constraints inhibiting the growth of small-scale farming in KwaZulu-Natal province. Other constraints include deprived access to land, information costs and high transaction costs. Using primary data sourced from two communal areas of KwaZulu-Natal province where 75 households were sampled in each of the two study areas during 1995/6, the study applied logit model and found that small-scale farmers are sternly inhibited by low levels of liquidity which curb investment in farm inputs, including hired labour. Credit has potential to alleviate the liquidity problems, but due to low incomes the farmers are unable to service debts and to offer collateral when applying for credit (Fenwick and Lyne, 1999). The findings also revealed that access to land, information costs and high transaction costs are significant inhibiting factors.

Furthermore, Wynne and Lyne (2003) investigated the elements that influence the growth of small-scale chicken businesses in KwaZulu-Natal. The study was restricted to finding reasons that deter success among poultry farmers in the province. The study employed a block-recursive regression analysis of data collected from a sample of 123 poultry farmers and the results showed that enterprise growth rate is inhibited by deprived access to credit, high transaction costs and unreliable local markets. Chisasa and Makina (2013) investigated the impact of bank credit on agricultural output in South Africa. The study used annual secondary data from 1970 to 2009 to analyse the impacts of bank credit, capital accumulation along with other control variables on agricultural output. They applied OLS technique to the Cobb-Douglas production function and the results showed that bank credit has a positive and significant impact on agricultural output in South Africa. Other elements of production held constant, increasing credit by 1% results in 0.6% increase in agricultural output. Capital accumulation also has a positive and significant impact on agricultural output, although lower than that of credit, as increasing credit by 1% results in 0.4% increase in agricultural output, other elements held constant.

Chisasa (2015) analysed the effect of credit on smallholder farmers agricultural output in South Africa, while employing a survey approach with 362 smallholder farmers from North West and Mpumalanga provinces. The study applied the OLS technique to estimate the Cobb-Douglas production function with agricultural output as the dependent variable and bank credit, land, labour and rainfall as the independent variables. The results indicate that an equilibrium relationship exists between the variables. With other conditions held equal, the study found that an increase in short-term credit leads to an increase in agricultural production, while long-term credit enhances agricultural output more than short-term credit. Farmers use the long term credit to purchase capital equipment, such as tractors, harvesters, and short term credit for working capital and inputs. Labour and rainfall were found to be insignificant although positive, but they were instrumental in agricultural production.

Mdoda, Meleni, Mujuru and Alaka (2019) used primary and secondary data for 2015/16 and 2016/17 seasons, sampling 300 farmers and empirically examined the effects of agricultural credit on smallholder crop farmers' input utilisation in the Eastern Cape province, South Africa. The study employed logistic model and found that agricultural credit has a significant impact on input use as well as realisation of smallholder crop farmers in the Eastern Cape province. Smallholder farmers who have access to financing will be able to purchase additional inputs for use on their fields, resulting in increased output.

2.4. Literature gap

Most of the studies reviewed concentrate on agriculture output as a whole, which includes large commercial farmers. According to our knowledge, apart from the studies by Chisasa and Makina (2013) and Chisasa (2015), no other study has attempted to examine the effects of bank credit on agricultural output of small-scale farmers in South Africa. Chisasa (2015) only focused on North West and Mpumalanga provinces, while Chisasa and Makina (2013) focused on total farm credit (both smallholder debt and commercial farm debt) from all financial institutions as an independent variable to total agricultural output. Both studies used the OLS technique, the study by Chisasa and Makina (2013) covered a period from 1970 to 2009 (39 years). The current study is more relevant as it is spanning from 1978 to 2020 (42 years). The current study only concentrates on South African small-scale farmers and intends to analyse the relationship between bank credit and agricultural output at a national level using the VECM with the goal of supplementing the few existing empirical studies. None of the South African studies used the VECM to analyse the relationship among the variables. The choice of variables, which is guided by the theories, model specifications and the span of time covered also made this study distinct from the other studies.

Thus, the difference between this study and the previous studies reviewed presents the research gap. Table 2.1 presents a summary of the empirical literature on bank credit and agricultural output.

Table 2.1: Summary of empirical literature review

Author(s) and year	Country	Data period	Methodology	Dependent Variables	Independent Variables	Findings
Developed countries						
Tomasz, S (2008)	Poland	annual secondary time series data 1997 – 2006 (9 years)	one-factor ANOVA, Pearson correlations and linear regression	Agriculture development	a) Agriculture loans b) Gross value added in agriculture per employee (in millions) c) Farm area (ha) d) Employment in agriculture (%) e) Farm production per 1 ha (in millions)	The study found that the agricultural credit funded by co-operative banks have statistically significant positive impact on agricultural growth of only two regions amongst country's 16 regions.
Dong, F., Lu, J., and Featherstone, A. M. (2010)	China	Survey data on 511 rural households. 2008	Endogenous switching regression model	Production output	a) Socio-economic variables b) Credit history c) Collateral d) Labour e) Savings	Found that agricultural productivity can be enhanced with increased usage of credit. The study also concluded that households which were credit constrained had lower productivity and the households who were not credit

						constrained had higher productivity.
Simsir, N. C. (2012)	Turkey	annual secondary time series data 1970 to 2008 (38 years)	OLS	a) Real gross national product b) Real agricultural income	a) Agricultural employment (thousands people) b) Agricultural loans	The researcher found that bank Credit showed a positive significant influence on agricultural income and employment. Similarly, the Granger-causality test has shown a significant unidirectional relationship between credit and agricultural output. The causality goes from credit to real agricultural income.
			Developing countries			
Foltz, J. (2004).	Tunisia	Survey data. 1995	Endogenous switching regression model	Agricultural profitability	a) Socio-economic variables b) Total debts owed c) Expenditure d) Agricultural equipment e) Own land	The results have revealed that the existence of credit market constraints does impact significantly on farm profitability, but not on

						investments.
Das, A., Senapati, M and John, J. (2009).	India	annual secondary time series data 2001-2006 (6 years)	Arellano–Bond regression	per capita agriculture output	a) per capita direct agriculture credit amount outstanding b) per capita direct agriculture credit number of accounts c) per capita indirect agriculture credit amount outstanding d) per capita indirect agriculture credit number of accounts e) agriculture area f) rain	The amount of agricultural credit has a positive and statistically significant effect on agriculture production and that the effect can be observed immediately. The indirect agriculture credit also has a positive significant impact on agriculture output, but with a year lag.
Ammani, A. A. (2012)	Nigeria	annual secondary time series data 1981 to 2009 (28 years)	OLS	a) Aggregate output of the crop sector b) Aggregate output of the livestock sector c) Aggregate output of the fishing sector	a) Formal credit to the crop sector in millions b) Formal credit to the livestock sector in millions c) Formal credit to the fishing sector in millions	The author found that formal credit had a positive influence on productivity of crops, livestock and fishing sectors.
Duy, V.Q. (2012)	Vietnam	household survey	Stochastic frontier analysis and quantile	Rice production	a) Area rice b) Seeds c) Fertilizer d) Pesticides	Found a positive effect of institutional and non-institutional

			regression		e) Hired labour f) Hired machinery	credit on farm output and production efficacy in Vietnam.
Obilor, S.I. (2013)	Nigeria	annual secondary time series data 1983 – 2007 (24 years)	OLS	Agricultural Production Output Index	a) Commercial Bank's Credit to the Agricultural Sector b) Agricultural Credit Guarantee Scheme loan by purpose c) Government Financial Allocation to Agricultural sector d) Agricultural Produce Price	The study revealed that commercial banks' credit to agricultural sector had no significant positive impact on agricultural productivity in Nigeria.
Agunuwa, E. V., Inaya, L. and Proso, T (2015)	Nigeria	annual secondary time series data 1980 – 2013 (33 years)	OLS	Agricultural Productivity	a) Commercial banks' credit to the agricultural sector b) Interest rate on Commercial banks' credit to agriculture c) Government spending on the agricultural sector	The OLS results revealed that commercial banks credit and government expenditure have positive and significant effects on agricultural productivity whereas interest rate has negative effect on agricultural

						output.
Faridi, M.Z., Chaudhry, M.O. and Tahir, N (2015)	Pakistan	annual secondary time series data from 1975-2012 (37 years)	VECM	Agricultural output measured in terms of million rupees	a) Total Credit Disbursed by Formal Sources in million Rs b) Agricultural Labour force in millions c) Pesticides Consumption in metric tons d) Fertilizers Take Off in metric tons e) Improved Seed Distribution in metric tons f) Production of Tractors in numbers g) Total Cropped Area in million hectors h) Inflation Index as measured by GDP deflator i) Water Availability j) Number of Tube-wells	The results indicate that the institutional credit is insignificant but positively impacts the agriculture productivity.
Chandio,A. A., Yuansheng, J., Sahito, J.G.M and Larik, S, A	Pakistan	annual secondary time series data 1996 – 2015 (19 years)	Johansen co-integration OLS	Agricultural output measured in million rupees	credit disbursement from all institutions in million rupees	The Johansen co-integration test results indicated that a long run relationship between formal

(2016)						credit and agricultural output exists. The findings revealed that formal credit has a significant positive impact on the agricultural output in Pakistan.
Udoka, C.O., Mbat, D. O and Duke, S. B. (2016)	Nigeria	annual secondary time series data 1970-2014 (44 years)	OLS	Agricultural output, measured by agricultural gross domestic product in Nigeria.	a) Commercial banks' credit to agricultural sector in Nigeria b) Government expenditure on agriculture in Nigeria c) Agricultural credit guarantees scheme fund d) Interest rate, represented by lending rate	Findings revealed that commercial banks' credit, government expenditure on agriculture in Nigeria and agricultural credit guarantee scheme fund exert a significant effect on agricultural productivity in Nigeria.
Ahmad, D., Chani, M.I. and Afzal, M. (2018)	Pakistan	annual secondary time series data 1973 – 2014 (41 years)	ARDL	Agriculture Output at time (billions rupees)	a) Agriculture Credit at time (m rupees) b) Cropped Area at time (m ha) c) Agriculture Labor Force at time (m) d) Trade Openness at time	The findings of the study indicated a proof of long-run positive and significant relationship between agriculture credit and agricultural

					(measured by the ratio of agriculture exports to agriculture)	output.
Emenuga, P. E (2019)	Nigeria	annual secondary time series data 1981-2017 (37 years)	OLS	Agricultural Productivity at time	a) Commercial banks' credit to Agriculture b) Interest on banks' credit to Agriculture c) Agricultural credit guarantee scheme fund at time	A long run relationship was revealed among the variables. The study also revealed that commercial banks' credit to agriculture and agricultural credit guarantee scheme are positively related to agricultural development while interest rate was found to be negatively related to agricultural development in Nigeria.
Medugu, P. Z., Musa, I and Abalis, E.P (2019)	Nigeria	annual secondary time series data 1980-2016 (36 years)	OLS	Agricultural output	a) Commercial banks credit to agriculture b) Government expenditure on Agriculture c) Interest rate (using lending	The co-integration test revealed that a long run relationship exists among the variables. The result of this study revealed that both

					rate as a proxy)	commercial banks credits to agriculture and expenditure made on agriculture by government are positively related to agricultural output in Nigeria.
Least developed countries						
Girabi, F. (2013)	Tanzania	Primary data 2010 – 2010 (98 respondents)	descriptive statistics and multiple regression analysis	Agricultural production (maize and sunflower)	a) Fertilizer b) Improved seeds c) Tech d) Hire labour e) Land size	The result showed that credit beneficiaries had high agricultural productivity compared to the non-credit beneficiaries' respondents. The study highlights lack of information, inadequate credit supply, high interest rates and defaulting as key
Rimal, N.S (2014)	Nepal	annual secondary time series data 2002-2012 (10 years)	OLS	Agricultural Gross Domestic Product per Cultivated Area	a) Agricultural Credit per Cultivated Area b) Consumption of Fertilizer per Cultivated Area c) Consumption of	Agricultural credit flow of commercial banks during the study period was positively and significantly

					Improved Seeds per Cultivated Area	impacting the agricultural gross domestic production of Nepal.
Florence, N. and Nathan, S (2020)	Uganda	Quarterly time series data 2008Q3 to 2018Q4. (10 years)	ARDL	Agricultural sector GDP contribution to overall country GDP, measured in billion Uganda shillings	a) Commercial bank credit to agriculture sector b) Commercial bank agriculture credit that specifically goes to production c) Commercial bank agriculture credit that specifically goes to processing and marketing d) Quarterly percentage change in the price of goods and services k) Interest rate (percentage rate at which money is lent out to farmers)	The study found that in the long run, credit has significant positive impact on agricultural output. Credit to production was found to have a much higher impact on agriculture output in comparison with credit to processing and marketing. In the short run, bank credit does not have an immediate impact on the agricultural output. The study found that commercial banks' credit plays a positive role in agricultural GDP performance.
South Africa						

Fenwick, L.J. and Lyne, M. C. (1999)	South Africa	Primary data (150 respondents) 1995-1996	Logit model	Small farmer development	a) Land size (ha) b) Rent c) Liquidity d) Formal savings e) Informal savings f) Family labour g) Visits by an extension officer h) Transaction cost i) Dependency	Authors empirically analysed the importance of liquidity and other constraints inhibiting the growth of small-scale farming in KwaZulu-Natal province. The study found that small scale farmers are sternly inhibited by low levels of liquidity which curb investment in farm inputs.
Wynne, A.T. and Lyne, M.C (2003)	South Africa	Primary data (123 poultry farmers' respondents) 2002-2003	Block-recursive model	a) Credit b) Initial size c) Technology d) Growth rate	a) Group (member or non-member) b) Company (CC or private) c) Liquidity d) Wealth (number of vehicles owned) e) Education of the producer, e.g. diploma f) Experience g) Tenure (tribal land or otherwise) h) Gender i) Transaction	Authors empirically analysed factors affecting the growth of small-scale poultry enterprises in KwaZulu-Natal. The study found that enterprise growth rate is inhibited by deprived access to credit, high transaction costs and unreliable local markets.

					costs j) Utilities (piped water and electricity) k) Local market l) Initial information (from input suppliers or government-extension officers) m) Operation period n) Current information (if provided by extension officers or input suppliers) o) Management (quality created by principal component analysis	
Chisasa, J. and Makina, D. (2013)	South Africa	annual secondary time series data 1970 – 2009 (39 years)	OLS	Agricultural GDP measured in million rands	a) Bank credit disbursed from all institutions in million Rands b) Labour force in millions c) Annual changes in farm fixed improvements, machinery and inventory of livestock in million Rands	The study found that bank credit and capital accumulation has a positive and significant impact on agricultural output.

					d) Annual rainfall in millilitres	
Chisasa, J(2015)	South Africa (North West and Mpumalanga Provinces)	2015 – 2015 (362 respondents)	OLS	Agricultural output	a) Credit b) Labour c) Rainfall d) Land	The results indicate that an equilibrium relationship exists between the variables. The study found that an increase in short credit leads to an increase in agricultural output with other factors constant, but the long term credit increase the agricultural output further than the short term credit.
Mdoda, L., Meleni, S., Mujuru, N. and Alaka, K. O (2019)	South Africa.	Primary and secondary data 2015/ 16 and 2016/17 seasons. 300 farmers sampled.	Logistic model	Agricultural credit	a) Employed labour b) Family labour c) Size of farm d) Funds fluctuation e) Superiority of seeds used	The study found that agricultural credit had a significant impact on input use as well as realisation of smallholder crop farmers in the Eastern Cape province.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter outlines the methodology used in the study to empirically establish the effect of bank credit on the agricultural output of small-scale farmers in South Africa. The chapter is divided into four sections. Section 3.2 specifies the research design of the study, section 3.3 indicates the model specification. Section 3.4 provides data sources and explanation of variables, followed by estimation techniques in section 3.5.

3.2. Research design

The study will be guided by a quantitative research design that focuses on variable quantification and statistical controls. Because time-series secondary data will be used, the study will be classified as quantitative. Quantitative research employs a language of variables and hypotheses and is highly influenced by positivist ideals. The hypothesis presented in the introductory chapter will be put to the test in this study.

3.3. Model specification

For a better understanding of this study, the relationship will be analyzed using the Eviews 9 statistical software, employing five variables. The dependent variable in this study is agricultural gross domestic product (AGDP), while the independent variables are BC (bank credit), CI (capital investment), NL (number of labour), and R (rainfall). The following is the functional form of the model used in this study:

$$AGDP = f(BC, CI, NL, R) \tag{3.1}$$

Where:

AGDP= Agricultural gross domestic product of small-scale farmers measured in billion rands;

BC= Bank credit disbursed to small-scale farmers from all institutions in billion rands;

CI= Capital investment (small-scale farmers' annual changes in livestock, machinery, farm fixed improvements, and inventory are measured in billions of rands);

NL= Number of labour in small-scale farming sector in thousands;

R = Annual rainfall in milliliters.

All variables were transformed into natural logarithmic form to ensure that there is standardisation in the variables and this is shown in equation (3.2). The model is as follows:

$$logAGDP_t = \beta_0 + \beta_1 logBC_t + \beta_2 logCI_t + \beta_3 logNL_t + \beta_4 logR_t + \varepsilon_t \quad (3.2)$$

β_0 is the intercept;

't' is the time trend, in this case from 1978 to 2020;

'$\mathcal{E}$' is the random error term;

β_1- β_4 are the slope coefficients.

On *a priori*, it is expected that bank credit, capital investment, number of labour will positively affect agricultural gross domestic product while annual rainfall will either affect agricultural gross domestic product positively or negatively.

Table 3.1: Expected signs of the variables

Variable	Expected sign	Theory
BC	+	The neo-classical model of growth shows a positive relationship between bank credit and output.
CI	+	The neo-classical model of growth shows a positive relationship between capital investment and output.
NL	+	The neo-classical model of growth shows a positive relationship between labour and output.
R	+/-	Faures, Bernardi and Gommes in 2010

Source: Author compilation

3.4. Data sources and explanation of variables

The study employs annual secondary time-series data for the period 1978 to 2020, making 43 observations. Data is sourced from Statistics South Africa (StatsSA), the Department of Agriculture, Land Reform and Rural Development (DALRRD), the Land and Agricultural Bank of South Africa (Land Bank) and South African Weather Service (SAWS).

Table 3.2: Variables and their definitions

Variable	Variable definition	Source
Dependent variable		
Agricultural gross domestic product, *AGDP*	Agricultural gross domestic product of small-scale farmers measured in billion rands (outputs of small-scale farmers)	StatsSA
Independent variables		
Bank credit, *BC*	Bank credit disbursed to small-scale farmers from all institutions in billion rands	DALRRD, Land Bank
Capital investment, *CI*	annual changes in farm fixed improvements, machinery and inventory of livestock of small-scale farmers in billion rands	DALRRD
Number of labour, *NL*	Number of labour in small-scale farming sector in thousands	StatsSA
Annual rainfall, *R*	Annual rainfall in milliliters	SAWS

The terms ‘agricultural production’ and ‘agricultural output’, AGDP, as a representation of the final product of an agricultural activity, they are used interchangeably in the literature. This study used South African agricultural gross domestic product of small-scale farmers as a proxy for small-scale farmers’ agricultural output.

The inclusion of bank credit, BC, as an independent variable in the production function has been questioned since it does not affect output directly, but rather indirectly affects output by alleviating the financial constraints of farmers in purchasing inputs. In the empirical studies, Nkurunziza (2010) questioned the use of credit as an explanatory variable in the agricultural production function. According to Carter (1989) and Sial et al. (2011), improved seeds and other inputs such as tractors and fertilizers that may be purchased with credit money have a key impact on agricultural productivity and are directly affected by credit availability.

The function of capital investment in the agricultural production process justifies its inclusion as one of the independent variables of the study. According to Baumol and Blinder (2006), capital investment (CI) refers to the inventory of plant, equipment, and other productive resources held by an individual, a firm, or some other organization. Firms increase their capital base through investment process and then use this capital in production. The amount of money spent on investment determines capital stock growth. The quantity of money invested by firms is determined by the actual interest rate they pay on borrowed funds. The lower the actual interest rate, the more money will be invested.

In South Africa, the DALRRD measures gross capital invested in agriculture by adding permanent improvements, machinery and tools, tractors, and changes in livestock inventory (RSA, DALRRD, 2020). The study is going to adopt the definition of DALRRD to measure capital investment. Increases in agricultural physical assets are expected to have a favorable impact on output. Even though some authors challenge the inclusion of credit and capital on the model, the study includes both as credit acquired from banks is not only used to purchase capital, but also to finance working capital needs as well as production costs such as fertilizers and seeds.

The total employment in the small-scale agricultural sector, NL, is the proxy for labour used in this study. The number of agricultural employees in the small-scale sector is represented by this figure (RSA, DALRRD, 2020). Both skilled and unskilled labour is included on the proxy. In this study, based on the neo-classical model of growth theory by Robert Solow 1956, a positive relationship is expected between the variables. Finally, the model includes annual rainfall, R, to show the importance of seasonal rainfall in determining agricultural production in South Africa. This study uses average annual rainfall data from the South African Weather Service as a proxy for the variable rainfall (SAWS, 2020). The effect of the rainfall on agricultural output may be either negative (if too much rainfall has a detrimental effect on output) or positive (if rainfall has a positive effect on output).

3.5. Estimation procedure

This study employed the VECM (restricted VAR) presented by Johansen (1995). VECM is used to establish the long-run and short-run relationship between the agricultural gross domestic product and bank credit, as the focus of the study. The reason for choosing the technique is that the relationship between agricultural gross domestic product and bank credit goes beyond the short-term period as it takes time before bank credit provided to farmers becomes effective on their agricultural output. Furthermore, the technique allows for opportunity to simultaneously estimate both long-run and short-run relationship.

3.5.1. Descriptive statistics, correlation probability and unit root test

The arranging of data is generally the first step in data processing. The data is frequently condensed into one or two useful summaries, such as mean and standard deviation or correlation, or shown using graphical approaches such as scatter plots and histograms. The variables employed in the regression analysis were subjected to correlation analysis, since the main goal of the study was to assess the relationship between bank credit and agricultural output. As shown in Table 4.2, on *a priori*, bank credit has a linear and strong association with agricultural output. This indicates that increasing the amount of bank credit available to small-scale farmers will lead to a linear rise in agricultural output.

The first stage in performing a unit root test is to verify the order of integration of each variable in a model to determine whether each series is stationary or non-stationary, and whether they are stationary in level or become stationary after differencing. According to Gujarati (2003:807), a data series is stationary if the mean and variance remain constant throughout time. It is a prerequisite for time series data to be non-stationary before performing co-integration test. In this study, the Augmented Dickey-Fuller (ADF) and the Phillips-Peron (PP) tests were employed to test for stationarity.

The ADF test is represented by the following equation:

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{i=1}^{p} \alpha_1 \Delta Y_i + \varepsilon_t \text{..} (3.3)$$

Where Δ is a first difference operator, y_t is the relevant time series, t is a linear trend and $\mathcal{E}_t$ is the error term.

The PP test is represented by the following equation:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \varepsilon_t \quad (3.4)$$

Where α_0 and α_1 are parameters estimates and ε_t is error term. The null hypothesis, H_0, maintains that the series has a unit root, indicating that it is non-stationary. The alternative hypothesis, H_1, is that the series are stationary, which means they do not have a unit root. If the ADF or PP calculated value exceeds one of the crucial values at a certain level of significance, the null hypothesis is rejected. In the event where the series have unit root in levels, to correct for unit root, series have to be differenced until they become stationary.

3.5.2. Determination of lags length

Since every model with lagged variables is vulnerable to the number of lags in the regression, determining the correct lag length is critical. As a result, since the lag length influences the VAR model, the best lag length must be determined. The assessment of the suitable lag length is based on different information criteria for the selection of a model such as Final Prediction Error (FPE) (Chellasamy and Anu, 2017), Hannan-Quinn information criterion (HQ) (Hannan and Quinn, 1978), Akaike information criterion (AIC) (Akaike, 1973), sequential modified test statistic (LR) (Chellasamy and Anu, 2017) and Schwarz information criterion (SIC) (Schwarz, 1978). These information criteria are accessible in the E-Views statistics software, and they may be used to select the most acceptable model by determining the optimal lag length of the VAR system. The information criteria with the lowest values are ideal, and they are always marked with an asterisk.

3.5.3. Co-integration test

The co-integration test must be used after the order of integration of the variables has been determined using the stationary test and it has been shown that at least two variables become stationary after the first difference. As a result, the co-integration test involves determining if two or more series have a long-run equilibrium relationship. This test is frequently used to determine whether an unrestricted VAR (standard VAR) or a restricted VAR (VECM) should be used to investigate the relationship between variables (Meniago, Peterson, Mongale, 2013). Before advancing to the Johansen cointegration, it is essential that one should make sure that all the series in the data sets have the same order of integration I (1) before advancing to a co-integration test (Khetsi, 2014). If variables are integrated in the same order, according to Olayiwola and Rutaihwa (2010), the Johansen technique must be used to test for a co-integrating relationship. In this study, the Johansen co-integration test was used since it is ideal for dealing with multivariate time series. The Johansen technique is also embraced as it resolves the problem of endogeneity of independent variables by permitting error correction model with lag restrictions.

Depending on the type of the equation being studied, the co-integration test can be used in a variety of ways. This study employs the co-integration which can be tested using Johansen and Juselius (1990) approach. Since this modelling technique comprises a multivariate system, the Johansen co-integration test is the most appropriate.The Johansen co-integration uses two statistics, the maximal eigenvalue and the trace statistic to determine the number of co-integrated vectors in a model. Johansen and Juselius (1990) theorised that these tests assesses the null hypothesis of no co-integration in the variables with the alternative hypothesis of co-integration. The following equations sum up these tests:

$$Jtrace\ test = -T\sum_{i=r+1}^{n} in(1-\overset{\wedge}{\underset{I}{\lambda}}) \quad (3.5)$$

$$Jmax = -T(1-\overset{\wedge}{\underset{R}{\lambda}}+1) \quad (3.6)$$

Equation (3.5) represents the trace test, while equation (3.6) represents the maximum eigenvalue test.

The *T* represents the size of the sample, and $\overset{\wedge}{\underset{I}{\lambda}}$ the largest canonical correlation.The trace test assesses the null hypothesis of r co-integrating vectors versus the other hypothesis of co-integrating vectors. In contrast, the maximum eigenvalue test assesses the null hypothesis of r co-integrating vectors versus the other hypothesis of n co-integrating vectors (Hjalmarsson and Par, 2007).

When the test statistic value is less than one critical value, we reject the null hypothesis. When the results of the two tests are in conflict, the maximum eigenvalue is chosen over the trace statistic. This is because this statistic has a clearer alternative hypothesis and focuses on determining the precise number of co-integrating vectors (Akanbi, 2012). This is also supported by Enders (2004:354) The coefficients of *t*-statistics do not have an asymptotic *t*-distribution in general. When variables are co-integrated yet the variable sequence is serially correlated, the absence of asymptotic *t*-distribution occurs. If the variables have co-integration, the vector error correction model (VECM) is used to find the short-run relationship, and if the variables do not have a long-run relationship, the unrestricted VAR approach is used to determine the short-run relationship.

3.5.4. Vector error correction model

After establishing the existence of co-integrating relationship, vector error correction model is estimated to test dynamics of the short-run. The study employs VECM to check for properties of the co-integrated series in the short-run. The beginning point of VAR of order P is considered by the Johansen technique as follows:

$$Y_t = A_1 Y_{t-1} + \cdots A_p Y_{t-p} + \beta x_t + s_t \quad (3.7)$$

As a result, in order to perform the Johansen test, VAR must be converted to a VECM model and written as:

$$\Delta = M Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + \beta x_t + s_t \quad (3.8)$$

Where

$$\Pi = \sum_{i=1}^{p} A_{i} - 1 \text{ and } \Gamma_i = -\sum_{j=i+1} A_j \quad (3.9)$$

If the coefficient matrix Π has reduced rank r < k, there are k x matrices α and β, each with rank *r* such that π = αβ' and β'y_t is I(0). The components of α are identified as the adjustment parameters in the vector error correction model, and each column β of is a cointegrating vector. R is the number of cointegrating relationships. It can be demonstrated that for a given *r*, the highest likelihood estimator of β defines the combination of y_{t-1} that yields the *r* largest canonical correlations of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present.

3.5.5. Diagnostic and stability tests

In order to determine the reliability, stability, and validity of the obtained results, the following tests have to be passed: The Jarque-Bera residual test is used to determine whether the residuals are normal. The null hypothesis in this case is that residuals are normally distributed, which is tested against the alternative that they are not. If Jarque-Bera statistics are greater than the significant level, we reject the null hypothesis. If Jarque-Bera statistics are less than the significant level, we do not reject the null hypothesis. The Breusch-Godfrey LM test is used to determine if there is serial correlation. The null hypothesis is that there is no serial correlation, while the alternative hypothesis is that there is serial correlation. The Lung-BoxQ statistic test was used to examine the presence of autocorrelation, with the null hypothesis stating that there is no autocorrelation and the alternative hypothesis stating that autocorrelation exists. To test for heteroscedasticity, the ARCH heteroscedasticity test was used, with the null hypothesis stating that there is no heteroscedasticity in the model and the alternative hypothesis stating that there is heteroscedasticity.

Before checking for co-integration and VECM, the AR root graph was employed in order to check the stability of the model. The AR root graph indicates the inverse roots of the characteristic AR polynomial. The VAR deemed stable if all the roots have less than one modulus and lie within the unit cycle. In addition to the above tests, The Regression Equation Specification Error Test (RESET) was also employed in the study to determine whether or not the econometric model was accurately specified.

CHAPTER FOUR
DATA ANALYSIS AND INTERPRETATION OF RESULTS

4.1. Introduction

This chapter presents empirical findings of this study using annual secondary data covering the period 1978 to 2020. Therefore, this chapter consists of five sections. The following section presents the descriptive statistics, followed by the unit root test results and VECM in section 4.3. The diagnostic tests and stability test results are presented in section 4.4.

4.2. Descriptive statistics and correlation probability

This study used annual time series data for small-scale agriculture from 1978 to 2020. The data were obtained from Statistics South Africa (Stats SA), The Department of Agriculture, Land Reform and Rural Development (DALRRD), Land Bank and South African Weather Service. Table 4.1 shows that between 1978 and 2020, agricultural gross domestic product (AGDP) produced a minimum of R1.8 billion and a maximum of R28 billion. Credit increased from a low of R3 billion to a high of R33 billion. Similarly, capital investment grew from a low of R480m to a high of R5bn. Employees in the labor force increased from a low of 294147 to a high of 910 200, with a mean of 457 490. Rainfall totaled 799.883 mm on average, with lows of 347 mm and highs of 1365 mm. All variables have variability (standard deviation) below the mean when using nominal data. According to Jarque-Bera statistics, agricultural output and the independent variables follow a normal distribution across time.

Table 4.1: Descriptive statistics

	AGDP	BC	CI	NL	R
Mean	1.331	1.514	2.507	457490.7	783.488
Median	1.222	1.437	2.477	441098.0	776.000
Maximum	2.880	3.397	5.184	910200.0	1365.000
Minimum	1.810	3.809	4.881	294147.0	347.000
Std. Dev.	9.460	9.299	1.622	133243.1	286.518
Skewness	0.262	0.284	0.154	1.059741	0.246
Kurtosis	1.512	1.642	1.495	4.257634	2.103
Jarque-Bera	4.461	3.883	4.223	10.88230	1.875
Probability	0.107	0.143	0.121	0.433009	0.391

Sum	5.725	6.500	1.087	19672101	33690.00
Sum Sq. Dev.	3.764	3.629	1.107	7.46E+11	3447891.
Observations	43	43	43	43	43

Source: EViews 9

Table 4.2 demonstrates a positive and significant correlation between agricultural output and bank credit, agricultural output and capital investment, and agricultural output and rainfall ($p < 0.05$). Agriculture output was shown to be negatively correlated with labour. A positive and significant association was discovered between agricultural output and bank credit, meaning that increasing bank credit would lead to increased agricultural output.

Table 4.2: Correlation probability

Covariance Analysis: Ordinary					
Sample: 1978 2020					
Included observations: 43					
Variables	LAGDP	LBC	LCI	LNL	LR
LAGDP	1.000				

LBC	0.997	1.000			
	(0.000)	-----			
LCI	0.997	0.996	1.000		
	(0.000)	(0.000)	-----		
LNL	-0.851	-0.855	-0.845	1.000	
	(0.000)	(0.000)	(0.000)	-----	
LR	0.830	0.824	0.836	-0.594	1.000
	(0.000)	(0.000)	(0.000)	(0.007)	-----
Note P-values are in parentheses					

Source: EViews 9

4.3. Unit root test results and VECM

Stationarity tests were performed on the data employed in this study. The stationarity qualities of the variables were then examined using the Augmented Dickey-Fuller test and Phillips-Perron unit root tests. The null hypothesis in both the ADF and PP tests is that the series has a unit root, whereas the alternative hypothesis is that it does not. This is expressed in the following way:

H_0= series has a unit root

H_1 = series has no unit root

In this case, the PP test was utilized to confirm the ADF results. To stabilize the variances, all of the series were converted into logarithms. Table 4.3 shows the results of the ADF and PP unit root tests for all of the variables.

Table 4.3: Results of unit root tests

Variable	**Intercept**		**Trend and Intercept**		**Order of Integration**
	Augmented Dickey-Fuller	**Phillips-Perron**	**Augmented Dickey-Fuller**	**Phillips-Perron**	
LAGDP	-1.870 (0.342)	-2.026 (0.274)	-0.664 (0.969)	-0.454 (0.982)	
ΔLAGDP	-7.111 (0.000)	-7.074 (0.000)	-7.739 (0.000)	-7.706 (0.000)	I(1)
LBC	-0.785 (0.812)	-0.769 (0.817)	-1.072 (0.921)	-1.339 (0.863)	
ΔLBC	-5.971 (0.000)	-6.051 (0.000)	-5.969 (0.000)	-6.043 (0.000)	I(1)
LCI	-1.475 (0.536)	-1.346 (0.598)	-0.412 (0.983)	-0.732 (0.963)	
ΔLCI	-5.758 (0.000)	-5.885 (0.000)	-5.967 (0.000)	-6.022 (0.000)	I(1)

NL	-2.115 (0.239)	-1.791 (0.379)	-5.254 (0.000)	-5.183 (0.000)	
ΔNL	-9.466 (0.000)	-31.092 (0.000)	-9.343 (0.000)	-30.539 (0.000)	I(1)
LR	-2.437 (0.137)	-2.219 (0.202)	-4.092 (0.012)	-4.160 (0.010)	
ΔLR	-9.394 (0.000)	-11.092 (0.000)	-9.283 (0.000)	-10.971 (0.000)	I(1)
Notes: Reported values under levels and first difference are ADF and PP t-statistics values P-value in parentheses I (1) denotes a variable that is stationary at first difference and Δ denotes a variable that has been differenced once.					

Source: EViews 9

All variables were found to be stationary at first difference in both ADF and PP test using intercept as well as trend and intercept except for number of labour and rain where they were stationery at level, which implies that they are all integrated of order one (1). As a result, the variables are I (1). The findings of the ADF test were backed up by the results of the PP test. The length of the lag was the next step. The various lag lengths indicated by each criterion are shown in Table 4.4. The study uses the information criteria approach to carefully select the lag length order. This is a prerequisite of the Johansen method to show the order of lags and the deterministic trend assumption of VAR. Asterisks indicates the information criterion that has the least value. Appendix 1 contains the findings of the VAR lag order selection criterion.

Table 4.4: VAR lag order selection criteria

Lag	Log L	LR	FPE	AIC	SC	HQ
0	121.161	NA	2.071	-5.808	-5.596	-5.731
1	263.282	241.604*	5.981*	-11.664	-10.397*	-11.206*
2	288.417	36.445	6.320	-11.670*	-9.348	-10.831

3	305.698	20.737	1.091	-11.284	-7.907	-10.063
Notes * indicates lag order selected by the criterion LR: sequential modified LR test statistic (each test at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion						

Source: EViews 9

The sequential modified likelihood ratio (LR) test statistic, final prediction error (FPE), Akaike information criterion (AIC), Schwartz information criterion (SC) and Hannan-Quinn information criterion (HQ) recommended an optimal lag length of one to be used in the study. In most empirical studies, the AIC and SC are used. The best lag length was determined by both AIC and SC, and thus our study followed suit. Since the ADF and PP tests showed that the variables were stationary after the first difference. It is important to decide if those variables have a long-term relationship. Co-integration is generally used to determine the presence of equilibrium relation between two or more-time series. For this study co-integration is utilised to determine the long-run relationship among the variables agricultural gross domestic product (LAGDP), bank credit (LBC), capital investment (LCI), number of labour (LNL) and rainfall (LR). This study took into account both the Trace test and the Maximum Eigenvalue test.

Table 4.5: Johansen co-integrating test allowing deterministic intercept and trend in CE and no intercept in VAR

Hypothesised No of CEs	Eigen Value	Trace Statistic	0.05 Critical Value	Prob	Max Eigen Statistic	0.05 Critical Value	Prob
None*	0.626	105.409	88.803	0.001***	40.369	38.331	0.028**
At most 1*	0.512	65.040	63.876	0.039**	29.470	32.118	0.101
At most 2*	0.414	35.569	42.915	0.222	21.938	25.823	0.150
At most 3	0.187	13.631	25.872	0.687	8.5348	19.387	0.771
At most 4	0.116	5.096	12.517	0.582	5.0962	12.517	0.582
Trace test indicates 2 co-integrating equation(s) at the 0.05 level							

Max-eigenvalue test indicates 1 co-integrating equation(s) at the 0.05 level
*** and ** denotes rejection of the null hypothesis at 1% and 5% level of significance, respectively

Source: EViews 9

The Johansen co-integration test has been used to test for co-integration in the model, as shown in Table 4.5. The deterministic trend specification used to test for linear trend in the data was intercept and trend in CE and no intercept in VAR. The null hypothesis affirms that there is no co-integration, whereas the alternative hypothesis states that there is co-integration. Because the trace statistic (105.409) is larger than the critical value (88.803) and the Max-Eigen statistic (40.369) is larger than the critical value (40.369), the null hypothesis of no co-integrating equation (CE) is rejected at the 5% level of significance for both trace and Max-Eigen tests since the trace statistic (105.409) is larger than the critical value (88.803), and the Max-Eigen statistic (40.369) is larger than the critical value (38.331). The probability value of the trace (0.001) and the probability value of Max-Eigen (0.028) are both larger than the 5% level of significance, implying that the null hypothesis of no co-integrating vectors is likewise rejected.

The trace statistic indicates two co-integrating equations while the Maximum-Eigen value indicates one co-integrating equation. This study used the results of the maximum eigenvalue test over the trace statistic. The reason for this is that maximal eigenvalue has a more precise alternative hypothesis and typically pinpoints the exact number of co-integrating vectors (Akanbi, 2012). Moreover, in contrast to these contradicting results, Enders (2004:354) emphasized the use of maximum eigenvalue over trace statistics since *t*-statistics coefficients do not have an asymptotic *t*-distribution in general. The absence of asymptotic t-distribution is a situation in which variables can be co-integrated but the sequence of variables is serially correlated. These findings show that agricultural output, bank credit, investment, labour, and rainfall are all co-integrated in the long-run.

To further explain this long run relationship, the long run co-integrating model is presented by normalized equation as reported in table 4.6, detailed report in Appendix 2. The long-run equation is estimated to determine whether there is positive or negative relation between the variables. The long-run relationship was estimated with the log-transformed agricultural output as the dependent variable. In the analysis, which spanned the years 1978–2020, a total of 41 observations were included after adjustments.

Table 4.6: Normalized long-run co-integrating equation

Normalized co-integrating coefficients				
LAGDP	LBC	LCI	LNL	LR
1.000000	-0.674***	-0.597**	-0.059***	0.047***
	(0.168)	(0.118)	(0.053)	(0.035)
	[-4.003]	[-5.031]	[-1.110]	[1.334]
Notes: *** and ** denote significance at 1% and 5% levels, respectively. Standard errors in ( ) and t-statistics in [ ]				

Source: EViews 9

The normalized coefficients presented in Table 4.6 represent the long-run elasticities, and the normalised coefficients for the model generated from the co-integrating vector are displayed as follows:

$$LAGDP - 0.674LBC - 0.597LCI - 0.059LNL + 0.047LR = 0 \qquad (4.1)$$

The long-run equation was derived from the normalized coefficients in relation to a single co-integrating vector:

$$LAGDP = 0.674LBC + 0.597LCI + 0.059LNL - 0.047LR \qquad (4.2)$$

The long-run co-integrating equation is indicated by the above results. The equation shows how changes in bank credit (LBC), capital investment (LCI), labour supply (LNL), and rainfall (LR) affect agricultural gross domestic product (LAGDP) over time. As shown in equation (4), the signs for each value must be reversed before interpretation; a positive sign becomes a negative, and a negative sign becomes a positive as the equation is transformed into equation (4.2). This is a process for normalizing the long-run equation in VECM.

The results show that bank credit influence agricultural output positively at the 1% level of significance while capital investment influence agricultural output positively at the 5% level of significance. The result is that, according to the a *priori* expectation, there exists a positive relationship between bank credit and agricultural output in South African small-scale agriculture. This means that the null hypothesis of bank credit not having a positive and significant impact on agricultural output in South African small-scale farmers is rejected and the alternative accepted.

A percentage increase in bank credit will lead to a 0.67 percent increase in agricultural output, while a percentage increase in capital investments will lead to a 0.59 percent increase in agricultural output, ceteris-paribus. These are in line with the argument made by Rajni (2013) that capital formation is at the heart of economic development and that development is impossible without adequate capital resources. Farmers can get credit in both short-term and long-term loans; long-term loans can be used to buy farm machinery and equipment, irrigation equipment, combine harvesters, and tractors are examples of these. Short-term financing, on the other hand, is necessary for working capital as well as the purchase of supplies such as fertilizer and pesticides. The results of the study are consistent with studies by Chisasa and Makina (2013) and Mdoda, Meleni, Mujuru, and Alaka (2019), which concluded that bank credit has a favorable and significant association with agricultural output in South Africa, according to the findings.

Small-scale farm labour, as expected, has a beneficial and considerable impact on agricultural productivity. A 1 percent increase in labour results in a 0.05 percent increase in agricultural output, all else being equal. However, the coefficient for rainfall was observed to be negative and significant. A percentage decrease in rainfall will lead to a 0.04 percentage decrease in agricultural output, ceteris-paribus. This is due to the fact that South Africa is a semi-arid country, with only 28% of the country receiving more than 600 mm of rainfall per year (Food and Agricultural Organisation, 2006). Irrigation is used to complement water needs for agriculture. Crops become waterlogged during periods of heavy rain, resulting in lower yields. Drought causes crops to wither, resulting in poor harvests.

The short-run results of the VECM are presented on Table 4.7 and detailed report in Appendix 3. As expected, the error correction term coefficient is negative and highly significant, showing that agricultural gross domestic product rapidly adjusts to short-run disruptions. The speed of adjustment is -0.741 which shows that the system adjusts to equilibrium. This means that deviations from equilibrium are rapidly corrected by 74% per annum.

Table 4.7: Summary of the VECM estimates

Variables	Coefficients	Standard Error	t – statistics
D(LAGDP(-1))	0.074*	0.239	0.313

D(LBC(-1))	-0.006*	0.460	-0.014
D(LCI(-1))	0.114*	0.355	0.321
D(LNL(-1))	-0.001*	0.077	-0.016
D(LR(-1))	-0.057	0.058	-0.985
EC	**-0.741*****	**0.345**	**-2.145**
C	**0.055*****	**0.018**	**3.001**
*** Statistically significant at 1% level * Statistically significant at 10% level			

Source: EViews 9

According to empirical evidence, bank credit has a negative impact on agricultural output in the short-term at a 10% confidence level. The relationship is also significant. According to our findings, credit has a long-term positive effect. As a result, the short-term negative impact could be due to a variety of factors specific to South Africa. First, it could be because of the high interest rates levied on small-scale farmer loans because the sector is risky in nature and because of the fact that it has a longer production period than other industries. Second, the short-term structure of farm finance, with banks forcing farmers to repay loans even before harvesting and selling their products, could be to blame. Agricultural production cycle is generally longer than repayment period of the loans. Hence a mismatch between repayment cycles and production would negatively influence output. These credit challenges to small-scale farmers have been broadly documented in the literature (Pissarides, 1999; Spio, 2002; Spio, 2003; Okurut, Banga and Mukungu, 2004; Machethe et al, 2011; Chisasa and Makina, 2012).

Capital investment is observed to be significant with positive coefficients. Agricultural productivity is negatively associated with labour in the short term. Due to stringent labour restrictions and substantial unionization, both of which have a detrimental influence on productivity, this is expected in the South African setting. In the short-run, however, the rainfall coefficient was shown to be negative and inconsequential.

4.4. Diagnostic and stability tests

Table 4.8 below presents a summary of the diagnostic test results. The study employs four tests to determine the reliability, stability, and validity of the results. The tests that have been performed are the normality test, serial correlation, heteroskedasticity and stability tests. The findings are acknowledged as robust and accurate if all these checks indicate that there are no problems with the results. The null hypothesis, H_0, is not rejected if the p-value is greater than the level of significance (given as 5%). However, reject H_0 when the p-value is less than 5%.

Table 4.8: Summary of diagnostic test results

Test	H_0	P-value	Conclusion
Jarque-Bera	Residuals are normally distributed	0.771	Null hypothesis is not to be rejected (H_0). As a result, the residuals are distributed normally.
Breusch-Godfrey LM test	No serial correlation	0.697	Null hypothesis is not to be rejected (H_0). As a result, there is no serial correlation.
Ljung-Box Q	No auto/serial correlation	0.914	Null hypothesis is not to be rejected (H_0). As a result, there is no auto/serial correlation.
ARCH LM	No heteroskedasticity	0.449	Null hypothesis is not to be rejected (H_0). As a result, there is no heteroskedasticity
Ramsey RESET	The model is correctly specified	0.299	Null hypothesis is not to be rejected (H_0). Since the p-value is greater than the level of significant at 5%.

Source: EViews 9

The Jarque-Bera test is used to evaluate if residuals are normally distributed. The p-value for the results is 0.771, which is more than the 5% level of significance. As a result, the null hypothesis of normally distributed residuals is not rejected, implying that residuals are normally distributed. The Breusch-Godfrey LM test is used to assess whether serial correlation exists in the model. The results show a P-value of 0.697, which is 69%. This level of significance is larger than 5%, indicating that the null hypothesis is not rejected. As a result, the equation has no serial correlation. The Ljung-Box Q was used to determine whether there was auto-correlation. The results show a p-value of 0.914, which is larger than the level of significance of 5%. As a result, the null hypothesis cannot be rejected, and no auto-correlation can be established.

The ARCH LM test is used to determine if the model has heteroscedasticity or not. The p-value of 0.449 is much higher than the 5% level of significance. This means that the null hypothesis was not rejected, and there was no evidence of heteroscedasticity in the model. The results demonstrate that the model passed all the above diagnostic tests. The model is correctly specified. The Ramsey RESET was performed to test whether the model is correctly specified. Table 4.9 depicts the results of the Ramsey RESET performed. Detailed results for the Ramsey Reset test are presented in Appendix 9. According to the results of this test, the null hypothesis is not rejected since the p-value of 0.299% is greater than 5% level of significance, and thus, the model is correctly specified.

The inverse roots of AR characteristic polynomial were employed to check the stability of the model as displayed in Figure 4.1. The estimated VAR is stable if all roots have modulus less than one and lie inside the unit circle. It should be emphasized that if the parameters of the VAR fall outside of these bounds, they are regarded as unstable and unreliable. The VAR meets the stability condition, meaning that the findings are reliable and valid.

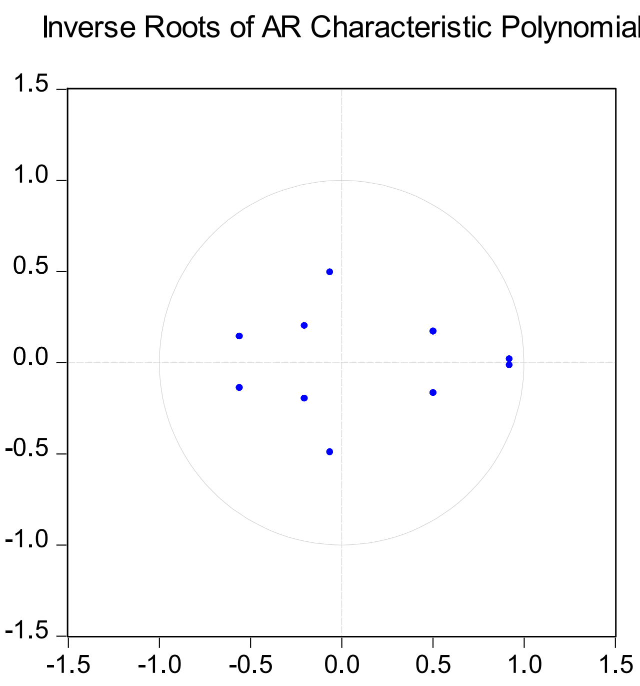


Figure 4.1: Inverse roots of AR characteristic polynomial

Source: EViews 9

CHAPTER FIVE
SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1. Introduction

The goal of this study was to investigate the influence of bank credit on the agricultural output of small-scale farmers in South Africa. In addition, the study needed to determine if there was a short-run and long-run relationship between bank credit and agricultural productivity. This chapter provides the summary and conclusions from the results while also highlighting possible policy recommendations for future policy formulation. As a result, this chapter is structured as follows: section 5.2 presents the general outline of the study, section 5.3 provides the key findings of the study, the conclusion of the study is presented in section 5.4, and policy recommendations are presented in section 5.5. In addition, section 5.6 outlines the limitations of the study.

5.2. General outline of the study

The first chapter of this study outlined the introduction and background of the study and also gave a background to the agricultural sector. It laid all the ground work necessary to the study including the objectives, research hypotheses, problem statement, research questions, research method along with justification of the study and lastly the organisation of the study. Chapter two discussed the theoretical and empirical literature applicable to this study. Methodology was discussed in chapter three whereby the study applied the Johansen procedure with agricultural output as the dependent variable and bank credit, capital investment, labour and rainfall as independent variables. Then chapter four empirically examined the impact of bank credit on agricultural output of small-scale farmers in South Africa, using annual data for the period 1978 to 2020, while adopting the VECM. The Johansen-Juselius co-integration test was performed and the presence of a long-run relationship among the variables agricultural output, bank credit, capital investment, labour and rainfall was established.

5.3. Key findings

The study empirically examined the effect of bank credit on agricultural output of small-scale farmers in South Africa, using annual data for the period 1978 to 2020, while adopting the VECM. Individual variables prove to be non-stationary and are linear cointegrated. The dynamic impact of bank credit on agricultural output varies across time horizon. The Johansen-Juselius co-integration test was performed and the presence of a long-run relationship among the variables agricultural output, bank credit, capital investment, labour and rainfall was established. The results show that there is a positive and significant relationship among bank credit, capital investment and labour and agricultural output in South Africa. A percentage increase in bank credit will lead to 0.67 percentage increase in agricultural output while a percentage increase in capital investments will lead to 0.59 percentage increase in agricultural output, ceteris-paribus. Also, a percentage increase in labour will lead to 0.05 percentage increase in agricultural output, ceteris-paribus. Furthermore, the study discovered that rainfall had a significant negative impact on agricultural productivity.

The short-run results of the VECM found that capital investment has a significant positive effect on agricultural output in the short-run. The relationship is significant at the 1% level of confidence. Conversely, bank credit and labour are found to be significant with negative coefficients, while rainfall is observed to be insignificant with a negative coefficient. Nevertheless, the ECM coefficient is negative and highly statistically significant, showing that agricultural gross domestic product rapidly adjusts to short-run disruptions. Although credit has a negative short-run impact on agricultural output, the long-run adjustment process is quick, with deviations from equilibrium being adjusted at a rate of 74% per annum.

5.4. Conclusion

Empirical studies revealed the impact of bank credit on agricultural output to be significant and positive in South Africa (Chisasa and Makina, 2013; Mdoda *et al*., 2019). The empirical results of this study are in line with the previous studies. The study concludes that increasing credit availability to small-scale farmers in South Africa will, on average, increase agricultural output. Small-scale farmers need more long-term credit to buy equipment and machinery. This stems from the observation that long-term credit contributes positively to agricultural output of small-scale farmers, whereas the empirical results have shown that short-term credit negatively affects the agricultural output of small-scale farmers in the short-term. Nonetheless, short-term credit is still required for working capital financing. Agriculture and agricultural-related activities are very important to the South African economy. Due to a lack of access to bank funding, small-scale farmers have been unable to boost their farm production. Commercial bank credit is one of the most important sources of funding for the sector, thus its availability and affordability will make it easier for small-scale farmers to access necessary inputs at the correct time, encouraging them to produce on a large scale. This study thus argues that an increase in bank credit supply to small-scale farmers will boost their productive capacity by increasing pesticides, inputs, capital equipment, and consequently technical efficiency, ceteris-paribus. In conclusion, this study found that providing small-scale farmers with continuous access to bank loans has the potential to increase agricultural output and expand farming operations.

5.5. Recommendations

This study recommends that long-term credit to small-scale farmers should be increased, since bank credit has been found to be negatively correlated with agricultural output in the short-term, this implies that short-term credit to this sector should be discouraged. Hence, only long-term credit should be encouraged in promoting growth in the agricultural small-scale farming sector. Long-term credit is used to purchase capital equipment and machinery, whereas working capital requires short-term financing. According to this study, long-term lending enhances agricultural productivity more than short-term credit. In both the long and short run, capital investment was found to have a large and favorable impact on agricultural output. Furthermore, because of its greater contribution to agricultural output, capital equipment finance should be prioritised. This will enable the small-scale sector to acquire advanced machinery to increase its productivity. Moreover, the government ought to promote the use of this machinery for the small-scale sector to expand their production. The Land Bank is a state-owned entity which offer credits to all farmers in South Africa. The findings revealed that government spending, through the Land Bank credits, have a long-term relationship with agricultural output, making it critical for the government to increase spending on the small-scale agricultural sector. More investment in the small-scale sector is critical, and policy makers should allow both private and public sector investments to ensure that the sector is advanced to its full potential. Policies governing the industry must not just be for the short-term, but also for the long-term. The study suggests that lending financial products tailored to the risk profiles of small-scale farmers be developed. Moreover, the government should formulate policies that will urge the banks to offer credits to small-scale farmers at a concessionary interest rate.

5.6. Limitations and suggestions for further studies

This study could not focus on all variables impacting agricultural output in the South African small-scale sector. For example, it investigated certain key variables only, rather than other contributing variables to the agricultural production process such as land, fertilizers and water irrigation scheme which also have impact on the output of agriculture. Some variables were not included in the study due to a lack of efficient and consistent data, nevertheless for further research, as data becomes accessible, some variables that were left out in this study may be included. In addition, the study used the VECM to generate the desired results. As a result, future research could take into account different techniques and perhaps produce different results. The key variable under investigation was bank credit and its influence on agricultural output. The study did not include the marketing of the produce, despite the fact that it is critical to the cash flows and long-term growth of the small-scale farmers. Marketing threats and opportunities could be examined for future studies. The study concedes that due to high default risk probabilities, the supply of bank credit to small-scale farmers has been constrained. Further research is needed to identify techniques for minimizing default risk in agricultural portfolios, as there are none available for South Africa.

REFERENCES

Abdul, S, Hussain, M and Munir, M, 2009. Impact of Micro Credit in Alleviating Poverty: An Insight from Rural Rawalpindi, Pakistan. Pakistan Journal of Social Sciences 7(1), 90-97.

Agunuwa, EV, Inaya, L, and Proso, T, 2015. Impact of Commercial Banks' Credit on Agricultural Productivity in Nigeria. International Journal of Academic Research in Business and Social Sciences 5(11), 2222-6990

Agricultural Business Chamber (ABC), 2011. Executive summary of ABC workshop on finance and development finance in agriculture held on 15th April 2011. Available from: https://agbiz.co.za/Documents/Workshops/tabid/409/Default.aspx [Accessed on 28-10-2019].

Ahmad, D, Chani, MI and Afzal, M, 2018. Impact of formal credit on agricultural output: empirical evidence from Pakistan. Sarhad Journal of Agriculture 34(3), 640-648.

Akaike, H., 1973. Information Theory as an Extension of the Maximum Likelihood Principle. Second International Symposium on Information Theory, 267-281.

Akanbi, O, 2012. Role of Governance in Explaining Domestic Investment in Nigeria. South Africa Journal of Economics 80(4), 473-489.

Akram, W, Sial, Z, and Ijaz, 2008. Agricultural credit constraints and borrowing behaviour of farmers in rural Punjab. European Journal of Scientific Research 23(2), 294-304.

Akinboade, OA and Kinfack, EC, 2014. Financial Sector Development Indicators and Economic Growth in Cameroon and South Africa. Social Indicators Research 115(2), 813 – 836.

Ammani, AA, 2012. An investigation into the relationship between agricultural production and formal credit supply in Nigeria. International Journal of Agriculture and Forestry 2(1), 46-52.

Arellano, M, and Bond, S, 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 58: 277–297.

Ata, A, Korpi, M, Ugurlu, M, and Sahin, F, 2015. Factors influencing the credit rationing in the commercial lending process. Journal of Business, Economics & Finance 4(2), 250-267.

Aziakpono, M, 2006. Financial Integration amongst the SACU: Evidence from interest rate pass-through analysis. Studies in Economics and Econometrics, 30(12), 12-15.

Bandyopadhyay, A. 2007. Credit risk models for managing bank's loan portfolio. [online] Available from: http://mpra.ub.uni-muenchen.de/5358/ [Accessed on 14-09-2020].

Bartlett, W and Bukvič, V, 2001. Barriers to SME growth in Slovenia. MOST: Economic Policy in Transitional Economies 11(2):177–195.

Bradstock, A, 2005. Key experiences of land reform in the Northern Cape province of South Africa. Available from: https://www.eldis.org/document/A20605 [Accessed on 14-09-2020].

Baumol, WJ and Blinder, AS, 2006. Economics: Principles and policy. Tenth edition. New York: Thompson South-Western.

Brooks, C, 2002. Introductory Econometrics for Finance. 6 ed. Cambridge: Cambridge University Press.

Carter, MR, 1988. Equilibrium credit rationing of small farm agriculture. Journal of Development Economics [Online] 28:83–103. Available from: http://www.aphl.org/aphlprograms/lss/performance/Documents/LSIP_2011Feb16_WI-PHL-Assessment-Report.pdf [Accessed on 14-08-2020].

Carter, MR, 1989. The impact of credit on peasant productivity and differentiation in Nicaragua. Journal of Development Economics 31(1), 13-36.

Chandio, AA, Yuansheng, J, Sahito, JGM and Larik, SA, 2016. Impact of formal credit on agricultural output: Evidence from Pakistan. African Journal of Business Management 10(8), 162-168.

Chellasamy, P and Anu, KM, 2017. Investigating the Relationship between Current Account Deficit and Capital Flows of India using ARDL Approach. India: Bharathiar University.

Chisasa, J, 2015. An Econometric Analysis of Bank Lending and Agricultural Output in South Africa: A Survey Approach. The Journal of Applied Business Research 31(1),163-174.

Chisasa, J and Makina, D, 2012. Trends in credit to smallholder farmers in South Africa, International Business and Economic Research Journal 11 (7), 771-784.

Chisasa, J and Makina, D, 2013. Bank credit and agricultural output in South Africa: A Cobb-Douglas empirical analysis. International Business and Economics Research Journal 12(4), 387–398.

Coleman, S and Cohn, R, 2000. Small firm's use of financial leverage: evidence from 1993 national survey of small business finances. Journal of Business. Entrepreneurship 12(3), 81-98.

DALRRD (The Department of Agriculture, Land Reform and Rural Development). Republic of South Africa. 2012. A framework for the development of smallholder farmers through cooperative development. Department of Agriculture, forestry and fisheries. July 2012.

DALRRD (The Department of Agriculture, Land Reform and Rural Development). Republic of South Africa. 2015. Catalogue for producer support and development.

DALRRD (The Department of Agriculture, Land Reform and Rural Development). Republic of South Africa. 2018. National Policy on Comprehensive Producer Development Support: Draft 5 ver. 3.

DALRRD (The Department of Agriculture, Land Reform and Rural Development). Republic of South Africa. 2003-2019. Trends in the agricultural sector 2020. Pretoria: Department of Agriculture, Forestry & Fisheries.

DALRRD (The Department of Agriculture, Land Reform and Rural Development). Republic of South Africa. 2020. Abstract of agricultural statistics. Available from: https://www.dalrrd.gov.za/ [Accessed on 22 March 2021].

Das A, Senapati M and John J, 2009. Impact of Agricultural Credit on Agriculture Production: An Empirical Analysis in India. Reserve Bank of India Occasional Papers 30(2).

Du Randt, R and Makina, D, 2012. An appraisal of agricultural financing models in South Africa. Paper presented at the Southern African Finance Association Conference, 18–20 January, Cape Town.

Dong, F, Lu, J and Featherstone, AM, 2010. Effects of credit constraints on productivity and rural household income in China. Center for Agricultural and Rural Development, Iowa State University.

Duy, VQ, 2012. The role of access to credit in rice production efficiency of rural households in the Mekong Delta, Vietnam. Center for Asian Studies Discussion Paper No. 284.

Emenuga, PE, 2019. Effect of Commercial Banks' Credit on Agricultural Productivity in Nigeria. Acta Universitatis Danubius 15(3), 417-428.

Enders, W, 2004. Applied Econometrics Time Series. Wiley: John Wiley & Sons Inc.

Engle, R and Granger, C, 1987. Co-integration and Error Corrrection: Representation, Estimation and Testing. Econometrica 55(1), 251-276.

Essang, S and Olajide, S, 1974. Intermediate Economic Analysis. Ibadan: Aromolara Publishing Company Limited.

FAO (Food and Agriculture Organization of the United Nations), 2010. White maize: A traditional food grain in developing countries. Available from: http://www.fao.org/docrep/w2698e03.htm [Accessed on 29 April 2021].

Faridi, MZ, Chaudhry, MO and Tahir, N, 2015. Institutional Credit and Agricultural Productivity: An Evidence from Pakistan. Pakistan Journal of Life and Social Sciences 13(3), 183-188.

Faures, JM, Bernardi, M and Gommes, R, 2010. There is no such thing as an average: How farmers manage uncertainty related to climate and other factors. Water Resources Development, 26(4):523–542.

Fenwick, LJ, and Lyne, MC, 1999. The relative importance of liquidity and other constraints inhibiting the growth of small-scale farming in KwaZulu-Natal. Development Southern Africa 16(1), 141-155.

Florence, N and Nathan, S, 2020. The Effect of Commercial Banks' Agricultural Credit on Agricultural growth in Uganda. African Journal of Economic Review 8(1), 162-175.

Foltz, J, 2004. Credit market constraints and profitability in Tunisian agriculture. PhD dissertation, University of Wisconsin, USA.

Girabi, F, 2013. Impact of Microfinance on Smallholder Farm Productivity in Tanzania: The Case of Iramba District. Asian Economic and Financial Review 3(4), 227-242.

Greenberg, S, 2010. Status report on land and agricultural policy in South Africa, 2010. Research Report 38, Programme for Land and Agrarian Studies, University of Western Cape.

Greenwood, J and Jovanovic, B, 1990. Financial Development, Growth, and the Distribution of Income. Journal of Political Economy, 98(5), 1076-1107.

Gujarati, DN, 2003. Basic Econometrics. 4th ed. U.S: McGraw-Hill.

Hannan, EJ and Quin, BG, 1978. The Determination of the Lag Length of an Autoregression. Journal of the Royal Statistical Society,190-195.

Harvie, C, 2011. Framework Chapter: SME Access to Finance in Selected East Asian Economies, in Harvie, C., Oum, S. and Narjoko, D. (eds.), Small and Medium Enterprises (SMEs) Access to Finance in Selected East Asian Economies. ERIA Research Project Report 2010-14, Jakarta: ERIA.

Hjalmarsson, E. and Österholm, P., 2010. Testing for Cointegration using the Johansen Methodology when Variables are Near-integrated: Size Distortions and Partial Remedies, *Empirical Economics*, 39(1), pp. 51–76.

Huppi, M and Feder, G, 1990. The role of groups and credit cooperatives in rural lending. World Bank Research Observer 5(2),187–204.

International Finance Corporation. 2011. Scaling up access to finance for agricultural SMEs policy review and recommendations. Available from: http://www.ifc.org/wps/wcm/connect/04da89804a02e2e19ce0fdd1a5d13d27/G20_Agrifinance_Report.pdf?MOD=AJPERES [Accessed on 09-03-2018].

Johansen, S and Juselius, K, 1990. Maximum Likelihood Estimation and Inference on Co- integration with Applications to the Demand for Money. Oxford Bulletin of Economics and Statistics ,169-210.

Johnston, BF and Cownie, J, 1969. The Seed-Fertilizer Revolution and Labor Force Absorption, American Economic Review, American Economic Association 59(4), 569-582.

Khetsi, QS & Mongale, IP, 2014. The Impact of Capital Markets on the Economic Growth in South Africa. Journal of Governance and Regulation 3(2), 154-163.

King, RG, and Levin, R, 1993. Finance and Growth: Schumpeter Might Be Right. Quarterly Journal of Economics 108(1), 717-738.

Lahiff, E and Cousins, B, 2005. Smallholder agriculture and land reform in South Africa. Institute of Development Studies. Bulletin 36(2),127-131.

Land Bank Research Report, 2011. Addressing challenges of financing emerging farmers. Land and Agricultural Development Research (LADR) Report No 1/2011.

Land Bank, 2016. Annual report. Available from: http://www.landbank.co.za/ [Accessed on 21-07-2019].

Land Bank, 2019. Annual report. Available from: http://www.landbank.co.za/ [Accessed on 31-10-2020].

Lefophane, MH, Belete, A and Jacobs, I, 2013. Technical efficiency in input use by credit and non-credit user emerging farmers in Maruleng Municipality of Limpopo Province, South Africa. African Journal of agricultural research 8 (17), 1719-1724.

Machethe, CL, 2004. Agriculture and poverty in South Africa: can agriculture reduce poverty? Paper presented at the Overcoming Underdevelopment Conference, Pretoria, South Africa.

Machethe, C, Moyo, T, Mahlati, V, Vink, N, and Coetzee, G, 2011. The Status of Agricultural and Rural Finance in Southern Africa (Final Draft). Centre for Inclusive Banking in Africa for FinMarkTrust.

Makhura, M, 2001. Overcoming transaction costs barriers to market participation of small-scale farmers in the Northern Province of South Africa. PhD thesis. University of Pretoria, Pretoria.

Mayowa, BT, 2015. Determinants of Agricultural Credit Acquisition from the Land Bank of South Africa: A Case Study of Smallholder Farmers in Peri-urban Areas of Mopani District, Limpopo Province. M Thesis, Published. South Africa: University of Limpopo.

Maziku, M, 2012. Credit Rationing for Small and Medium Scale Enterprises in Commercial Bank Loan Market. Research on Poverty Alleviation’s 17th Annual Research Workshop. White sands Hotel, Dar as Salam, Tanzania.

Mbonyane, B and Ladzani, W, 2011. Factors that hinder the growth of small businesses in South African townships. European Business Review 23(6), 550–560.

McKinnon, R, 1973. Money and Capital in Economic Development. Washington: The Brookings Institute.

Mdoda, L, Meleni, S, Mujuru, N and Alaka, KO, 2019. Agricultural credit effects on smallholder crop farmers input utilisation in the Eastern Cape Province, South Africa. Journal of Human Ecology 66(1/3), 45-55.

Medugu, PZ, Musa, I and Abalis, EP, 2019. Commercial Banks" Credit and Agricultural Output in Nigeria: 1980 -2018. International Journal of Research and Innovation in Social Science.3(1), 2454-6186.

Meniago, C, Mukudden-Peterson, J, Peterson, MA and Mongale, IP, 2013. What Causes Household Debt to Increase in South Africa? Economic Modelling 33(1), 482- 492.

Mudhara, M, 2010. Agrarian transformation in smallholder agriculture in South Africa: A diagnoses of bottlenecks and public policy options. University of KwaZulu-Natal.

Nkurunziza, JD, 2010. The effect of credit on growth and convergence of firm size in Kenyan manufacturing. The Journal of Trade and Economic Development 19(3), 465–494.

Ndlovu, N, 2013. A century later: A historical look at the Land Bank and its role in South Africa. Corporate and commercial farming. Harvest SA. Available from: http://www.harvestsa.co.za/articles/a-century-later-3748.html [Accessed on 11-07-2020].

Obilor, SI, 2013. The impact of commercial banks" credit to agriculture on agricultural development in Nigeria: An econometric analysis. International Journal of Business, Humanities and Technology 3(1),85–94.

Okurut, F, Banga, M and Mukungu, A, 2004. Microfinance and poverty in Uganda. Research Series (41). Economic Policy Research Center. Makerere University, Kampala.

Olayiwola, WK and Rutaihwa, JL, 2010. Trade Liberalisation and Employment Performance of Textile and Clothing Industry in Tanzania. International Business Research 3(3), 47-55.

Schwarz, G, 1978. Estimating the Dimension of a Model. The Annals of Statistics, 461-464.

Ortmann, GF and King, RP, 2007. Agricultural cooperatives II: Can they facilitate access of small-scale farmers in South Africa to input and product markets? Agrekon 46(2), 219-244.

Papaioannou, E, 2007. Finance and Growth A Macroeconomic Assessment of the Evidence from A European Angle, European Central Bank, Working Paper Series, No. 787, July.

Perderson, G, 2003. Rural Finance Institutions, Markets and Policies in Africa. Paper presented at a Pre-IAAE Conference on African Agricultural Economics, Bloemfontein, South Africa, August 13-14, 2003.

Pissarides, F, 1999. Is lack of funds the main obstacle to growth? European Bank for Reconstruction and Development's experience with small- and medium-sized businesses in Central and Eastern Europe. Journal of Business Venturing [Online] 14(5-6),519–539. Available from: http://www.sciencedirect.com/science/article/pii/S0883902698000275 [Accessed on 13-07-2020].

Qureshi, KS, Akhtar, H and Shan, F, 1996. A critical review of rural credit policy in Pakistan. The Pakistan Development Review 31(4), 781 – 801.

Rajni, P, 2013. Empirical investigation of capital formation by agriculture and industry on industrial productivity in India. Research Journal of Management Sciences 2(3), 8-11.

Rimal, NS, 2014. Agricultural Credit flow of Commercial Banks and Impact on Agricultural Production in Nepal. Scholars Journal of Arts, Humanities and Social Sciences 2(2), 372-376.

Salame, E, 2011. Applying Data Mining Techniques to Evaluate Applications for Agricultural Loans. Ph.D. Thesis, University of Nebraska, Lincoln, NE, USA. Available from: https://digitalcommons.unl.edu/agecondiss/10/[Accessed on 14-09-2020].

SARB (South African Reserve Bank), 2020. Annual report. Available from: https://resbank.onlinereport.co.za/2020/documents/south-african-reserve-bank-annual-report-2019-20.pdf [Accessed on 14-08-2020].

SARB (South African Reserve Bank), 2019. Selected South African banking sector trends.

Schumpeter, JA, 1911. The theory of economic development. Cambridge, MA: Harvard University Press.

Shaw, ES, 1973. Financial Deepening in Economic Development London: Oxford University Press.

Sial, MH, Awan, MS and Waqas, M, 2011. Institutional credit and agricultural production nexus. International Journal of Business and Social Science 2(13), 279-284.

Simsir, NC, 2012. An econometric analysis of the relationships between economic growth and agricultural credits for pro-poor growth in Turkey. International journal of social and humanity studies 4(2), 1309-8063.

Solow, RM, 1956. A Contribution to the Theory of Economic Growth. The Quarterly Journal of Economics 70(1), 65-94.

South African Weather Service, 2020. Available from: http://www.weathersa.co.za/ [Accessed: 24-10-2020].

Spio, K, 2003. The impact and accessibility of agricultural credit: a case study of small-scale farmers in the northern province of South Africa. PhD thesis, University of Pretoria.

StatsSA (Statistics South Africa), 2020. Statistical release, P0441. Gross domestic product. Available from: http://www.statssa.gov.za/publications/P0441/P04411stQuarter2020.pdf [Accessed on 22-08-2020].

StatsSA (Statistics South Africa), 2020. Census of commercial agriculture, 2017. Financial and production statistics P104. Pretoria: Statistics South Africa. Available from:

http://www.statssa.gov.za/publications/Report-11-02-01/Report-11-02-012017.pdf [Accessed on 14-09-2020].

Steijvers, T and Voordeckers, W, 2009. Collateral and credit rationing: A review of recent empirical studies as a guide for future research. Journal of Economic Surveys 23(5), 924–946.

The DTI, 2008. Annual review of small business in South Africa 2005-2007. Pretoria: Department of Trade and Industry.

Tregurtha, N, Vink, N and Kirsten, J, 2010. Presidency Fifteen year review project-review of agricultural policies and support instruments in South Africa 1994-2009. Available from: http://www.tips.org.za/foles/agriculture_presidency_fidteen_year_review_final_reportjuly2010_final.pdf [Accessed on 14-09-2019].

Tomasz, S, 2008. Do farm credits stimulate development of agriculture in Poland? Congress of European Association of Agricultural Economists, EAAE 2008.

Uchida, H, 2011. What do banks evaluate when they screen borrowers? Soft Information, Hard Information and Collateral. Journal of Financial Services 40(1), 29-48.

Udih, M, 2014. Bank credits and agricultural development: Does it promote entrepreneurship performance? International Journal of Business and Social Science 5(11), 102–107.

Udoka, CO, Mbat, DO and Duke, SB, 2016. The Effect of Commercial Banks' Credit on Agricultural Production in Nigeria. Journal of Finance and Accounting 4(1), 1-10.

Umoh, GS, 2003. Nigeria macroeconomic environment and the perennial crop. Global Journal of Agriculture Sciences 2(1), 53 – 61.

Umoren, AA, Edet, JU and Sunday, BA, 2014. Analysis of loan default among agricultural credit guarantee scheme (ACGS) loan beneficiaries in Akwa Ibom State, Nigeria. African Journal of Agricultural Economics and Rural Development 2(2), 121-128.

Waldner, F, Hansen, MC, Potapov, PV, Low, F, Newby, T, Ferreira, S and Defourny, P, 2017. National-scale cropland mapping based on spectral-temporal features and outdated land cover information. PLoS ONE 12(8)

Waweru, D, 2016. Factors that Affect Access to Credit Finance by Small Scale Women Entrepreneurs in Gilgil Sub County, Nakuru County- Kenya. M Dissertation, Published. Kenya: University of Nairobi.

Williams, C and van Zyl, N, 2008. Capital and market access constraints in land reform projects; three case studies from Mpumalanga. Available from: https://www.tips.org.za/publication/capital-and-market-access-constraints-land-reform-projects-three-case-studies-mpumalanga [Accessed on 14-10-2019].

Women in Informal Employment Globalizing and Organizing (WIEGO), 2014. Smallholder farmers. Available from: http://wiego.org/informal-economy/occupational-groups/smallholder-farmers. [Accessed on 14-07-2019].

World Bank Development Report, 2008. Agriculture for development. Available from: https://http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTWDRS/0,,contentMDK:23062293~pagePK:478093~piPK:477627~theSitePK:477624,00.html [Accessed on 12-08-2020].

Wynne, AT and Lyne, MC, 2003. An empirical analysis of factors affecting the growth of small-scale poultry enterprises in KwaZulu-Natal. Development Southern Africa 20(5), 563–577.

Zhou, W, 2009. Bank Financing in China’s Private Sector: The Payoffs of Political Capital. World Development 37(4), 787-799

APPENDIX

APPENDIX 1: Determination of lag lengths

VAR Lag Order Selection Criteria
Endogenous variables: LAGDP LBC LCI LNL LR
Exogenous variables: C
Date: 09/11/21 Time: 12:50
Sample: 1978 2020
Included observations: 40

Lag	LogL	LR	FPE	AIC	SC	HQ
0	121.1619	NA	2.07e-09	-5.808093	-5.596983	-5.731763
1	263.2823	241.6047*	5.98e-12*	-11.66412	-10.39746*	-11.20613*
2	288.4171	36.44544	6.32e-12	-11.67085*	-9.348645	-10.83122
3	305.6985	20.73765	1.09e-11	-11.28492	-7.907164	-10.06363

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

APPENDIX 2: Johansen cointegration test

Date: 09/11/21 Time: 13:09
Sample (adjusted): 1980 2020
Included observations: 41 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: LAGDP LBC LCI LNL LR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.626416	105.4093	88.80380	0.0019
At most 1 *	0.512659	65.04013	63.87610	0.0398
At most 2	0.414382	35.56972	42.91525	0.2224
At most 3	0.187929	13.63115	25.87211	0.6879
At most 4	0.116885	5.096274	12.51798	0.5826

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.626416	40.36913	38.33101	0.0288
At most 1	0.512659	29.47041	32.11832	0.1018
At most 2	0.414382	21.93857	25.82321	0.1502
At most 3	0.187929	8.534877	19.38704	0.7712
At most 4	0.116885	5.096274	12.51798	0.5826

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LAGDP	LBC	LCI	LNL	LR	@TREND(79)
27.41853	-18.48174	-16.38657	-1.643297	1.299741	0.071636
5.272257	22.74118	-21.00522	6.924182	0.552236	-0.190770
0.560970	-5.093029	6.325899	7.058818	-6.706544	0.140334
-3.183510	-20.85411	17.29981	4.852188	1.804307	0.356590
5.396801	-6.670866	-2.779148	0.999616	0.843805	0.083155

Unrestricted Adjustment Coefficients (alpha):

D(LAGDP)	-0.027027	-0.034772	0.015164	0.002275	0.015360
D(LBC)	0.007479	-0.030194	0.002385	0.010329	0.005495
D(LCI)	0.016294	-0.029664	0.008426	0.000795	0.014934
D(LNL)	-0.012235	-0.062383	-0.058107	-0.036798	-0.008582
D(LR)	-0.022486	-0.114201	0.094431	-0.027358	-0.019515

1 Cointegrating Equation(s): Log likelihood 247.1400

Normalized cointegrating coefficients (standard error in parentheses)

LAGDP	LBC	LCI	LNL	LR	@TREND(79)
1.000000	-0.674060	-0.597646	-0.059934	0.047404	0.002613
	(0.16835)	(0.11877)	(0.05395)	(0.03551)	(0.00314)

Adjustment coefficients (standard error in parentheses)

D(LAGDP)	-0.741050
	(0.34539)
D(LBC)	0.205071
	(0.24213)
D(LCI)	0.446760
	(0.29581)
D(LNL)	-0.335474
	(0.72335)
D(LR)	-0.616522
	(1.09776)

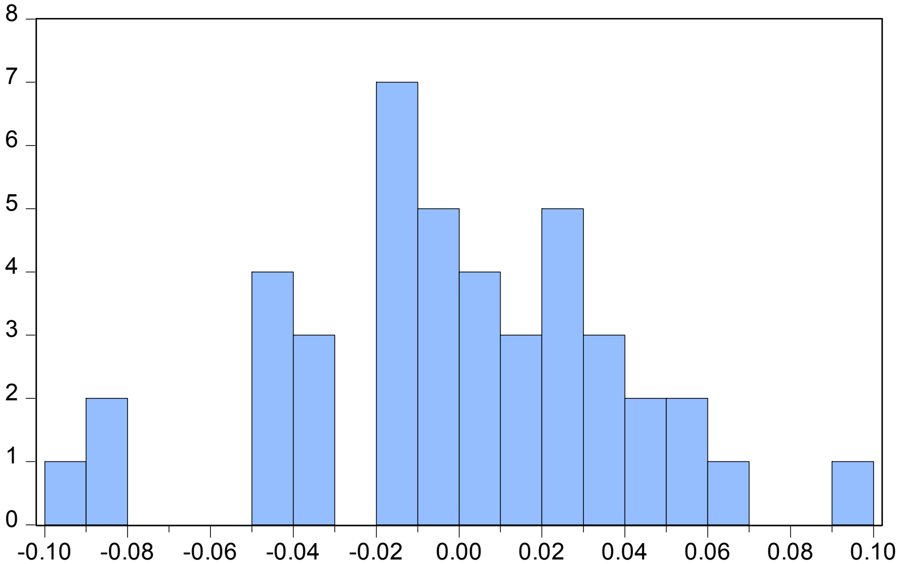
APPENDIX 3: Vector error correction model

Vector Error Correction Estimates
Date: 09/11/21 Time: 14:32
Sample (adjusted): 1980 2020
Included observations: 41 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LAGDP(-1)	1.000000
LBC(-1)	-0.674060
	(0.16835)
	[-4.00383]

LCI(-1)	-0.597646 (0.11877) [-5.03178]				
LNL(-1)	-0.059934 (0.05395) [-1.11087]				
LR(-1)	0.047404 (0.03551) [1.33492]				
@TREND(78)	0.002613 (0.00314) [0.83109]				
C	5.851306				
Error Correction:	**D(LAGDP)**	**D(LBC)**	**D(LCI)**	**D(LNL)**	**D(LR)**
CointEq1	-0.741050 (0.34539) [-2.14558]	0.205071 (0.24213) [0.84694]	0.446760 (0.29581) [1.51029]	-0.335474 (0.72335) [-0.46378]	-0.616522 (1.09776) [-0.56162]
D(LAGDP(-1))	0.074992 (0.23935) [0.31331]	0.103544 (0.16780) [0.61707]	0.057682 (0.20500) [0.28137]	-0.261674 (0.50128) [-0.52201]	1.204522 (0.76076) [1.58331]
D(LBC(-1))	-0.006758 (0.46089) [-0.01466]	-0.217895 (0.32311) [-0.67438]	0.504085 (0.39474) [1.27701]	0.539337 (0.96525) [0.55875]	1.411173 (1.46488) [0.96333]
D(LCI(-1))	0.114423 (0.35548) [0.32188]	0.165594 (0.24921) [0.66447]	-0.140185 (0.30446) [-0.46044]	-0.395181 (0.74450) [-0.53080]	-1.637346 (1.12987) [-1.44915]
D(LNL(-1))	-0.001264 (0.07759) [-0.01629]	0.011343 (0.05439) [0.20854]	0.038575 (0.06645) [0.58049]	-0.475060 (0.16250) [-2.92350]	-0.260223 (0.24661) [-1.05521]
D(LR(-1))	-0.057878 (0.05874) [-0.98537]	-0.036968 (0.04118) [-0.89778]	-0.086496 (0.05031) [-1.71938]	0.196650 (0.12301) [1.59860]	-0.438286 (0.18669) [-2.34768]
C	0.055952 (0.01864) [3.00118]	0.047881 (0.01307) [3.66347]	0.037605 (0.01597) [2.35508]	-0.017297 (0.03905) [-0.44300]	-0.032353 (0.05926) [-0.54599]

APPENDIX 4: Jarque-Bera



Series: Residuals	
Sample 1978 2020	
Observations 43	
Mean	-3.79e-15
Median	-0.001518
Maximum	0.097364
Minimum	-0.093570
Std. Dev.	0.040136
Skewness	-0.244251
Kurtosis	3.226754
Jarque-Bera	0.519675
Probability	0.771177

APPENDIX 5: Breusch-Godfrey serial correlation LM test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.307428	Prob. F(2,36)	0.7372
Obs*R-squared	0.722078	Prob. Chi-Square(2)	0.6970

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 09/11/21 Time: 15:33
Sample: 1978 2020
Included observations: 43
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBC	-0.005194	0.162719	-0.031922	0.9747
LCI	0.007706	0.143946	0.053535	0.9576
LNL	0.006173	0.066931	0.092222	0.9270
LR	-0.004337	0.045895	-0.094504	0.9252
C	-0.095804	1.649698	-0.058074	0.9540
RESID(-1)	0.132262	0.174127	0.759573	0.4525
RESID(-2)	-0.047916	0.183145	-0.261628	0.7951

R-squared	0.016793	Mean dependent var	-2.36E-16
Adjusted R-squared	-0.147075	S.D. dependent var	0.052255
S.E. of regression	0.055966	Akaike info criterion	-2.780252
Sum squared resid	0.112758	Schwarz criterion	-2.493545
Log likelihood	66.77541	Hannan-Quinn criter.	-2.674523
F-statistic	0.102476	Durbin-Watson stat	1.752531
Prob(F-statistic)	0.995642		

APPENDIX 6: LJUNG-Box Q

Date: 09/11/21 Time: 15:30
Sample: 1978 2020
Included observations: 43

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
. |*. |	. |*. |	1	0.116	0.116	0.6243	0.429
. | . |	. | . |	2	-0.029	-0.043	0.6644	0.717
. |*. |	. |*. |	3	0.108	0.119	1.2318	0.745
. | . |	. | . |	4	0.002	-0.028	1.2320	0.873
. |*. |	. |*. |	5	0.076	0.092	1.5238	0.910
.*| . |	.*| . |	6	-0.101	-0.142	2.0585	0.914
.*| . |	. | . |	7	-0.090	-0.047	2.4934	0.928
.*| . |	.*| . |	8	-0.161	-0.187	3.9189	0.864
.*| . |	.*| . |	9	-0.171	-0.112	5.5824	0.781
.*| . |	. | . |	10	-0.068	-0.059	5.8504	0.828
.*| . |	.*| . |	11	-0.159	-0.117	7.3848	0.767
. | . |	. | . |	12	-0.039	0.009	7.4818	0.824
. | . |	.*| . |	13	-0.065	-0.069	7.7536	0.859
.*| . |	. | . |	14	-0.077	-0.054	8.1449	0.882
. | . |	.*| . |	15	-0.054	-0.115	8.3492	0.909
.*| . |	.*| . |	16	-0.101	-0.135	9.0844	0.910
. | . |	. | . |	17	0.037	-0.042	9.1855	0.934
. | . |	.*| . |	18	-0.021	-0.104	9.2187	0.954
. | . |	. | . |	19	0.032	-0.014	9.3024	0.968
. | . |	. | . |	20	0.060	-0.038	9.6053	0.975

APPENDIX 7: ARCH LM

Heteroskedasticity Test: ARCH

F-statistic	0.551784	Prob. F(1,38)	0.4622
Obs*R-squared	0.572512	Prob. Chi-Square(1)	0.4493

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 09/11/21 Time: 15:38
Sample (adjusted): 1981 2020
Included observations: 40 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005517	0.001921	2.872700	0.0066
RESID^2(-1)	-0.114669	0.154370	-0.742821	0.4622

R-squared	0.014313	Mean dependent var	0.004886
Adjusted R-squared	-0.011626	S.D. dependent var	0.010829
S.E. of regression	0.010891	Akaike info criterion	-6.152992
Sum squared resid	0.004508	Schwarz criterion	-6.068548
Log likelihood	125.0598	Hannan-Quinn criter.	-6.122460
F-statistic	0.551784	Durbin-Watson stat	2.056715
Prob(F-statistic)	0.462157		

APPENDIX 8: Ramsey RESET tests results

Ramsey RESET Test
Equation: UNTITLED
Specification: AGDP BC CI NL R C
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.052846	37	0.2992
F-statistic	1.108484	(1, 37)	0.2992
Likelihood ratio	1.269318	1	0.2599

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	6.78E+17	1	6.78E+17
Restricted SSR	2.33E+19	38	6.14E+17
Unrestricted SSR	2.26E+19	37	6.12E+17

LR test summary:

	Value	df
Restricted LogL	-938.9586	38
Unrestricted LogL	-938.3239	37

Unrestricted Test Equation:
Dependent Variable: AGDP
Method: Least Squares
Date: 09/11/21 Time: 15:39
Sample: 1978 2020
Included observations: 43

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BC	0.348483	0.244804	1.423517	0.1630
CI	3.288385	1.050124	3.131426	0.0034
NL	-490.1240	1604.715	-0.305427	0.7618
R	-51942.07	767696.6	-0.067660	0.9464
C	-7.58E+08	1.18E+09	-0.640778	0.5256
FITTED^2	3.15E-12	2.99E-12	1.052846	0.2992

R-squared	0.993979	Mean dependent var	1.33E+10
Adjusted R-squared	0.993166	S.D. dependent var	9.46E+09
S.E. of regression	7.82E+08	Akaike info criterion	43.92204
Sum squared resid	2.26E+19	Schwarz criterion	44.16779
Log likelihood	-938.3239	Hannan-Quinn criter.	44.01267
F-statistic	1221.669	Durbin-Watson stat	1.053796
Prob(F-statistic)	0.000000		