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RESEARCH ARTICLE

AGRICULTURAL CREDIT GUARANTEE SCHEME FUND AND FOOD CROP PRODUCTIVITY IN SOUTHERN NIGERIA

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ABSTRACT

Agriculture has the potential to accelerate the pace of economic growth in any country. Unfortunately, the contribution of agriculture most especially food crops to the Gross Domestic Product(GDP) of Nigeria has been on the decline since oil was discovered in commercial quantities in 1970s. To salvage the sector, the Federal Government of Nigeria established the Agricultural Credit Guarantee Scheme (ACGS) in 1977, with the purpose of increasing the level of bank credit to the agricultural sector through the provision of guarantee in respect of loans granted by any bank for agricultural purposes. This study conducted a 14 year impact analysis of this agricultural credit guarantee scheme fund on food crop production by smallholder farmers in Southern Nigeria. The study specified a model based on the Cobb-Douglas production function with three explanatory variables. Data were generated from the Central Bank of Nigeria Statistical bulletin and National Bureau of Statistics (NBS). The results were analyzed using fixed effects panel data analysis. The results revealed that agricultural credit guarantee has a positive significant impact on food crop production of smallholder farmers in Southern Nigeria.

INTRODUCTION

Finance for agricultural development and productivity has an increasing role in contemporary times. Globally, agricultural credit guarantee schemes have been identified as the major input for the development of agricultural sector because of its traditional role in filling up the financial gap between farmers and financial institutions for increased productivity. According to N. Nzotta and E. Okereke (2009), agricultural credit guarantee affects economic growth, and its absence can stagnate or decline any economic system. However, a growing concern has developed over the years considering the need for effective access to credit facilities for farming purposes (C. Akinseye, 2011). The Nigerian government also recognises that credit to agriculture is an essential tool for promoting agricultural development because the agricultural sector is one of its main sources of sustainability. More so, access to agricultural credit is an incentive for increasing the performance of the agricultural sector. Credit serves as a source of funds to farmers that can be utilized in the production process (Awotodunbo, 2008). Agriculture holds the potential in accelerating the pace of economic growth and development of several countries of the world. It is the largest single employer and contributor to GDP in most African countries (International Fund for Africa's Development, 2001). In Nigeria, during the pre and immediate post-Independent era, Agriculture was the mainstay of the economy.

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Agriculture contributed 60% of the Nation's Gross Domestic Product and foreign exchange (Central Bank of Nigeria, 1995) and small-holder farmers play a dominant role in this contribution (Rahji & Fakayode 2009). In southern Nigeria states, small-holder farmers extensively cultivate crops such as cassava, yams, cocoyam and potatoes. In terms of production, most states in Southern zones such as Cross River, Akwa Ibom, Rivers and Delta states dominate yam and cassava production in the South-South. Ogun, Ondo and Oyo states dominate cassava and yam in the South -West and Enugu and Ebonyi states dominate yam and cassava production in the South- East. By zone, the North Central zone produced over 7 million tonnes of cassava a year. South- South produces over 6 million tonnes a year while the South -West and South- East produce just less than 6 million tonnes a year. The North-West and North- East are small by comparison at 2 and 0.14 million tonnes respectively, (Federal Ministry of Agriculture and Water Resources (FMARD, 2008).These crops are dominantly produced in these regions because of their agro ecological zones such as High forest, Derived savannah, mangrove and rainforest (National Bureau Statistics 2009). Most recent attempts to expand cassava and yam production have been done under the Roots and Tubers Expansion Programme (RTEP). The institutional framework for cassava and yam production in Nigeria includes the National Root Crops Research Institute (NRCRI), Umudike: Establishment of substation for Yam seed Multiplications Programme, Cassava Improvement/Seeding, etc, Cassava Multplication Programme (CMP), International institute for tropical agriculture (IITA), Ibadan, Nigeria and RTEP. The Roots and Tubers Expansion Programme, funded by a loan from IFAD, was established

mainly for multiplication and distribution of planting materials. RTEP is an IFAD-assisted project with counterpart contributions from federal and state governments. It was initially conceived as a root and tuber multiplication scheme, but later included a post-harvest component as a result of anticipated production expansion. The program was implemented in twenty seven cassava-producing states and was recently recommended to include processing and marketing components (Presidential Research and Communication; PRCU 2006). Meanwhile, the expansion of food crop production by small-holder farmers in Nigeria has been hindered by poor accessibility to credit amongst several factors to sustain production let alone expand production to harness the growing export market of major Agricultural commodities, (Food and agricultural Organization, 2010). This was further emphasized by B. Omojimite (2012), who stressed that Nigerian agriculture is largely subsistence and access to adequate funds have been a major bottleneck. According to A. Olaitan (2006) credit was identified as one of the major causes for declining agricultural production (shortage of primary production). In a study conducted by the Central Bank of Nigeria in 1976, this shortage was attributed to reluctance by the banks to provide credit for real sector activities, especially agricultural production. It is estimated that only 2.5 percent of total Commercial Bank loans and advances is directed at agriculture (CBN; 2008). The importance of credit to Agricultural production cannot be overemphasized and in view of this, the Agricultural Credit Guarantee Scheme Fund (ACGSF) was set up with the sole purpose of providing guarantee in respect of loans granted by any bank for agricultural purposes.

According to A.Wahab (2011), the lack of interest by commercial bank and merchant banks in agricultural financing necessitated the need for the establishment of the scheme. The Scheme was established by Decree 20 of March, 1977 and was amended on 13th June, 1978 (N.Oguoma, B.Chendo & H.Ukoha, 2010). Agricultural credit guarantee plays a fundamental role in determining access to the needed inputs that facilitates farming and other extensive agricultural practices which ultimately transforms into increased output and link (multiplier effect) in the development of other sectors. This also translates to higher income and better quality of life for the rural poor (Hazell,2005). It commenced with a fund of one hundred million naira subscribed to by the Federal Government and Central Bank of Nigeria in the ratios of 60% :40% respectively. The Scheme provides guarantee cover for loans advanced to the agricultural sector by banks and the cover pledges to pay to the banks 75% of any outstanding default balance by borrowers provided that collateral pledged has been realised and applied to the account. The Central Bank of Nigeria manages the Fund, and is responsible to a Board. The Bank issues a guarantee certificate to the lending bank to pay 75% of any outstanding balance in the event of default less the amount realised from the security pledged by the borrower. The lending bank can file a claim on the Fund if the above has been fulfilled. The purposes for which loans can be granted under the scheme are those connected with the following: establishment/management of plantations for the production of rubber, oil palm, cocoa, coffee, tea and similar crops; cultivation of cereal crops, tubers, fruits, cotton, beans, groundnut, sheanuts, benniseed, vegetables, pineapples, banana and plantains; animal husbandry i.e. poultry, piggery, cattle rearing, fish capture and fish farming; processing, especially where integrated with at least 50% of farm output; and farm machinery and hire services, (CBN, 1990). Indeed, there has been a number of financial institutions, schemes and programmes in Nigeria that can adequately provide the financial needs of farmers. Among the measures introduced since 1970 in recognition of the unhealthy condition of the Nigerian agricultural sector were the large-scale mechanized farming by state and federal governments, the River Basin Development Authority, Nigeria Agriculture and Cooperative Bank(NACB), National Accelerated Food Production (NAFP), Operation Feed the Nation (OFN), Green Revolution Programme (GRP), Structural Adjustment Programme (SAP), and the Directorate for Food, Roads and Rural Infrastructure (DFRRI) (A.Enoma; 2010). More so, the risk perception faced by banks to lend to farmers who cannot provide adequate security in form of collateral for such loans has been eliminated by the credit guarantees of ACGS. It is of concern that the major problem of the Nigerian agriculture still remains inadequate funding by government and private financial institutions. According to the CBN (2007), about 65 percent of Nigeria's economically active population lack access to formal financial services, hence the continuous efforts by successive governments to address the issue. Moreso, A. Olaitan (2006) noted that the country has been grappling with the decline in agricultural production which is worsened by an increasing population. Inadequate finance to the agricultural sector has caused a decline in agricultural production and agribusinesses. This of course raises doubts about the effectiveness of the Agricultural Credit Guarantee Scheme Fund which was introduced to specifically provide guaranteed credits to farmers to enhance agricultural production. ased on the aforementioned scenario, it becomes imperative to analyse the effect of the Agricultural Credit Guarantee Scheme Fund (ACGSF) on agricultural production output in Nigeria. The study focussed on food crop production by smallholder farmers at regional levels. This is because the successful operation of the ACGSF in enhancing access to finance is an opportunity to increase the level of entrepreneurial capabilities of the smallholder farmers in Nigeria. It is also a tool to increase agricultural productivity, food security, raw materials for related industries, employment generation and export promotion potentials. Hence such an assessment will reveal the extent to which the scheme has stimulated agricultural production especially after more than 30 years of its operation in Nigeria.

Statement of the Problem

Agriculture holds the potential in accelerating the pace of economic growth and development of several countries of the world. It is the largest single employer and contributor to Gross Domestic Product in most African countries (International Fund for Africa's Development, 2001). In Nigeria, during the pre and immediate post-Independent era, agriculture was the mainstay of the economy. Agriculture contributed 60% of the Nation's Gross Domestic Product and Foreign exchange earnings (Central Bank of Nigeria, 1995). Finance on the other hand for agricultural development has an increasing role in contemporary times. Globally, agricultural credit guarantee has been identified as the major input for the development of agricultural sector due to its advantage of easy credit access to farmers for increased productivity. The Nigerian government recognises that credit to agriculture is an essential tool for promoting agricultural development because

the agricultural sector is one of its main sources of sustainability. More so, access to agricultural credit is an incentive for increasing the agricultural sector's productivity. Smallholder farmers dominate the agricultural economy in Nigeria. Over 80 percent of the farming population in Nigeria are small holders residing mostly in rural areas (J. Afolabi, 2010). The need for agricultural loan among the small holder farmers cannot be over emphasized as it enables them to establish and expand their farms. A major problem confronting smallholder enterprises including farmers in Nigeria is inadequate capital and collateral to access credits from financial institutions, despite the fact that smallholder farmers produce the bulk of the food consumed locally and some export crops which generate foreign exchange for the country. This makes agricultural loan imperative because the Nigerian policy makers have been trying to encourage private investors and diversify the economic and revenue base of the country. Lack of access to credit is generally seen as one of the main reasons why many people in developing economies remain poor coupled by inadequate collateral required by financial institutions. Lack of access to financial services makes most rural farmers to seek informal sources for loans from self help associations or traditional institutions. An example exists in Ikwere Area of Rivers State in South-South region which have a new form of informal agricultural loan within their immediate communities known as "NGWETA" in local parlance (E. Ofuoku, 2011). Unfortunately such schemes have insufficient capital base and very short lending window periods to assist investments that can last for more than one year.

It is worthwhile to note that credits can be accessed from formal credit institutions. Unfortunately the collateral requirements and bureaucratic bottlenecks in such institutions makes their loans outside the reach of local farmers. Some conventional credit finance policies exist in Nigeria to subsidise interest rates for small farmers and rural people, but the irony is that subsidised interest rates causes loans to be expensive for borrowers. This is based on the purview that the interest rates become too low for lenders to grapple with high inflation rates and transaction costs. As a solution to these problems facing rural farmers' access to finance, the Agricultural Credit Guarantee Scheme Fund (ACGSF) was established by the Federal military government of Nigeria through the Central Bank of Nigeria in 1977 and commenced operations from 1978 to date. The ACGSF goes beyond subsidising interest for farmers; it considers critical issues in diversifying appropriate development strategies capable of providing the required finance for farmers and small and medium enterprises in Nigeria (CBN, 2009). The ACGSF in Nigeria was established to provide some measure of risk coverage as well as to encourage commercial banks to increase their lending to agriculture (F. Olagunju & A. Ajiboye, 2010). The scheme also assists farmers on how to improve their productivity and ensures a good market environment for their product. The ACGS fund makes access to finance much easier for rural farmers. It also guarantees credit facilities from the bank to farmers at about 75 percent of total funds borrowed without any security which contributes to improving the livelihoods of farmers and emerging entrepreneurs (CBN, 2009). The Central Bank of Nigeria handles the operation of the scheme and stipulates the guidelines for the eligibility of farmers to access the funds. The Agricultural Credit Guarantee Scheme (ACGS) is also a policy established by the Federal government not only to enhance agricultural credit by providing guarantee on loans granted by banks to farmers for agricultural production and agro-allied processing. It also addresses the problem of shortage of credit finance and low recovery rate on agricultural lending which discouraged banks from providing credits especially for agricultural activities (M. Olaitain, 2006).

The guarantee scheme mitigates the risks associated with agricultural production, such as high cost of administration of agricultural loans and the inability of farmers to provide the necessary collateral. According to the guidelines governing the execution of the ACGS fund, the purpose of the credit scheme is to provide guarantee in respect of loans granted by any bank for agricultural purposes with the aim of increasing the level of bank credit to the agricultural sector (CBN, 1990). Loans in this context refer to advances, overdrafts and any credit facility. However, the success of the ACGS depends on the role of the guarantor of the credit, and the farmers for effective usage of funds (F. Nwosu, N. Oguoma, N. Ben-Chendo& A. Henri-Ukoha, 2010). In spite of this aforementioned effort by the government towards ensuring fund availability to the sector, the Gross Domestic Product of the agricultural sector as percentage of total GDP increased sluggishly from 35.63% in 1981-85 periods, to 37.75% in 1986-90 periods, to 39.82% in 1991-95 to 41.85% in 1996-2000 periods, reaches its peak of 43. 85% 2001-2005 and reduced to 43.68% in the 2006-2010 periods. Agricultural credit guarantee to agricultural sector as percentage of total credit to the economy increased from 8.5% in 1981-85 periods, to 13.3% in 1986- 90 periods, to 18.39% in 1991-95periods, to 20.2% in 1996-2000 periods, to 25.1% in 2001 to 2005 periods and later fell to 1.44% in the 2006-2010 periods (CBN Statistical Bulletin, 2011:2).

This situation raises doubts about the effectiveness of the ACGSF which was introduced to specifically provide guaranteed credits to farmers to enhance agricultural production. If indeed the fund provided has been effectively utilised, it should reflect on the output of agricultural production. Hence this calls for a comprehensive research to analyse the effects of the ACGSF on agricultural production output in Nigeria. This is because the successful operation of the ACGSF in enhancing access to finance is an opportunity to increase the level of entrepreneurial capabilities of the smallholder farmers in Nigeria. Therefore, it is important to determine the extent to which the scheme has stimulated agricultural production after more than 30 years of its operation in Nigeria. The research question that arises is to what extent has ACGSF stimulated the agricultural production in Nigeria?. An enquiry into the performance of the credit finance provided under the Agricultural Credit Guarantee Scheme Fund is imperative with respect to assessing the extent to which it has created access to finance, increased productivity and ultimately delivered its intended objectives. The study focussed on cassava production by smallholder farmers in Southern Nigeria. Hence the study specifically sought to provide answers to the question on what is the impact of ACGSF on cassava and yam production of smallholder farmers in Southern Nigeria? The null research hypotheses that guided the study are.

Ho_1: The ACGSF has no significant impact on cassava production of smallholder farmers for the states in Southern Nigeria regions.

Ho_2: The ACGSF has no significant impact on yam production of smallholder farmers for the states in Southern Nigeria regions.

Scope of the study

The study is a fixed effect panel analysis focusing on agricultural credit guarantee scheme fund and food crop production in Southern Nigeria. The period of the study is from 1999 to 2013.The data is obtained from Central Bank of Nigeria Statistical bulletin and National Bureau of Statistics(NBS), comprising of Agricultural outputs proxy by cassava production, value of agricultural credit guarantee fund(VACGSF), Average Rainfall and Agricultural Labour.

Literature Review

Conceptual framework

The importance of the Nigerian agricultural sector to the entire economy cannot be overemphasized. It was once the major foreign exchange earner before the advent of the oil boom in 1970s which diverted the focus on agriculture. Nigerian agriculture is characterized by crop and regional diversity. Although agriculture has a broad role in the economic development and structural changes in Nigeria, the country relies heavily on the oil industry for its budget and foreign exchange earnings. Oil generates about 95 percent of Nigeria's foreign exchange earnings while agriculture contributes less than five percent. Nigeria is however still a predominant agricultural society. This is because smallholder farmers are people who live directly from agricultural production systems, either as full- or part-time farmers, or as members of farming households that support farming activities (FAO 2008a). They produce food and non-food products on small form with limited external inputs, cultivating field and tree crops as well as livestock, fish and other aquatic organisms. The food crops produced for the purposes of the paper are conceptualized as cassava and yam. These smallholder farmers are characterized by marginalization, in terms of accessibility, resources, information, technology, capital and assets, but there are great variation in the degree to which each of these scenario applies to each farmer (S.Murphy 2010). The study conceptualized credit as monetary or financial aspect of capital resources; an important component of agricultural input. It serves as an intermediate input and does not directly enter as an input into agricultural production. It is therefore an enabling input. It plays a complex role in farmers' production decisions, unlike physical inputs that have a more transparent relationship with the levels of output. The major agricultural inputs provided by Agricultural credit guarantee scheme are conceptualized as improved seeds, pesticides, fertilizers and cash loans. The provision of credit on sustainable basis and rational use of these inputs in the right proportion and time are crucial to increasing agricultural productivity.

Participation in borrowing is considered as a function of the smallholder farmers for credit demand and access to credit market. The outcome of this process is conceptualized as the amount of loan borrowed on one hand and occurrence of loan rationing on the other hand. To analyse their links, demand and supply determinants need to be investigated. However, chronological decisions need to be taken by borrowers and lenders. First, smallholder farmers should be able to access the different sources of credit before they decide on whether to apply for credit or not. Secondly, the lenders decide on whether to give the applicants loans in full, or partially reduce the credit amount, or fully reject the loan application. Therefore, one must distinguish between those who have no credit because they have no demand and those who have no credit because they received insufficient supply. Similarly, smallholder farmers with a positive supply of credit may not have received the full amount of credit they asked for. Thus, a distinction is needed between those who received sufficient credit and those with excess demand who failed to access such loans. Apparently, this decision is expected to affect the profitability of agricultural farming for smallholder farmers in Southern Nigeria. It is also expected that access to affordable credit will enhance food crop production especially, among the smallholder farmers. For agricultural practice to be meaningful, one of the enabling factors is addressed by availability of adequate credit to finance agricultural production. The impact of agricultural credit guarantee on agricultural production, efficiency and productivity could potentially occur through multiple channels. First of all, an agricultural credit guarantee can be used to purchase inputs over the cropping season, enabling a farmer to maximize the yield from the cultivated area, given a level of capital stock. This channel represents a direct and within-season impact on production. Secondly, agricultural credit guarantee can be used to make investments in irrigation facilities, machines and draught animals that represent the use of credit for building up capital stock to support agricultural production. This second channel typically impacts production with a time lag. Thirdly, agricultural credit guarantee is often used to replace informal credit associated with high interest burden.

Anecdotal evidence suggests that farmers often borrow from formal sources to pay off high interest loans taken from money lenders. This has the effect of relieving credit constraints, reducing the interest burden and indebtedness. Existing economic literature on wealth effects and risk aversion suggests that this often enables farmers to make decisions that increase profitability and efficiency (Miller 1975) . Even when formal credit is diverted to consumption, there could be an implicit wealth effect that impacts farmer's production decisions. Collectively, formal agricultural credit could also enable a farmer to move to the production frontier so that given prevalent technology, a farmer is using levels of inputs that enable him/her to produce at the frontier, from among many feasible combinations of crops. In Furtherance to, it could enable a farmer to move on to a superior production frontier, so that given a level of inputs, the farmer is able to produce more of one or more of the crops. The fourth is represented as a move from within the production possibility set to the frontier (constituting efficiency improvement) and the fifth is represented as a shift of the frontier itself (constituting productivity improvement). The impact of formal agricultural credit guarantee on agricultural output conflates these two aspects of productivity and efficiency effects. Therefore, this framework is much relevant and applicable to this study. More specifically, this applicability of framework may assist in deriving recommendations for the sustainability of agricultural credit guarantee services in southern Nigeria. It is upon this premise that the conceptual framework on the effect of availability/non availability of credit on Southern Nigerian farmers is depicted in Figure 1 as follows:

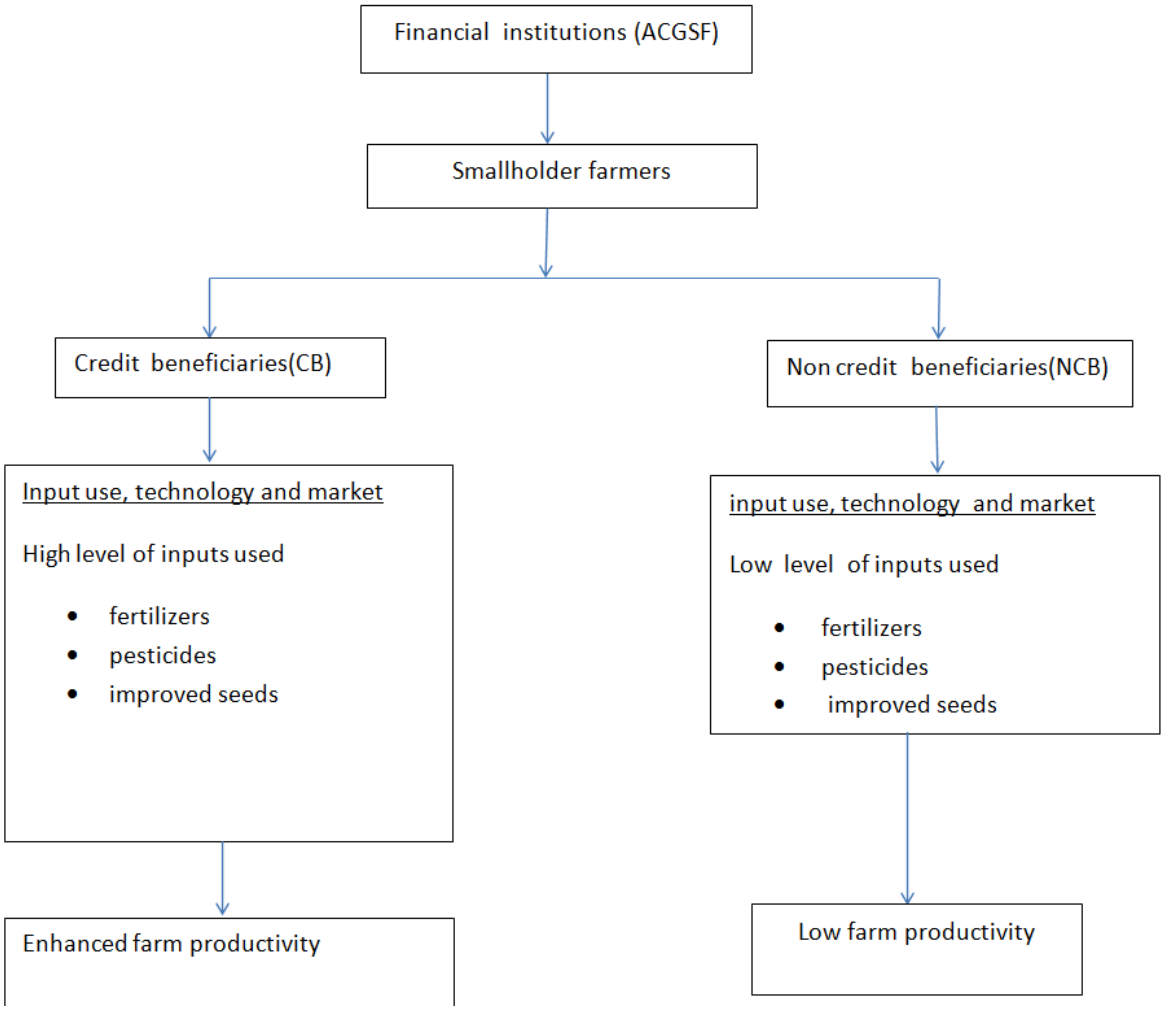

Fig. 1. Effect of availability/non availability of credit on rural farmers in Southern Nigeria

Figure 1 illustrates the conceptual framework on expected impact of Agricultural credit guarantee scheme fund and agricultural productivity (food crop production). Given the limitations of credit facilities in rural areas, it was expected that, some will access credit from Agricultural Credit Guarantee Scheme Fund while others will not. Those who will access credit were expected to improve their farming technologies and input use. The inputs considered in this study include agrochemicals such as fertilizers, pesticides and improved seeds. Credit beneficiary farmers were also expected to be able to apply improved farming technology such as power tillers or ox-plough. Consequently, farm productivity was expected to increase for farmers who are credit beneficiaries (CB) compared to non credit beneficiaries(NCB). Changes in productivity levels depend on types and quantities of inputs and technology used. It is also expected that, farmers who accessed credit would have more opportunity to access more markets for their products compared to the non credit beneficiaries. This is because their increased productivity will enable their production costs to be lower per unit of output. This will enable such farmers to sell at lower prices, access bigger markets, increase incomes, and generate more employment which will positively increase the Gross Domestic Product of the nation.

Empirical literature

Various research works have been done in the area. U. Afangideh (2006), used the simulation approach and data from 1970 – 2005 for Nigeria, to study financial development and agricultural investment in Nigeria. The results of their study found that bank credit and lending have a positive and significant effect on real gross national saving and real agricultural output. M. Nosiru, M. Omobolanle (2010) studied Micro credits and agricultural productivity in Ogun State, Nigeria. They found a positive relationship between provision of micro credits and increased agricultural productivity. Muftan (2002) examined the trend of commercial banks credits to the agricultural sector in Kenya. Their study made a forecast of the amount of commercial banks' credit that would be needed to boost the productivity of the agricultural sector. Some other researchers have tried to unravel credit accessibility to agricultural productivity in Nigeria and beyond. Some of these studies focused on determinant, role, technical change and efficiency, review, and risk management in Agricultural finance in Nigeria. For instance, F. Olagunju (2013) examined the determinants of credit access by rural farmers in Oyo state, Nigeria, using descriptive statistics and logit model. F. Nwosu, N. Oguoma, N. Ben-Chendo, and A. Henri-Ukoha,.(2010) examined the Agricultural Credit Guarantee Scheme with respect to its roles, problems and prospects in Nigeria's quest for Agricultural Development. J. Nwaru (2010) investigated on a Credit use and Technical change in smallholder food crop production in Imo State of Nigeria. They employed stochastic frontier production functions by the methods of maximum likelihood and ordinary least squares in their study. J. Nwaru, Ubon Asuquo Essien

and R. Enyeribe Onuoha (2011) worked on the determinants of Informal Credit Demand and Supply. The respondents in their work were food crop Farmers in Akwa Ibom State. M. Aziakpono (1994), investigated the effects of interest rate deregulation on Nigerian agricultural financing by commercial banks. His work however excluded the Agricultural Credit Guarantee Scheme Fund operation in the banks. E.Eyo (2008), measured the effect of the macroeconomic environment and the agriculture sector growth in Nigeria. Other researchers such as S. Akinleye, K.Akanni and A. Sekumade (2005) appraised the Agricultural Credit Guarantee Scheme in Nigeria, but did not consider how the scheme has impacted on agricultural production especially at the regional levels. While some attempts have been made to examine the performance of the Agricultural Credit Guarantee Scheme Fund in Nigeria, the focus has not been on a comparative study on its effect on food crop production, especially at the regional levels. Hence, this study is an attempt to bridge this gap in the literature by taking a further step to analyse the effect of the scheme at regional levels on food crop production performance by smallholder farmers in southern Nigeria from 1999 to 2013. This will reveal the contribution of the scheme to sustainable growth and financial empowerment in favour of a large portion of smallholder farmers in various states in Southern Nigeria.

MATERIALS AND METHODS

Theoretical framework

The theoretical framework upon which the study is hinged is the Sustainable livelihood theory and the Cobb Douglas production theory. The basic tenets of both theories are outlined as follows:

Sustainable Livelihood Theory

Chambers and Conway (1991) defined sustainable livelihoods as “the capabilities, assets (including both capital and social resources) and other farming practices required for a means of living”. This theory maintained that increased output can only be achieved by ensuring secured ownership of, or access to capital resources and income-earning activities, including reserves and assets to offset risk, ease shocks and meet contingencies as well as enhancement and maintenance of productive resources on a long term basis. Thus increased agricultural outputs is not just food affordability, but ability to produce food and earn income permanently by farmers.

Theory of Production Function

Production function has been used as an important tool of economic analysis in the neoclassical tradition. It is generally believed that Philip Wicksteed (1894) was the first economist to algebraically formulate the relationship between output and inputs as $p = f(x_1, x_2,\ldots,\ldots x_m)$ although there are some evidences suggesting that Johann von Thünen first formulated it in the 1840’s (T. Humphrey, 1997). The formulation of production function assumes that the engineering and managerial problems of technical efficiency have already been addressed and solved, so that analysis can focus on the problems of allocative efficiency. That is why a production function is defined as a relationship between the maximal technically feasible output and the inputs needed to produce that output (R. Shephard, 1970). However, in many theoretical and most empirical studies it is loosely defined as a technical relationship between output and inputs, and the assumption that such output is maximal (and inputs minimal) is often tacit. Further, although the relationship of output with inputs is fundamentally physical, production function often uses their monetary values. The production process uses several types of inputs that cannot be aggregated in physical units. It also produces several types of output (joint production) measured in different physical units. There is an extreme view that (in a sense) all production processes produce multiple outputs (M. Faber, J. Proops, and S.Baumgärtner; 1998) 1998). One of the ways to deal with the multiple output case is to aggregate different products by assigning price weights to them. In so doing, one abstracts away from essential and inherent aspects of physical production processes, including error, entropy or waste. Moreover, production functions do not ordinarily model the business processes, whereby ignoring the role of management, of sunk cost investments and the relation of fixed overhead to variable costs (wikipedia). Moreso, T. Humphrey (1997) gives an outline of historical development of the concept and mathematical formulation of production functions before the enunciation of Cobb-Douglas function in 1928. Paul Douglas, on a sabbatical at Amherst, asked mathematics professor Charles W. Cobb to suggest an equation describing the relationship among the time series on manufacturing output, labor input, and capital input that Douglas had assembled for the period 1889–1922, and this led to their joint paper. The postulations of the sustainable livelihood theory links increased agricultural output to availability and utilization of food production resources (input). The inputs by the Agricultural credit guarantee scheme are conceptualized as improved seeds, pesticides, fertilizers and cash loans provided to achieve increased output which is farm productivity. Hence the sustainable livelihood theory is considered suitable for this work. In addition, the traditional Cobb Douglas production also stipulates a functional relationship between inputs such as labour, capital and technology, hence it is also considered suitable for the work above other theories. This study also adopts an extended production function that expresses output as a function of capital input and other food production inputs, hence the Cobb-Douglas production function is expressed in the following form:

$$P(L,K) = bL^{\alpha} K^{\beta} \quad \ldots\ldots\ldots\ldots(1)$$

where:

- P = total production (the monetary value of all goods produced in a year)
- L = labour input (the total number of person-hours worked in a year)
- K = capital input (the monetary worth of all machinery, equipment, and buildings)
- b = total factor productivity
- α and β are the output elasticities of labour and capital, respectively.

These values are constants determined by available technology. Output elasticity measures the responsiveness of output to a change in levels of either labour or capital used in production. This study adopts the variables stated above. However in order to appreciate their effect on agricultural

output, another major non financial input that strongly influence agricultural output like rainfall was also incorporated in the model as well as to make it more robust.

Based on the above, the performance of the agricultural sector is envisaged to be affected by certain variables in an agricultural production model. The analysis will focus on the extent to which the ACGS fund has affected food crop production of the smallholder farmers in Southern Nigeria. The model postulates that agricultural production in Nigeria is a function of the amount of credit from the ACGS (value of agricultural credit guarantee scheme fund), Annual Rainfall and Agricultural Labour.

P= Agricultural output proxy by cassava and yam production
L= Agricultural Labour
K= A vector of agricultural capital input which includes agricultural financing such as value of agricultural credit guarantee fund(VACGSF).

Thus, the theoretical framework for this study is based on the following assumptions:

- Credit is the only variable form of capital available for agricultural production; all other factors of production remain constant.
- ACGSF is the only source of agricultural credit available to Nigerian farmers. Thus, ACGSF is taken as proxy to formal agricultural credit in Nigeria.
- There may be time lag between credit acquisition and credit utilization for agricultural production.
- There are no changes in technology and Agricultural Output by smallholder farmers.
- There exists a linear relationship between crop produced and credit.

However, the methodology is a fixed effect panel model pooled from the 3 (Three) South zones in Nigeria, namely South-east, South-south, and South-west, making up eighteen states viz: Abia, Anambra, Ebonyi, Enugu and Imo states in south-east, Lagos, Oyo, Ogun, Ondo, Osun, Ekiti and Kwara states in south-west and Delta, Bayelsa, Rivers, Cross-River, Edo and Akwa-ibom states in south-south. The reason for this regional disaggregation is to account for variations in state impact of ACGSF on food crop production in Southern Nigeria regions as well as to analyse the impact of ACGSF on cassava production for the states in Southern Nigeria.

Model specification

To estimate the impact of ACGSF on cassava production of smallholder farmers for states in Southern Nigeria regions, the model is specified as follows:

$$CAPROD_{it} = \ell^{\alpha_i + \beta_1 VACGFF_{it} + \beta_2 NLoans_{it} + \beta_3 AL_{it} + \beta_4 AR_{it} + \mu_{it}} \quad \ldots\ldots(2)$$

The above model is in exponential form and has to be linearized by taking natural log form as follows:

$$\ln CAPROD_{it} = \ln \alpha_i + \beta_1 \ln Vacgsf_{it} + \beta_2 \ln AL_{it} + \beta_3 \ln AR_{it} + \mu_{it} \quad \ldots\ldots..(3)$$

where $InCaprod_{it}$ = natural logarithm of Cassava production;
$InVacgsf_{it}$=natural logarithm of Value of Agricultural Credit Guarantee scheme fund;
$InAL_{it}$= natural logarithm of Agricultural labour;
InAR=natural logarithm of Average Rainfall;
μ_{it} is the error term;
β1, β2 and β3 are the coefficients.

In the Fixed effect assumption $E(In\alpha_i, X_i) \neq 0$ that is, the unobserved heterogeneity and vector of explanatory variables are co-related which will result to estimation bias. In order, to address the bias, equation 3 will be transformed by taking the mean difference of each of the variables.

$$\ln CAPROD_{it}^{*} = \gamma_1 \ln Vacgsf_{it}^{*} + \gamma_2 \ln AL_{it}^{*} + \gamma_3 \ln AR_{it}^{*} + \mu_{it} \quad \ldots\ldots(4)$$

ɣ1 ɣ2 and ɣ3 are the fixed effect estimators.

Where

$$\ln CAPROD_{it}^{*} = \ln CAPROD_{it} - \overline{InCAPROD_i}$$
$$\ln VACGSF_{it}^{*} = \ln VACGSF_{it} - \overline{lnVACGSF_i}$$
$$\ln AL_{it}^{*} = \ln AL_{it} - \overline{\ln AL_i}$$
$$\ln AR_{it}^{*} = \ln AR_{it} - \overline{lnAR_i}$$

To model objective two, which is to analyse the impact of ACGSF on yam production of smallholder farmers for states in Southern Nigeria regions, the model is specified thus;

$$YAPROD_{it} = \ell^{\alpha_i + \lambda_1 VACGFF_{it} + \lambda_2 NLoans_{it} + \lambda_3 AL_{it} + \lambda_4 AR_{it} + \mu_{it}} \quad \ldots(5)$$

The log transformation of the equation is taken in order to standardize the values of the variables, achieve linearity as well as allow for the easy interpretation of their coefficients as elasticities, Amakom (2006).

$$\ln YAPROD_{it} = \ln \alpha_i + \lambda_1 \ln Vacgsf_{it} + \lambda_2 \ln AL_{it} + \lambda_3 \ln AR_{it} + \mu_{it} \quad \ldots\ldots(6)$$

where lnyaprod= Natural logarithm of yam production, μ_{it}= Error term

ɣ1, ɣ2 and ɣ3 are the coefficients of the variables.

Under the fixed effect assumption, $E(\alpha_i, x_{it}) \neq 0$. In other words, the unobserved heterogeneity and vector of explanatory variables are co-related as depicted above which will result to estimation bias. In order to address the bias, equation 6 will be transformed by taking the mean difference of each of the variables.

$$\ln YAPROD_{it}^{*} = \varphi_1 \ln Vacgsf_{it}^{*} + \varphi_2 \ln AL_{it}^{*} + \varphi_3 \ln AR_{it}^{*} + \mu_{it} \quad \ldots\ldots(7)$$

Where

φ_1, φ_2, and φ_3 are the fixed effect estimators.

$$\ln YAPROD_{it}^{*} = \ln YAPROD_{it} - \overline{\ln YAPROD_i}$$
$$\ln VACGSF_{it}^{*} = \ln VACGSF_{it} - \overline{\ln VACGSF_i}$$
$$\ln AL_{it}^{*} = \ln AL_{it} - \overline{\ln AL_i}$$
$$\ln AR^{*}{}_{it} = \ln AR_{it} - \overline{lnAR_i}$$

Y= Agricultural Output, proxy by cassava (CAPROD) and yam(YAPROD) production.

CAPROD = Cassava production
YAPROD = Yam production
VACGSF = Value of agricultural credit guarantee scheme fund.
AR = Average Rainfall.
AL = Agricultural Labour.

Justification of the model

The composition of Agricultural Output (cassava and yam), ACGSF and other explanatory variables used in this study highly differ per state and are subject to many factors. Therefore, the compositions of these variables differ cross-sectionally. Thus, the econometrical reasoning behind the applied model is explained by suitability for the attained sample. Research often focuses on the dynamic change of variables or the dynamic relation between variables. However, in order to conduct any meaningful hypothesis test solely by the use of time-series data requires an extensive sample. In addition, this approach is highly suitable since the pool of cross sections and time series data replicates the problem of heterogeneity of the analyzed states.

Diagnostic test

Hausman Test was used to test for the presence of fixed effects in the sample.

Estimation technique

The Pooled Ordinary Least Square Estimator is not appropriate because it does not take into consideration possible correlation between the explanatory variable and the error term which is caused by the presence of unobservable factors across the states and region. Thus, the Fixed Estimation technique controls for unobservable factors thus yielding unbiased estimators. This will capture the variability within the states and regions over time. The model assumes a constant slope, but different intercept across the countries, states, or other entities.

Source of data

Panel data on food crop production by smallholder farmers was obtained from Central Bank of Nigeria (CBN) Statistical bulletin and National Bureau of Statistics (NBS). Meanwhile, the value of agricultural credit guarantee scheme fund and average rainfall was obtained from CBN Statistical bulletin, while the agricultural output proxy for cassava production, and agricultural labour was obtained from National Bureau of Statistics publications for several years.

Econometric software package

Stata 11.0 will be used for the analysis

Data Analysis

Descriptive analysis of data

This section provides the summary statistics of the dataset in terms of its mean, standard deviation, overall standard deviation, between standard deviation and within standard deviation.

Table 1. Summary statistics of dataset

Variable	Mean	Overall Standard deviation	Between standard deviation	Within Standard Deviation
CAPROD	960.3373	810.4589	664.5792	488.0982
YAPROD	632.2807	569.8344	430.3346	386.2143
AGRIC LABOUR	80140.67	182801.5	30924.61	180304.8
AVR	2179.225	1540.073	1144.332	1063.24
VACGSF	103616.2	233.854.3	90074.36	216787.3

Source: Estimated by the authors using STATA 11.

From Table 1, all the variables have both between variations and within variations. The mean value of each of the variables is presented in the second column. The between standard deviation depicts the variation across the states in the data set. The within standard deviation depicts the variation within the individual states over time while the within variation is the variation within each of the states over time.

Hausman Test

The statistical justification of the fixed effect model is presented in Table 2 as follows

Table 2. Statistical justification of the fixed effect model

Variable	Coefficients (b) Fe	(B) re	(b-B) Difference	Sqrt(diag(v-b-v-B)) S.E.
Invacgsf	.16.73337	.1619432	.0053905	.0019084
Inavr	.1677373	.2265514	.0588141	.0295932
Inagriclabour	.0285033	.0312572	.0027539	-

Source: Estimated by the authors using STATA 11.

$Chi^2(3)= (b-B)' \{(V-b-v-B)^{(-1)}\} (b-B) = 8.25$

$Prob>Chi^2=0.0411$

Results on Table 2 depicts the statistical justification of the presence of the fixed effect model. This is because the P value coefficient(0.0411) is less than 0.05% level of significant.

RESULTS AND INTERPRETATION

Table 3 shows the estimation results for the impact of agricultural credit guarantee scheme fund on cassava production of smallholder farmers in Southern Nigeria.

Table 3. Impact of agricultural credit guarantee scheme fund on cassava production of smallholder farmers

Variables	Coefficient	P-Values
Invacgsf	.1673337	0.000
Inagriclabour	.0285033	0.044
Inavr	.1677373	0.174
-Cons	3.263576	0.000

Source: Estimated by the authors using STATA 11.

Table 3 depicts the summary of the results. The model shows the estimation result using value of agricultural credit guarantee scheme fund (Vacgsf), average rainfall (Avr) and agricultural labour(agriclabour) as predict variables and cassava production (Caprod) as variable outcome. The variables are presented in the first column. The estimation result for the model shows that the coefficient of the natural logarithm for value of agricultural credit guarantee scheme fund (Vacgsf) and natural logarithm for agricultural labour

were statistically significant at the 5% level. However, natural logarithm for average rainfall was not statistically significant at the 5% level. Thus, the marginal impact of the value of agricultural credit guarantee scheme fund on cassava production is 0.1673%. This shows that a marginal increase in the value of agricultural credit guarantee scheme fund by 1% will lead to an increase in cassava production of small holder farmers for the states in southern Nigerian regions by 0.1673%. Similarly, a marginal rise in agricultural labour by1 % will lead to 0.0285% rise in cassava production of smallholder farmers for states in southern Nigerian regions. Also, the marginal impact of average rainfall on cassava production is 0.1677%. Table 4 shows the estimation results for the impact of agricultural credit guarantee scheme fund on yam production of smallholder farmers in Southern Nigeria.

Table 4. Impact of agricultural credit guarantee scheme fund on yam production of smallholder farmers

Variables	Coefficient	P-values
Invacgsf	.1359856	0.000
Inagriclabour	-.0025748	0.891
Inavr	.1981013	0.226
-Cons	3.071353	0.011

Source: Estimated by the author using STATA 11.

The above table depicts the estimation results for model 2. The result reveals that allthe variable were statistically insignificant at 5% level except the value of agricultural credit guarantee scheme fund. The coefficient of natural logarithm of agricultural labor had a negative sign while the coefficient of natural logarithm of the value of agricultural credit guarantee scheme fund and the average rainfall were positively signed. Following the result above, the statistically significant of the value of agricultural credit guarantee scheme fund indicates that a unit rise in the value of agricultural credit guarantee scheme fund (Vacgsf) will lead to a marginal rise in yam production (Yaprod) by 0.14 or 14%.

Evaluation of Estimates

Economic a-priori criteria

This emphasizes on the expected signs and the magnitude of the parameters of economic relationships which is determined by the principles of economic theory. However, based on economic theory, the independent variables are expected to have a positive influence on the dependent variables.

The value of agricultural credit guarantee scheme fund

Following the results, there is a positive relationship between the natural logarithm of the value of agricultural credit guarantee scheme fund and natural logarithm of cassava and yam production. This conforms the positive signs of a-priori expectations and implies that the value of agricultural credit guarantee scheme fund has a significant positive impact on cassava and yam production. The result is consistent with the findings of (Afangideh 1996) that bank credit and lending have a positive and significant effect on real gross national savings and agricultural output.

Agricultural Labour

Labour is very essential in any agricultural activity. However, from the results, the estimated coefficient of natural logarithm of agricultural labour in table 3. was positive and significant. The positive sign of the coefficient is in agreement with a-priori expectation and imply that more agricultural labour could be attracted for enhanced productivity by making agricultural practice in southern Nigeria more attractive.

Average Rainfall

From the results, the natural logarithm of average rainfall on cassava production was statistically insignificant thus the coefficients confirmed the positive sign of the a-priori expectation at 5% level of significance therefore confirming the empirical findings of many experts that average rainfall exerts positive influence on agricultural output. Furthermore, the result showed that the relationship between average rainfall and the cassava production was not statistically significant probably because of irregular rainfall or over flooding which are threats to agricultural productivity.

Hypothesis Testing

The null hypotheses that guided the study were stated as follows:

H_{01}: The agricultural credit guarantee scheme fund has no impact on cassava production of smallholder farmers for the states in the southern Nigerian regions.

H_{02}: The agricultural credit guarantee scheme fund has no impact on yam production of smallholder farmers for the states in the southern Nigerian regions.

Following the results on table 3 and 4, it is shown that there is positive effect of agricultural credit guarantee scheme fund on cassava and yam production of small holder farmers for the states in the southern Nigerian regions. This is considering the fact that the core variable, value of agricultural credit guarantee scheme fund was found to be positive and significant at 5% level, thus resulting in the rejection of the null hypotheses. Conversely the alternate hypotheses are accepted that agricultural credit guarantee scheme has impacted positively on agricultural productivity in Southern Nigeria.

Policy Implications

Following the result of this study, agricultural credit guarantee was revealed to have a positive impact on food crop production in the southern Nigeria, this implies that there is an increase in agricultural credit facility on food crop production (agricultural output).Yet many factors/reasons might enhance or retard the growth of agricultural productivity in the southern Nigeria. Examples are increasing incidence of loan default due to natural disasters or climatic changes, loan processing costs, poor productivity, bureaucratic bottlenecks causing delay in access to loans etc. In line with the following:

Banks should reduce the cost of loan access and bureaucratic bottlenecks which weary loan applicants

The Central bank of Nigeria should assist in quick release of funds to participating banks. The government should aim at tackling loan default, diversion and misappropriations trough timelines in disbursement, effectiveness in loan supervision,

reducing loan processing costs and bottlenecks and ensuring optimal interest rates in rural- urban economy.

Summary

The study investigated the impact of agricultural credit guarantee scheme fund on food crop production of small holder farmers in the southern Nigeria. The literature review consists of various theoretical and empirical reviews which gave further insight to the study. However, some nonfinancial agricultural inputs such as average rainfall and agricultural labour were discovered to play deterministic roles with respect to food crop production, hence they were incorporated as part of the independent variables. According to the findings, agricultural credit guarantee has significant effects on food crop production of smallholders farmers in Southern Nigeria within the period of observations. The marginal impact of the value of agricultural credit guarantee scheme fund on cassava production was found to be 0.1673%. This shows that a marginal increase in the value of agricultural credit guarantee scheme fund by 1% will lead to an increase in cassava production of small holder farmers for the states in southern Nigerian regions by 0.1673%. Similarly, a marginal rise in agricultural labour by1 % will lead to 0.0285% rise in cassava production of smallholder farmers for states in southern Nigerian regions. In addition, a unit rise in the value of agricultural credit guarantee scheme fund (Vacgsf) lead to a marginal rise in yam production (Yaprod) by 0.14 or 14%. Hence the fund had a higher impact on cassava production. More so, Housman test revealed the presence of fixed effect model in the study.

Conclusion

The empirical literature on the effects of agricultural credit guarantee scheme fund on food crop production of smallholder farmers in the southern Nigeria is quite conclusive. Based on the analysis carried out on the available data, it is observed that there has been increase in agricultural credit guarantee scheme fund to the smallholder farmers in Southern Nigeria within the period of observation, from 1999-2013,for food crop production and these changes in the agricultural credit guarantee scheme fund to the smallholder farmers has a significant impact on food crop production.

Recommendations

Following the findings of this study, it is recommended that government should not only increase the credit facility made available to the smallholder farmers, but the utilization of the fund by the farmers should also be monitored so that fund is not diverted from the target. This is derived from the results which showed that a one percent increase of such funds will directly impact on productivity by approximately 0.2 percent for cassava and 0.14percent for yam production. This also suggests that more of such fund should be channeled towards cassava production. In addition, financial institutions should carefully screen their clients to reduce loan default by farmers. Credible guarantors and group lending arrangements are capable of offsetting default risk of potential borrowers. Government and the private sectors should invest more in agribusinesses to improve food crop production in the Southern Nigeria.

Agricultural policy consistency and micro economic stability are vital for favorable agricultural investment climate. Hence, Government should sustain this policy to improve funding to the agricultural sector. Furtherance, Nigerians farmers should be encouraged to adopt modern mechanized farming by providing them with modern farm implements/devices. These technical devices are intended to remove or minimize the disadvantages of traditional manual operations and substantially increase agricultural output as well as the earning capacity of the rural poor. This should not necessarily be done by government alone. Private ventures should also get involved in other to increase agricultural production and attain food security in Nigeria. Produce marketing mechanisms for the farmers should be strengthened to reduce production costs and risks that prevent private sector participation.

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Appendix

```
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  log type:  smcl
 opened on:  10 Mar 2016, 12:12:51

. *(6 variables, 270 observations pasted into data editor)

. xtset stateid
       panel variable:  stateid (balanced)

.
. xtsum caprod yaprod agriclabour avr vacgsf
```

Variable		Mean	Std. Dev.	Min	Max	Observations	
caprod	overall	960.3373	810.4589	11	6892	N =	270
	between		664.5192	43.79	2657.499	n =	18
	within		488.0982	-684.9294	5194.839	T =	15
yaprod	overall	632.2807	569.8344	.24	3065.18	N =	270
	between		430.3346	33.05	1882.911	n =	18
	within		386.2143	-1160.63	2657.614	T =	15
agricl~r	overall	80140.67	182801.5	2	886486	N =	270
	between		30924.61	19872.2	142874.3	n =	18
	within		180304.8	-62518.67	823752.3	T =	15
avr	overall	2179.225	1540.073	618	11302	N =	270
	between		1144.332	980.5667	5763.02	n =	18
	within		1063.24	-1474.295	11458.77	T =	15
vacgsf	overall	103616.2	233854.3	50	2714130	N =	270
	between		90074.36	7211.8	360563.7	n =	18
	within		216787.3	-252551.5	2457183	T =	15

```
. log close
      name:  <unnamed>
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  log type:  smcl
 closed on:  10 Mar 2016, 12:24:49
```

```
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  log type:  smcl
 opened on:  22 Feb 2016, 15:56:50

. *(7 variables, 270 observations pasted into data editor)

. xtset stateid year
       panel variable:  stateid (strongly balanced)
        time variable:  year, 1999 to 2013
                delta:  1 unit

.
. generate lncaprod=log(caprod)

. generate lnagriclabour=log(agriclabour)

. generate lnavr=log(avr)

. generate lnvacgsf=log(vacgsf)

. xtreg lncaprod lnagriclabour lnavr lnvacgsf,fe

Fixed-effects (within) regression               Number of obs      =       270
Group variable: stateid                         Number of groups   =        18

R-sq:  within  = 0.2654                         Obs per group: min =        15
       between = 0.1194                                        avg =      15.0
       overall = 0.1561                                        max =        15

                                                F(3,249)           =     29.99
corr(u_i, Xb)  = 0.0746                         Prob > F           =    0.0000

------------------------------------------------------------------------------
    lncaprod |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnagriclab~r |   .0285033   .0140782     2.02   0.044     .0007758    .0562309
       lnavr |   .1677373   .1229359     1.36   0.174    -.0743894    .4098641
    lnvacgsf |   .1673337   .0260329     6.43   0.000      .116061    .2186064
       _cons |   3.263576   .9048195     3.61   0.000     1.481501    5.045652
-------------+----------------------------------------------------------------
     sigma_u |  .88896326
     sigma_e |  .59460622
         rho |  .69089633   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(17, 249) =    28.74                 Prob > F = 0.0000

. log close
      name:  <unnamed>
       log:  C:\Users\Mimo Henezet\Documents\ozoalivcresult1.smcl
  log type:  smcl
 closed on:  22 Feb 2016, 16:19:24
```

```
      name:  <unnamed>
       log:  C:\Users\Mimo Henezet\Documents\d apple of GOD'S eye1.smcl
  log type:  smcl
 opened on:  22 Feb 2016, 16:43:14

. *(7 variables, 270 observations pasted into data editor)

. xtset stateid year
       panel variable:  stateid (strongly balanced)
        time variable:  year, 1999 to 2013
                delta:  1 unit

.
. generate lnyaprod=log(yaprod)

. generate lnagriclabour=log(agriclabour)

. generate lnavr=log(avr)

. generate lnvacgsf=log(vacgsf)

. xtreg lnyaprod lnagriclabour lnavr lnvacgsf,fe

Fixed-effects (within) regression               Number of obs      =       270
Group variable: stateid                         Number of groups   =        18

R-sq:  within  = 0.0923                         Obs per group: min =        15
       between = 0.0367                                        avg =      15.0
       overall = 0.0060                                        max =        15

                                                F(3,249)           =      8.44
corr(u_i, Xb)  = -0.1629                        Prob > F           =    0.0000

------------------------------------------------------------------------------
    lnyaprod |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnagriclab~r |  -.0025748   .0187021    -0.14   0.891    -.0394093    .0342596
       lnavr |   .1981013   .1633131     1.21   0.226     -.12355    .5197526
    lnvacgsf |   .1359856   .0345831     3.93   0.000     .0678728    .2040984
       _cons |   3.071353      1.202     2.56   0.011     .7039699    5.438736
-------------+----------------------------------------------------------------
     sigma_u |  1.1324841
     sigma_e |  .78989975
         rho |  .67272273   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(17, 249) =    24.71                 Prob > F = 0.0000

. log close
      name:  <unnamed>
       log:  C:\Users\Mimo Henezet\Documents\d apple of GOD'S eye1.smcl
  log type:  smcl
 closed on:  22 Feb 2016, 16:59:38
```

```
      name:  <unnamed>
       log:  C:\Users\Mimo Henezet\Documents\kambi.smcl
  log type:  smcl
 opened on:  12 Mar 2016, 09:45:10

. *(6 variables, 270 observations pasted into data editor)

. xtset stateid
       panel variable:  stateid (balanced)

.
. generate lncaprod= log(caprod)

. generate lnyaprod= log(yaprod)

. generate lnvacgsf= log(vacgsf)

. generate lnavr= log(avr)

. generate lnagriclabour= log(agriclabour)

. xtreg lncaprod lnvacgsf lnavr lnagriclabour lnagriclabour,fe
note: lnagriclabour omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       270
Group variable: stateid                         Number of groups   =        18

R-sq:  within  = 0.2654                         Obs per group: min =        15
       between = 0.1194                                        avg =      15.0
       overall = 0.1561                                        max =        15

                                                F(3,249)           =     29.99
corr(u_i, Xb)  = 0.0746                         Prob > F           =    0.0000

------------------------------------------------------------------------------
    lncaprod |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    lnvacgsf |   .1673337   .0260329     6.43   0.000      .116061    .2186064
       lnavr |   .1677373   .1229359     1.36   0.174    -.0743894    .4098641
lnagriclab~r |   .0285033   .0140782     2.02   0.044     .0007758    .0562309
lnagriclab~r |  (omitted)
       _cons |   3.263576   .9048195     3.61   0.000     1.481501    5.045652
-------------+----------------------------------------------------------------
     sigma_u |  .88896326
     sigma_e |  .59460622
         rho |  .69089633   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(17, 249) =    28.74                 Prob > F = 0.0000

. estimates store fe

. xtreg lncaprod lnvacgsf lnavr lnagriclabour,re

Random-effects GLS regression                   Number of obs      =       270
Group variable: stateid                         Number of groups   =        18

R-sq:  within  = 0.2647                         Obs per group: min =        15
       between = 0.1554                                        avg =      15.0
       overall = 0.1728                                        max =        15

Random effects u_i ~ Gaussian                   Wald chi2(3)       =     91.36
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
    lncaprod |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    lnvacgsf |   .1619432   .0259628     6.24   0.000      .111057    .2128294
       lnavr |   .2265514   .1193209     1.90   0.058    -.0073132     .460416
lnagriclab~r |   .0312572   .0140849     2.22   0.026     .0036513    .0588632
       _cons |   2.856935   .9004036     3.17   0.002     1.092176    4.621694
-------------+----------------------------------------------------------------
     sigma_u |  .80860236
     sigma_e |  .59460622
         rho |  .64903857   (fraction of variance due to u_i)
------------------------------------------------------------------------------

. hausman fe re
estimation result re not found
r(111);

. estimates store re

. hausman fe re

                 ---- Coefficients ----
                |      (b)          (B)          (b-B)     sqrt(diag(V_b-V_B))
                |       fe          re        Difference          S.E.
----------------+----------------------------------------------------------------
    lnvacgsf    |    .1673337     .1619432       .0053905        .0019084
       lnavr    |    .1677373     .2265514      -.0588141        .0295932
lnagriclab~r    |    .0285033     .0312572      -.0027539               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        8.25
                Prob>chi2 =      0.0411
                (V_b-V_B is not positive definite)

. log close
      name:  <unnamed>
       log:  C:\Users\Mimo Henezet\Documents\kambi.smcl
  log type:  smcl
 closed on:  12 Mar 2016, 10:09:48
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