# “The finance-growth nexus in South Africa’s agricultural sector: a structural equation modeling approach”


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# The finance-growth nexus in South Africa's agricultural sector: a structural equation modeling approach

## Abstract

This paper examines the relationship between finance and growth in the agricultural sector in South Africa using a structural equation model (SEM) approach. A total of 500 smallholder farmers were surveyed in the Mpumalanga and North West Provinces using a structured questionnaire. Data from the 362 responses received was captured in the Statistical Package for Social Sciences (SPSS) and analyzed using the Analysis of Moment Structures (AMOS). It was observed that short-term debt and long-term debt contribute to growth in the farmers' output. This is achieved through the acquisition of improved seed technologies and pesticides using short-term debt on the one hand. On the other, long-term debt is used to acquire capital equipment used on the farm. Furthermore, labor was observed to have a positive and significant influence on the farmer's output growth. The implications of the study are that farmers should use more long-term debt than short-term debt to maximize productivity. These results support policies directed at increasing credit supply to farmers in South Africa.

**Keywords:** finance, agriculture, South Africa, structural equation modeling.
**JEL Classification:** D2, G21, Q14.

## Introduction

This paper examines whether variations in bank lending to South Africa's farmers cause subsequent changes in agricultural productivity. In South Africa, agriculture contributes about 3 percent to gross domestic product (GDP) and approximately 7 percent to formal employment. With an unemployment rate hovering around 21 percent, it is important to understand where investment efforts need to be channelled to in order to improve economic growth and simultaneously alleviate unemployment. Banks play an important role in the transmission of monetary policy actions. A large amount of literature has focused on the relationship between finance and economic growth in the real economy.

Many farmers in South Africa, particularly smallholder farmers are credit constrained and are therefore unable to immediately substitute other forms of finance for bank loans. It has been argued that the lack of access to credit has adversely affected the productivity of farmers. Coetzee et al. (2002) and later Chisasa and Makina (2012) both examined the supply of credit to smallholder farmers in South Africa and concluded that smallholder farmers are indeed credit constrained mainly due to their inability to provide collateral required for formal bank credit. Wynne and Lynne (2003) confirmed that lack of credit was hampering the development of smallholder farmers in South Africa but did not test the contribution of credit to farm performance. Recently, Chisasa and Makina (2013) using the Cobb-Douglas production function of the Ordinary Least Squares (OLS) method and verified that at a macro level, credit makes a positive and significant contribution to agricultural output. This paper contributes to a better understanding of the impact of bank finance to growth in agricultural output of smallholder farmers since they are the ones most vulnerable to the credit granting criteria used by formal lenders due to lack of collateral. The paper uses structural equation modelling (SEM) which is a superior statistical technique to multiple regression used in previous studies to determine the effect of bank credit on the productivity of smallholder farmers in South Africa.

The rest of the paper proceeds as follows. Section 1 presents the literature review. Section 2 outlines the methodology. The results are presented and discussed in Section 3. The final Section concludes the study.

## 1. Literature review

**1.1. Credit as a factor of production.** The use of credit as an independent variable in the agricultural production function in empirical studies has been challenged (see for example Driscoll, 2004, p. 469; and Nkurunziza, 2010, p. 489). However, Sial et al. (2011, p. 128) have posited that improved seeds and other inputs like tractors, fertilizer and biocides that may be purchased using credit money play an important role in agricultural production and these can be directly influenced by the availability of credit.

The inclusion of credit as an explanatory variable in the production function is usually challenged on the grounds that it does not affect the output directly; rather it has an indirect effect on output through easing the financial constraints of the producers in purchasing inputs (Carter, 1989). Carter (1989, p. 19) argues that credit affects product in the agricultural sector in three ways. First, it encourages efficient resource allocation by overcoming constraints to purchase inputs and use them optimally – "...this sort of effect would shift the farmer along a given production surface to a more intensive and more remunerative input combination". Secondly, if the

credit is used to buy a new package of technology, say high-yielding seed and other unaffordable expensive inputs, it would help farmers to move not only closer to the production frontier but also shift the entire input-output surface. In this regard it embodies technological change and a tendency to increase technical efficiency of the farmers. Finally, credit can also increase the use intensity of fixed inputs like land (Kumar et al., 2013, p. 15), family labor, and management, persuaded by the "nutrition-productivity link of credit" – that raises family consumption and productivity. Carter's reasoning implies that agricultural credit not only improves management efficiency but also affects the resource allocation and profitability.

Gosa and Feher (2010) analyzed the financial resource implications on agriculture performance in Romania taking into account both bank and trade credit. First, direct bank credit to agriculture was observed to be low paving way for the development of trade credit (supplier's credit). Trade credit is a financing alternative agreed, in case of need, by input beneficiaries (farmers) and suppliers as well. Second, although trade credit was found to be more expensive than bank credit, it was seen to be more operative and thus more appealing. It can be inferred from this analysis that not only is credit required to enhance farmer profitability as was later concluded by Gosa and Feher (2010, p. 7), but that the turnaround time for accessing the credit was also found to be key.

Obilor (2013, p. 91) observed that commercial banks' credit to agricultural sector for the period of 1984 to 2007 had no significant positive impact on productivity in Nigeria. However the researcher noted that the agricultural credit guarantee scheme loan by purpose led to a significant positive growth in agricultural productivity in Nigeria. Thus, while generally concurring that credit is a necessary factor in the agricultural production function, Obilor (2013) emphasizes the provision of credit guarantees by government to lenders. The credit guarantee scheme indirectly acts as security for the repayment of bank loans advanced to the agricultural sector where loan repayment may be jeopardized by the risky nature of agricultural production. These results confirmed an earlier study by Ammani (2012) in Nigeria.

The strategic role of financial credit in accelerating agricultural production in Nigeria was also analyzed by Sogo-Temi and Olubiyo (2004). Generally, it was proved that one of the most important determinants of growth in agricultural output is availability of productive credit. However, it was opined that the insignificance of the parameter estimates could be attributed to diversion of bank credit to non-productive ventures such as marriage, funeral ceremonies and other social functions. Despite this setback, several empirical studies concur that credit is an important instrument that enables farmers to acquire commands over the use of working capital, fixed capital and consumption goods (Siddiqi et al., 2004, p. 161; Sial et al., 2011, p. 7; Simsir, 2012, p. 362). As agriculture is a multi-product industry, Saleem and Jan (2011, p. 3) used agricultural gross domestic product (AGDP) as the dependent variable and agricultural production was assumed to be the function of credit disbursed by different financial institutions for irrigation purposes, seeds, fertilisers, pesticides, implementation of tractors and other purposes. Over eighty percent of agricultural gross domestic product was observed to be attributable to total credit supplied.

While supporting the hypothesis that institutional credit positively impacts productivity in agriculture in India, Sidhu et al. (2008, p. 407) argue against the uniform supply of credit across all regions. Rather, they suggest that region-specific credit demand patterns must be assessed first, depending on crop patterns and current inputs and capital requirements in relation to targeted output growth rate. Afterwards, a policy framework should be put in place to meet those requirements, instead of increasing the credit supply uniformly across the regions of the country. Subsequently, Kumar et al. (2010, p. 259) reported that regional disparities in the distribution of institutional credit in India seem to have declined over time from 122 percent in 2000-01 to 81 percent in 2007-08. However, 81 percent still remains a significant level which demonstrates that the regional disparities in institutional credit flow do exist and still characterize the rural credit system.

**1.2. Non-financial factors which affect agricultural output.** Turning to nonfinancial factors which influence the level of agricultural output, this section discusses rainfall, land and labor as some of the factors that influence farm output. These are considered in the following subsections.

*1.2.1. Rainfall.* Erratic rainfall is an inherent characteristic of semi-arid sub-humid tropical agro-ecosystems, limiting landscape productivity (Barron et al., 2010, p. 543). Farmers not only have to contend with market risks but also with environmental factors such as weather (Development Bank of South Africa, 2011). During drought periods, crops wither before maturity. In times of excess rains, which normally result in floods and water logging, the yields are poor. According to Rouault and Richard (2003, p. 489) the 8 most severe droughts in the history of South Africa since 1921 occurred in 1926, 1933, 1945, 1949, 1952, 1970, 1982 and

1983. See also Blignaut et al. (2009, p. 61). The total number of wet and dry districts per decade seems to have increased since the 1960s. Faures et al. (2010, p. 529) argue that harvested area may depend on direct weather factors, for instance, when drought wipes out the crops from a farm, resulting in the harvested area being smaller than the planted area. On the other hand, yield is very much the result of the overall health of the plants, which is affected in more or less subtle and direct ways by weather, starting with sunshine, the driver of photosynthesis, and water availability from rainfall and irrigation, which defines to which extent plants can actually make use of available solar energy. In most places, water availability is the factor that most directly conditions crop yields, and in the areas where water is plenty, the main limiting factor usually becomes sunshine. Consequently, rainfall can either have a positive or negative impact on farm output. For instance, droughts and too much rain could have a negative impact while moderate rain could have a positive impact.

South Africa is characterized by a semi-arid climate. To supplement its water requirements for agricultural use, irrigation schemes have been set up (Fanadzo et al., 2010, p. 3516). According to Fanadzo (2010, p. 3516), the development of irrigation schemes started during the Cape Colony and went through several eras. The irrigation management transfer and revitalization era is the most recent and current smallholder irrigation system in South Africa. The management of the irrigation system was transferred from government to the farmers. Since then, government withdrew and water user associations were formed. Similar arrangements are also found in Nigeria; see for instance Olubode-Awosola et al. (2006, p. 305).

The above discussion demonstrates the importance of rainfall or water as a factor of production. See also Harris-White (2008, p. 549-561) and Nair (2008, p. 61). According to Nair, "... water resources management has been an issue in many African countries including ineffective functioning of institutions. In addition, the neglect of research and development and its funding has hindered the growth of the agricultural sector".

*1.2.2. Land.* Land is one of the key factors of production across sectors including agriculture (McMichael, 2009, p. 235; Lipmann, 2010, p. 90; Jaffe and Zeller, 2010, p. 531). Historically, black farming in South Africa has not been supported, while white farming has been given preferential support through government subsidies and legislation. This created a highly dualistic agricultural sector, with black farmers cultivating small pieces of land (Rother et al., 2008, p. 399; Palmer and Sender, 2006, p. 349) with insufficient investment or institutional support (Oettle, 1998, p. 6). Complementary to farmer efforts, government needs to formulate policy that makes it possible for farmers to acquire land to cultivate. As a result, land reform has been a topical subject around the world (Deininger, 2007, p. 16). According to Udoh (2011, p. 290), restrictive laws pertaining to land use need to be amended to make more land available for large scale agriculture. For example, the historical imbalances in South Africa require an intervention which will see the transfer of some amount of land to the previously disadvantaged farmers who operate on very small farms.

As reported by Graham and Darroch (2001, p. 295), land reform in South Africa took a two-pronged approach, namely, government assisted land acquisition and land acquired through private transactions. Households in government assisted projects had less tenure security than households that acquired land through private transactions. Using panel household data from India, together with state-level variation in the implementation of land reform, Deininger et al. (2007, p. 17) found land reform to have a positive impact on accumulation of assets in the form of physical as well as human capital. It was also observed that land reform leads to economic growth. Furthermore, Guirkinger and Boucher (2008, p. 36) found that a positive land reform policy is required as a precondition for alleviating credit constraints. For instance, the first stage of most financial liberalization programs in Latin America was accompanied by liberalization of agricultural land markets in the form of land titling programs, investment in land registry institutions, and elimination of legal impediments for the transfer of land. By instituting these reforms, credit rationing is reduced as a result of the use of land as collateral.

Mahabile et al. (2005) in Botswana also observed a strong relationship between farm size and access to credit arguing that farmers with secure land tenure (private farms) and larger herds of livestock use more agricultural credit than those relying on communal grazing land to raise cattle. Investments in fixed improvements to land and herd productivity were found to be positively related to secure land tenure via higher levels of liquidity from long term credit.

Although collateral does not provide a guarantee for accessing credit, it improves the chances of access. While owning land should help alleviate the credit constraint (Hertz, 2009, p. 76), where markets for farmland are thin or missing as they are in many countries with a socialist background, land is of limited value as collateral. The size of the land is also an important attribute to be considered (Mac-

Leod et al., 2008, p. 76). Progress has been made in addressing the land problem in South Africa. However, one of the constraints to maximizing productivity is the farm size. According to MacLeod et al. (2008, p. 76), many of these farmers will not be viable due to limited farm size.

*1.2.3. Labor.* Labor is an integral variable in the agricultural production function. Various definitions of labor have been put forward. For example, Baumol and Blinder (2006, p. 486) define labor input in the production function as the number of hours worked. Holding other factors constant, output rises as labor inputs increase.

Zuberi (1989, p. 53) recommended that any strategy designed to increase agricultural productivity in Pakistan must focus on channelling investment towards human capital development with emphasis being placed on both primary and secondary schools. In the case of South Africa, Fatoki and Odeyemi (2010, p. 133) suggest that educational institutions should introduce and strengthen entrepreneurial education. They argue that when learners are oriented into entrepreneurship at an early age, it increases their probability of success as entrepreneurs. A different view is offered by Dhehibi and Luchaal (2006, p. 255) for Tunisia. After investigating the patterns of productivity in Tunisian agriculture, they observed that capital was the most important contributor to output growth. The variable capital stock was defined as including machinery, installations and buildings. Labor was in fact found to be the least contributor to economic growth. Among other empirical work, these studies attempt to provide answers to the question posed by Cobb and Douglas (1928, p. 140) whether "... it may be possible to determine, again within limits, the *relative* influence upon production of labor as compared with capital?"

In light of the foregoing, Bratka and Praulins (2009, p. 14) posit that farm profitability is dependent upon both the amount of the factors of production employed and the ability to mix these factors such that profitability is maximized. The ability to productively combine the factors of production is also crucial. As a result of this analysis, Bratka and Praulins hypothesize that some managers are more successful in maximizing profits than others. In Cameroon, Bayemi et al. (2009, p. 907) found evidence supporting this hypothesis. A study was conducted to evaluate the impact of management interventions to solve constraints in smallholder dairy farms of the Western Highlands of Cameroon. A reduction in expenditure and an overall increase in farm income were observed. The intervention had a positive impact which led to poverty alleviation and some farmers acquired more cows. These results are consistent with those of Nuthall (2009, p. 413) who posits that "... the efficiency of production from a farm's land, labor and capital are critically dependent on the ability of the farm manager." Nathall argues that a farmer's exposure to experiences is a significant factor in ability, as is the farmer's management style and the family influence on early life experience.

## 2. Research model and hypotheses development

The hypothesized SEM model for agricultural output is presented as Figure 1 below. Within the context of structural modeling, exogenous variables represent those constructs that exert an influence on other constructs under study and are not influenced by other factors in the quantitative model. Those constructs identified as endogenous are affected by exogenous and other endogenous variables in the model. This model hypothesizes that agricultural output (AOutput) is predicted by land size (LS), labor (LH), short-term debt (STD), long-term debt (LTD) and rainfall. The single-headed arrows represent causal relationships between explanatory variables and the dependent variable while double-headed arrows represent covariances between explanatory variables.

Previous studies argue that land size is a significant predictor of agricultural output (Sial et al., 2011; Chisasa and Makina, 2013). This leads to the first hypothesis:

H1: There is no supported relationship between land size and agricultural output.

The number of man hours spent on the farm influences agricultural output, i.e., farmers who spend longer hours on the farm have a high level of productivity. This leads to the second hypothesis of this study:

H2: There is no supported positive and significant relationship between labor (hours) and agricultural output.

Furthermore, empirical evidence (Bernard, 2009; and Enoma, 2010) posits that short-term credit (STD) which is used to acquire inputs and pesticides (working capital) has a positive and significant influence on agricultural output. This leads to the third hypothesis:

H3: Short-term credit has no positive and significant influence on agricultural output.

Prior research in agricultural production has identified rainfall as a necessary input for agricultural production (Barron et al., 2010; Faures et al., 2010). This leads to the fourth hypothesis:

H4: There is no supported relationship between rainfall and agricultural output.

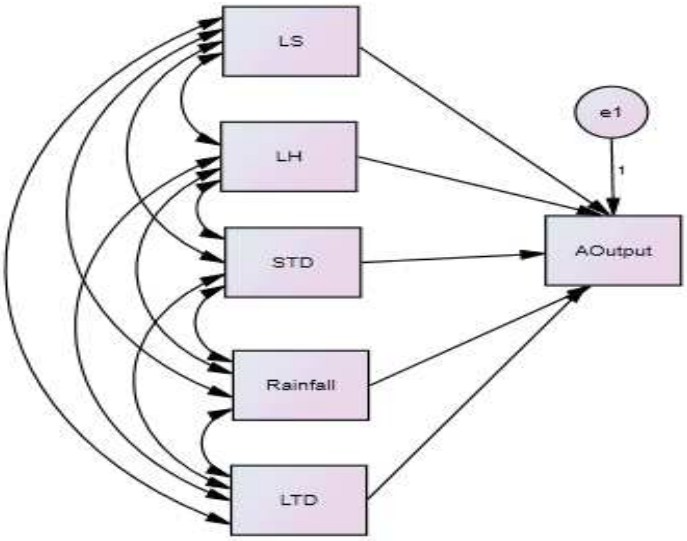


**Fig. 1. Impact of credit on agricultural output**

A number of researchers have explored the influence of long-term debt (LTD) on agricultural output. For instance, Darroch (2001) in South Africa and later Deininger et al. (2007) in India found long-term debt to facilitate private ownership of land required for farming. This leads to the fifth and final hypothesis of this study:

H5: Long-term debt has no positive and significant influence on agricultural output.

## 3. Data and methodology

To test the hypothesized agricultural output model, the paper utilizes survey data from Mpumalanga and North-West Provinces of South Africa. A total of 500 smallholder farmers were surveyed using a structured questionnaire. The two-stage sampling technique was used applying simple random sampling. The research instrument was successfully subjected to reliability and validity tests using the Cronbach alpha and confirmatory factor analysis (CFA) methods respectively. Three hundred and sixty-two (362) responses were received, representing a 72.4 percent response rate. The data were analyzed using the Statistical Package for Social Sciences (SPSS) Version 22.0. The research instrument satisfied the criteria for reliability with a Cronbach alpha value of 0.732.

This study utilizes structural equation modelling (SEM) using the Analysis of Moment Structures (AMOS) for robust results. Thus the study hypothesized that agricultural output is a function of land size (LS), climate (proxied by rainfall), labor (LH) and bank credit proxied by short-term debt (STD) and long-term debt (LTD).

## 4. Empirical results

### 4.1. Descriptive statistics.

Table 1. Descriptive statistics

| | Mean | Standard deviation | N |
|---|---|---|---|
| Agricultural output (AO) | 1.59 | 1.034 | 362 |
| Land | 3.22 | 1.417 | 362 |
| Labor | 2.7 | 1.139 | 362 |
| Short-term credit | 1.76 | 1.275 | 362 |
| Long-term credit | 1.65 | 1.279 | 362 |
| Rainfall | 504.36 | 129.383 | 362 |

From Table 1 above, the average total valid observations summed to $n$ = 362. An analysis of the descriptive statistics reveals that respondents attain agricultural output of between R50 000 and R60 000 annually (mean score = 3.22). This level of performance is supported by land sizes averaging 16-20 hectares. Both short-term and long-term credit were in the range of R35 000 to R110 000. With labour hours per person per day dedicated to the farm on a day-to-day basis, it appears less convincing that the resources dedicated to the farm by the respondents are sufficient to maximize production particularly given land sizes of 11 to 20 hectares.

**4.2. Chi-square test.** Table 2 below presents the chi-square test results for bivariate correlations between the predictor variables and agricultural output. All the predictor variables were observed to have significant correlations with agricultural output ($p < 0.05$). The Chi-square test results depicted in Table 2 lower fail to confirm that the model fits the data being observed. The probability level is found to be significant ($p < 0.05$). To verify these

results and cognisant of the weaknesses of the Chi-square test statistic elucidated above, further and more robust tests are applied using goodness of fit indices.

Table 2. Pearson chi-square test between predictors and agric output

| Item No. | Relationship | Value | df | Chi-sq |
|---|---|---|---|---|
| 1 | Land size | 38.242 | 20 | 0.008*** |
| 2 | Short-term debt | 70.931 | 25 | 0.000*** |
| 3 | Long-term debt | 111.907 | 25 | 0.000** |

Note: *; **; *** denotes significance at 1%, 5% and 10% respectively.

**4.3. Best fit model for agricultural output.** *4.3.1. Maximum likelihood estimates.* The regression model that forms part of the SEM process confirmed that there are relationships between most variables, which are consistent with theory. The path coefficients pre sented in Table 3 below are positive and significant at 5 per cent ($p < 0.5$). While previous studies have shown total credit to be positively and significantly related to agricultural output, this study breaks credit into its short-term and long-term components. It is observed that long-term credit has a higher contribution to agricultural output (.189 or approximately 19%) than short-term credit (.120 or 12%). These results are in line with Patil's (2008) recommendations for a long-term credit policy for Indian smallholder farmers. Similarly, a 1 unit increase in land size is observed to lead to a 10% increase in agricultural output holding other factors constant. The contribution of the variable land to agricultural output, though significant, is observed to command the lowest direct effect. These results confirm the theory of production.

Table 3. Regression weights (group number 1 – default model)

| | | | Estimate | S.E. | C.R. | *p* |
|---|---|---|---|---|---|---|
| Agricultural output (Q14) | <--- | Short-term debt (Q21) | .120 | .044 | 2.736 | .006 |
| Agricultural output (Q14) | <--- | Land size (Q7) | .100 | .037 | 2.710 | .007 |
| Agricultural output (Q14) | <--- | Long-term debt (Q22) | .189 | .043 | 4.376 | *** |

Table 4 below shows the simple correlations between exogenous variables. Both short-term and long-term credit have a strong correlation with land size ($p < .05$). Similarly, short-term credit and long-term credit have a strong bi-directional correlation.

Table 4. Covariances (group number 1 – default model)

| | | | Estimate | S.E. | C.R. | *p* |
|---|---|---|---|---|---|---|
| Land size (Q7) | <--> | Short-term credit (Q21) | .452 | .098 | 4.626 | *** |
| Land size (Q7) | <--> | Long-term credit (Q22) | .355 | .097 | 3.665 | *** |
| Short-term credit (Q21) | <--> | Long-term credit (Q22) | .646 | .092 | 7.015 | *** |

Table 5. Squared multiple correlations ($R^2$): (group number 1 – default model)

| | Estimate |
|---|---|
| Agricultural output (Q14) | .145 |

The results for the hypothesized Model 1 showed that labor and rainfall were insignificant in explaining agricultural output. Land size ($\beta$ =.014), short-term credit ($\beta$ =.15) and long-term debt ($\beta$ =.23) explain about 15% ($R^2$ =.145) of agricultural output model depicted in Figure 2 below. Table 5 above is illustrative. In keeping with the SEM methodology, rainfall and labor were not retained for modeling agricultural output using SEM. The final model is presented as Figure 2 below.

Where: AOutput: is the endogenous variable Agricultural output and e1: Error term. The other variables are as previously defined.

Chi-Square, Root mean square error of approximation (RMSEA), Tucker Lewis Index (TLI) and Comparative Fit Index (CFI) were used to determine the goodness of fit for Model 1 above. The results are presented below.

*4.3.2. Model Fit for SEM using goodness of fit indices.* The main objective of this study was to test the relationship between bank credit and agricultural output. All the indices in Table 6 below confirm that all the sample data fit the model significantly. CMIN = 0.00, GFI = 1.00, TLI = 0.00, CFI = 1.00, PCFI = 0.00, NFI = 1.00 and PCLOSE = 0.00. Only RMSEA showed a poor model fit, however, as the majority of indices confirmed a good model fit, results of the RMSEA index were discarded and consistent with Schreiber et al. (2010, p. 327) it was concluded that the model fits the data being tested.

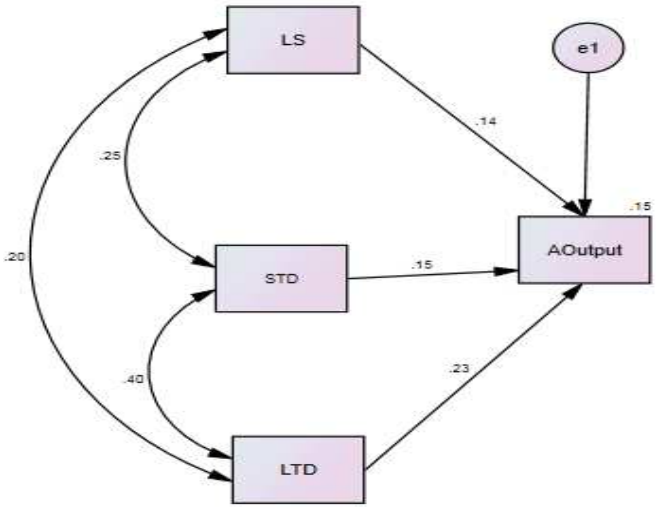


**Fig. 2. Impact of credit on agricultural output**

Table 6. SEM model fit indices

| Index | Recommended value | Output | Remark |
|---|---|---|---|
| CMIN | < 05 | 0.000 | Very good |
| GFI | ≥0.95 (not generally recommended). | 1.000 | Very good |
| TLI | ≤ 1 (values close to 1 indicate a very good fit) | 0.000 | Good |
| CFI | ≤ 1 (values close to 1 indicate a very good fit) | 1.000 | Very good |
| PCFI | Sensitive to model size | 0.000 | Very good |
| RMSEA | ≥ 0.06 to 0.08 with confidence interval. | 0.255 | Insignificant, therefore poor model fit. |
| NFI | ≤ 1 (values close to 1 indicate a very good fit); indices less than 0.9 can be improved substantially. | 1.000 | Very good |
| PCLOSE | < 05 | 0.000 | Very good |

**4.4. Discussion of results.** To account for the dearth of time series secondary data for smallholder farmers a survey approach was adopted for examining the influence of short-term credit, long-term credit, land size, labor and rainfall on agricultural output. The chi-square test results for bivariate correlations between the agricultural output and predictor variables was observed to be significant ($p < 0.05$). However, when applying structural equation modelling, only land size, short-term credit and long-term credit were found to significantly influence agricultural output. These results correlate with those obtained when using time series secondary data discussed above.

The results of this study have demonstrated that smallholder farmers need credit to improve their output. A 1% increase in short-term credit will result in a 0.14% increase in agricultural output holding other factors constant. Furthermore, a 1% increase in long-term credit will result in a 0.23% increase in output. These results suggest that smallholder farmers need more long-term credit facilities. The long-term credit may be utilized to purchase capital equipment required to mechanize farming operations. These may be in the form of tractors, irrigation equipment and combine harvesters. On the other hand, short-term credit is required to purchase inputs such as improved seed varieties for improved technical efficiency, fertiliser and pesticides, and to pay wages and salaries. These results are in line with those of Kohansal et al. (2008) who investigated the effect of credit accessibility of farmers on agricultural investment. Using a Logit model, the authors observed a strong relationship between access to credit, increased profitability of the farmer and poverty reduction in the agricultural sector. Similarly, Gosa and Feher (2010) found trade credit to enhance the competitiveness and profitability of farmers in Romania. Al Rjoub and Al-Rabbie (2010) examined whether changes in the level of credit supply by banks in Jordan would affect output. As with other empirical studies discussed above and Adewale (2014), results showed a positive and statistically significant correlation between bank credit and output growth.

Land has also been observed to have a significant contribution to production and its positive coefficient suggests that a 1% increase in land size will result in a 0.12% increase in farm output. These results correlate with those of Feder et al. (1990) who concluded that the quantity of land is an important and statistically significant determinant of output supply for constrained and unconstrained households in Chinese agriculture.

Both labor and rainfall were observed to be insignificant. However, their coefficients were positive suggesting that they are vital factors in the agricultural production function. Similar results were observed by Ehikioya and Mohammed (2013) in Nigeria.

## Summary and conclusion

The analysis of the relationship between bank credit and agricultural output is premised on the assump-

tion that the more credit is channelled to farmers, the higher will be the farm output. In South Africa, it has been argued that farmers perform poorly because they are credit constrained. When compared to private firms, farmers have received less credit from formal lending institutions. The purpose of this paper was to examine the relationship between bank credit and agricultural output in South Africa using survey data from Mpumalanga and North West Provinces. Data was captured into the Statistical Package for Social Sciences (Version 22.0) and analyzed using Analysis of Moment Structures (AMOS) in the form of a structural equation model.

Results show that short-term credit, long-term credit and land contribute positively to a farmer's output growth. Short-term credit is required to support working capital requirements of the farmer. Thus using short-term credit farmers are able to access pesticides and improved seed (increase technical efficiency). Long-term credit is applied in the mechanization of farming operations through acquiring capital equipment. Long-term credit also enables farmers to acquire more land through private transactions which can be used as collateral for further access to credit from financial institutions. In light of the strategic importance of the agricultural sector to South Africa's economy, this paper therefore, supports an increase in the supply of credit to farmers. The implications of the study are that farmers should use more long-term debt than short-term debt to maximize productivity. Owing to the absence of time series secondary data for smallholder farmers, this study was limited to cross-sectional analysis. An investigation covering a longer period could have given more informative results. Thus an extension of this study to other provinces is recommended.

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